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DIRECTOR OPERATIONAL TEST & EVALUATION



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NOTICE

This is an unclassified version of the FY 1988 Annual Report of the Director, Operational Test and Evaluation. The original, classified version of this report was submitted to the Secretary of Defense and the House and Senate Committees on Armed Services and on Appropriations on 19 January 1989 pursuant to the provisions of Section 138, Title 10, U.S. Code.

This unclassified version has been published in order to promote wider understanding of the role of operational testing in the development and acquisition of effective and affordable weapon systems.

Keywords: military research, test and evaluation, military vehicles, military equipment, electronic equipment, military aircraft. (KR)

FY88 DOT&E ANNUAL REPORT TO CONGRESS

The Office of the Director, Operational Test and Evaluation authored, compiled, and published this report to provide you with useful information on the current status of major programs and the initiatives that DOT&E pursued in FY 1988. Have we given you what you want? Please fill out your response to the questions below so that next year's edition can be improved and enhanced to better meet your needs. After filling out this questionnaire, fold, staple, and forward to the address on the back of this sheet. Your responses are appreciated. Thank You!

Was this report organized in an easy-to-use format? _____ yes _____ no

Were the subjects adequately covered? _____ yes _____ no

What changes would you make to the content of this report?

_____

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What changes would you make to the format of this report?

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Have we told you what you want to know?

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What did you like most about this report?

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What did you like least about this report?

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ATTN: JOHN F. GEHRIG

DIRECTOR'S INTRODUCTION

As Benjamin Franklin so wisely observed, an ounce of prevention is worth a pound of cure. As I see it, this means always striving to do the right thing, the right way, the first time, and every time.

This is the kind of thinking that underlies the Department of Defense's (DoD) commitment to "Total Quality Management" (TQM). It is also the basis for key policy, resource, and organizational initiatives conceived and championed by this office since 1985. Some have now been in place for quite a while. Others have been launched or have come to fruition during FY88 and are discussed in some detail in this report.

All of our initiatives are aimed at continuous improvement of the defense acquisition process through early, on-going, and ever-better operationally focused test and evaluation (T&E), and ever-better independent and timely reporting of T&E results and assessments to decision makers.

The measure of our success is "customer" satisfaction: Did the men and women in the field get what they wanted and needed when they wanted and needed it? Does it do the job the users want it to do? Do the users consider it reliable and maintainable.

In mandating the establishment of this office, Congress recognized that an operational T&E oversight official, independent of the development and acquisition community and with direct access to top DoD and congressional decision makers, is essential to improved customer satisfaction. I have interpreted the congressional mandate to mean just that—improved customer satisfaction: weapon systems and equipment that work as the *users* want them to work, fielded when the *users* want them fielded.

This has required an activist approach, involving the development of policies and techniques to permit the operational T&E community to (1) have early, independent, and continuous insight into the progress of programs; (2) have the means of independently reporting its findings to decision makers on a continuous, life-of-the-program basis; and (3) have the resources it needs to gather meaningful information from which derive its evaluations and assessments.

We have had significant success in all these areas, and there is great promise for continuous improvement on all fronts. Working with the Service operational test agencies (OTAs), we have developed such assessment and reporting tools as the Early Operational Assessment and the System Maturity Matrix. These and other devices and assessment processes permit independent, objective operationally oriented evaluation of system progress at every stage in the life of a program.

In turn, this provides the substance for reports to decision makers at all major decision milestones and on a continuous, "status report" basis. For milestone decisions, the forum is the Defense Acquisition Board (of which I am a permanent member) or the Service-level equivalent. When a decision is to be reached on entering full-rate production, I submit a detailed report (the "B-LRIP" report) on the adequacy of operational effectiveness and suitability of the system or system components tested. By law, these reports go to the Secretary, the Under Secretary for Acquisition, and the defense committees of Congress. We also provide copies to a substantial number of interested DoD, Service, and congressional officials. (All

unclassified B-LRIP reports issued during FY88 and the first quarter of FY89 are reproduced in Part VII of this report.)

Status reports are provided in a variety of ways, including our monthly operational T&E highlights letters to the Secretary and interested congressional staff and others; our Annual Report, such as you now hold in your hand; and a new mechanism, the Defense Acquisition Executive Summary (DAES), initiated by the Under Secretary for Acquisition. The DAES, presented to the Under Secretary at a monthly meeting, provides a snapshot look at the progress of a program. Each major defense acquisition program is covered in a DAES on a quarterly basis. Our office contributes an independent assessment of system progress toward operational effectiveness and suitability based on test results to date and other pertinent information.

We are striving constantly to improve the value of our reports to those who use them. We have developed sets of guidelines for assessment and evaluation of test results and for preparation of B-LRIP reports. This year, we have significantly revised the format of our Annual Report to make it more convenient to use and, as noted above, for the first time included all B-LRIP reports for the year, a feature that will be continued in future Annual Reports.

We have made what is perhaps our most significant progress in the T&E resources area. The President's Budget for FY90 includes—for the first time—a consolidated, DoD-level funding line for test resources to build up a significantly expanded and up-to-date National Test Capability Base. The program calls for investment of more than $1.3 billion in fiscal years 1990-94 and will be managed by the Test and Evaluation Committee, established in FY87 to oversee T&E resource and policy matters on a DoD-wide basis. This program is a dramatic and very important step toward assuring that, over the long term, we will have the test-resources planning, management, and investment necessary to evaluate properly the highly sophisticated systems now under development.

To cope with critical short-term gaps in test resources, we have implemented our Operational Test and Evaluation Capability Improvement Program (OT&E CIP). Begun in FY88, the OT&E CIP has given us the ability to quickly and very cost effectively acquire urgently needed test resources, including actual threat systems.

Organizationally, we have grown significantly. We now have a staff of 52, and we have recently established a deputy directorate for strategic systems. This deputy is responsible for oversight of T&E matters for all programs under the cognizance of the Defense Acquisition Board Strategic Systems Committee (e.g., B-2, MX Rail Garrison, SDS, and ACM).

We have also added a science advisor, a reliability and maintainability (RAM) specialist, and an information systems specialist. These highly experienced and expert professionals assist our program oversight staff in the evaluation of test plans and results, provide expert advice to me personally, and aid in the development of T&E policy. In addition, the science advisor and our staff assistant for T&E policy and compliance are working closely with the Service operational test agencies and the Defense Systems Management College to significantly improve the T&E education of program managers and other acquisition and T&E officials.

There is still some important unfinished business on the organizational front. Although establishment of the Test and Evaluation Committee and close cooperation between our office and that of the Deputy Director, Defense Research and

Engineering (Test and Evaluation) have done much to improve the effectiveness of OSD-level T&E oversight, there is still a critical need to implement the organizational realignment called for in the Report of the Secretary of Defense on Test and Evaluation in the Department of Defense (September 1987). The Department awaits congressional action on this question, and it is my sincere hope that it will be resolved early in the first session of the 101st Congress.

Not all agree with the approach we are following in carrying out the mandate of Congress. It has engendered not a little controversy. Of course, there is always room for improvement—"good enough" is *not* good enough. I welcome the suggestions and assistance of all who share our commitment to continuous improvement of the process to achieve ever-greater customer satisfaction by acquiring weapon systems that work as the *users* want them to, and fielding them when the *users* want them fielded. One thing you can do right now is let us know how we are doing with our Annual Report. There is a pre-addressed, brief questionnaire bound into the front of this volume. Please take a minute to fill it out and return it to us. Thank you.

John E. Krings
Director

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PART I

DOT&E ACTIVITY SUMMARY AND PROGRAM OVERSIGHT

ACTIVITY SUMMARY

During this fiscal year, DOT&E activity has involved oversight of 197 programs, including 21 under the purview of the Major Automated Information System Review Council (MAISRC) and four NATO comparative test programs. Our oversight activity commences with the early acquisition milestones, continues through approval for full-rate production and, in some instances, during full production until deleted from the DOT&E oversight list. During FY88, our review of test planning activities included Test and Evaluation Master Plans (TEMPS) for 43 programs as well as 21 operational test plans. We also prepared and submitted numerous reports to OSD Defense Acquisition Board (DAB) principals for consideration in DAB deliberations.

TEST AND EVALUATION MASTER PLANS REVIEWED

AAAM	DDN	NAVSTAR
ADDS/EPLRS	DLSC	PEACEKEEPER
AEPDS	DMSP	ROTH-R
AGM-130A	DSP	SADARM
ALCM	F-16C/D	SDS
AN/SQS-53C	FMTV/PLS	SEAWOLF (SSN-21)
AN/BSY-2	HARPOON	SINCGARS
AN/SQR-19TACTS	LANTIRN	SM-2
AN/SQQ-89	LCAC	STINGER RMP
AN/SQS-53C	M9 ACE	T-45TS
ASAT	MCM	TACIT RAINBOW
ATAS	MCS	TAOM/MCE
ATF	MILSTAR	TOMAHAWK
C-17A	MK 37 TOMAHAWK	
CSOC	MSE	

TEST PLANS REVIEWED

AIM-54C	CV-HELO (SH-60F)	MCS
AIM-7M SPARROW	F-14D	MILSTAR
AMRAAM	F-14A	MK-50 TORPEDO
AN/SQR-19	FDS	ROTH-R
ASPJ	FMTV/PLS	SINCGARS
COMBAT TALON II	IRV	SM-2
CORP/THEATER ADP	M939A2 5 TON TRUCK	T-45A

The Director and our staff assistants have met with Service test agencies, program officials, private-sector organizations, and academia; monitored test activities; and provided information to the DAB committees as well as the DAB principals, the Secretary and Deputy Secretary of Defense, the Under Secretary for Acquisition, and the Congress. We have supported proceeding with some programs and recommended against proceeding with others.

During FY88, the Director's personal involvement in T&E activities has included 28 trips, 16 of which were to test sites and military bases. His first-hand observations have included flying such aircraft as the B-1B, the F-15E, the MH-53H, and the Cobra helicopter; flying with operational AHIP helicopter crews in the Middle East; activities on-board surface ships in the Mediterranean Sea; operations aboard a Trident submarine; MSE testing at Fort Hood; and numerous other significant test and evaluation events. In an effort to increase the viability and effectiveness of DoD test and evaluation programs, he has spoken at 18 conferences, meetings, and symposia. Audiences at these speaking engagements included such professional associations as the American Defense Preparedness Association, the Armed Forces Communications & Electronics Association, the Association of Old Crows, and the International Test and Evaluation Association. He has represented the Secretary of Defense at such conferences as the National Aerospace & Electronics Conference and given lectures on test and evaluation at the Defense Systems Management College and the Industrial College of the Armed Forces. During the fiscal year, he has also formally testified several times before the Congress, and met on numerous occasions with individual members of the Congress and senior congressional staff to provide specific information on various emerging weapons systems. To further increase the awareness of the need for critical evaluations of weapon systems and equipment, he has provided interviews to the news media and authored a variety of articles to heighten public awareness of the need for candid, independent assessments upon which to base judgments concerning the capability of DoD systems.

Active on-site participation in and observation of tests and test-related activities remain one of our most effective tools. In addition to on-site participation, the Director and our staff assistants have completed a total of 264 trips to review the planning, conduct, and evaluation of operational test activities.

Although security considerations preclude identifying them in this report, the number of Special Access Programs (SAPs) under DOT&E oversight has increased during the fiscal year. We have produced the first low-observables test and evaluation security guidelines as part of OSD's SAP policy guidance, and have also participated in a broad review of DoD test resources for current and future low-observable vehicles.

The DOT&E staff prepared assessments for Defense Acquisition Board milestone reviews as well as five Beyond-LRIP Reports for the Secretary and the Congress during FY88. An additional five B-LRIP reports were submitted during the last quarter of calendar year 1988 (marked with an asterisk in the chart below).

BEYOND-LRIP REPORTS SUBMITTED TO CONGRESS

BIGEYE (INTERIM)	MK-48 ADCAP*
CV-INNER-ZONE ASW SH-60F	MSE*
LANTIRN*	OH-58D AHIP
M9 ACE*	S-3B WSIP
MH-53E HELICOPTER	STU-III*

The ongoing program-oversight activities of the DOT&E staff are perhaps best reflected in their observations on the individual programs presented in this report. Here are some of their comments, selected from the program OT&E summaries that appear in the Service OT&E sections of this report:

o To date, ALCM operational performance as demonstrated by FOT&E has met SAC's requirements for suitability, reliability, and maintainability.

o Test planning for the All Source Analysis System (ASAS) has not been adequate to provide results of sufficient quality to permit informed procurement decisions. The Army's planned Milestone IIIB production decision should not be made without complete and adequate OT&E.

o The C-5B performed well during the one-year FOT&E test period.

o With HARM (AGM-88A), user requirements for each Service are not totally met at this time, but fixes and test of fixes indicate that the full requirements can be met in the new versions.

o Emerging results on the M939A2 five-ton truck suggest that variants other than the wrecker go through a series of corrective actions and check testing.

o Degraded turning performance of the F-16C model caused by increased gross weight and leading edge flap schedule continues to detract from operational effectiveness.

o The AN/ALQ-172 was determined to be effective against the tested threat.

o Delays in the development of the AN/ALQ-135 update have required postponing operational tests until 1990.

o The Maneuver Control System has not been adequately tested in the field and has not demonstrated operational effectiveness or operational suitability for typical users in typical combat scenarios.

o Slow data transfer between the users is expected to cause additional delays in completion of technical testing of EPLARS.

o No operational tests on the AN/ALQ-161 have been accomplished to date.

o DOT&E finds the M9 ACE to be operationally effective and suitable.

o The FDT&E I of the Pedestal Mounted Stinger identified needed changes to the training, tactics, and logistical considerations necessary to increase the squad's fire unit performance.

o Continuing problems were encountered in maintenance and logistical support of the M1A1 Abrams main battle tank.

o AMRAAM missile reliability, performance in an ECM environment and against multiple targets, and software maturity are the major concerns for which corrections have been identified, but remain to be tested.

o Production options for Regency Net were exercised before OT&E. Regency Net OT&E has not been adequately planned or initiated.

o The need to supply operational units with operational guidance systems has delayed the remaining three Peacekeeper test launches.

o The Pioneer RPV system is marginally effective in providing battle-damage assessment.

o The AN/ALQ-184 system (a major upgrade to the AN/ALQ-119 ECM pod) was as effective as the AN/ALQ-119, but did not meet the criteria identified in the statement of need. DOT&E recommended the Air Force not proceed with low-rate initial production until the effectiveness deficiencies were corrected and retested.

o As tested in FOT&E, the MH-53E was considered only marginally operationally effective and not operationally suitable.

o The STU-III secure telephone system is usable but needs improvement. The system has strong potential to be operationally effective and suitable.

o Service approval of the TEMP and OT plan for the Marine Corps Tactical Air Operational Center/Modular Control Equipment (TAOC/MCE) is seriously delinquent.

o The T-45 aircraft raised some significant safety concerns and issues including poor waveoff and bolter performance, inadequate stall warning, excessive roll-off after stall, and pitch changes after speedbrake extension or retraction. It is not yet operationally effective in the carrier environment.

o The LANTRIN system provides a night, single-seat, low-altitude operational capability that does not currently exist in the tactical air forces.

During the fiscal year, we have continued to emphasize the use of all valid information for operationally oriented judgments as early as possible during the life cycles of all systems. This is particularly important when Congress authorizes a concurrent approach to development and

production of a system, with significant funds expended prior to the availability of a system (or prototype) for actual operational field testing. In such cases, we must use whatever pertinent information is available to make early assessments of expected system capabilities. Such information can include the output from high-quality, validated simulators as well as any other reliable information source.

PROGRAM OVERSIGHT

This office is responsible for approving the adequacy of plans for operational test and evaluation, and for reporting to the Secretary of Defense and the Congress the operational test results for all major defense acquisition programs. For DOT&E oversight purposes, major defense acquisition programs were defined in law to mean those programs meeting the criteria for reporting under Section 2432, Title 10, US Code (Selected Acquisition Reports (SARs)). Currently, there are about 114 such programs. The law (sec.138(a)(2)(b)) also stipulates that the DOT&E may designate any other programs for the purpose of his oversight, review, and reporting. With the addition of such "non-major" programs, the DOT&E currently is cognizant of 197 acquisition programs.

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

- o Congress or OSD agencies have expressed a high level of interest in the program.
- o Congress has directed that DOT&E assess or report on the program as a condition for progress or production.
- o GAO will monitor and/or report on operational testing.
- o The program requires joint or multi-Service testing (the law (sec.138(b)(4)) requires the DOT&E to coordinate "testing conducted jointly by more than one military department or defense agency").
- o The program exceeds or has the potential to exceed the dollar threshold definition of a major program according to DoD 5000.1, but does not appear on the current SAR list (e.g., highly classified systems).
- o The program has a close relationship to or is a key component of a major program.
- o The program is one in which an existing system is undergoing major modification.
- o The program is in trouble or has a history of serious problems.
- o The Service operational testing agencies (OTAs) have specifically requested DOT&E involvement.
- o The system falls under Special Operations Forces (SOF) purview.

PROGRAMS UNDER DOT&E OVERSIGHT AS OF OCTOBER 1988

A. Programs Meeting the Criteria of Section 2432, Title 10, U.S.C.

ARMY

AAWS-H
AAWS-M
ACCS
ADDS/EPLRS
AFV
AH-64 (APACHE)
AHIP (OH-58D)
ASAS/ENSCE (JTF)
ATACMS
ATM
BRADLEY FVS (M2/M3)
CH-47D (CHINOOK)
COPPERHEAD
FAADS (C2I, LOS-F-H, LOS-R, NLOS)
FHTV/PLS
FMTV
HELLFIRE (AGM-141A)
LHX
M1 TANK/M1 BLOCK 2
MLRS
MLRS-TGW
MSAM
MSE
PATRIOT
SADARM
SINCGARS
STINGER
STINGRAY
TOW 2
UH-60A (BLACKHAWK)

NAVY

AAAM
AIM-7M (SPARROW)
AIM-54C (PHOENIX)
AIWS
AN/BSY-1 (SSN-688 SUBACS)
AN/BSY-2 (SSN-21 COMBAT SYSTEM)
AN/SQQ-89, AN/SQS-53C, AN/SQR-19 TACTAS
ASPJ(ALQ-165)
AV-8B
A-6E/F
BATTLESHIP REACTIVATION
CG-47 AEGIS
CIWS (PHALANX)
CVN-72/73/74/75
C/MH-53E
DDG-51
EA-6B
E-2C
E-6A (TACAMO)
FDS
F-14
F/A-18
HARM (AGM-88A)
HARPOON
LAMPS MK III
LCAC
LHD
LRAACA
LSD-41/LSD-41 CV
MK-48 ADCAP
MK-50 TORPEDO (ALWT)
NATO AAWS
P-3C
SEA LANCE (ASW SOW)
SH-60F (CV HELO)
SSN-21
SSN-688
STANDARD MISSILE (SM-2)
T-45TS
TAO FLEET OILER
TOMAHAWK (BGM-109)
TRIDENT II MISSILE
TRIDENT II SUBMARINE
UHF FOLLOW-ON COMM
V-22
V-22 ASW VARIANT

AIR FORCE

ADI
AMRAAM (AIM-120A)
ATARS
ATF (INEWS/ICNIA)
B-1B
C-5B
C-17A
CIS (MARK XV IFF)
DMSP
DSCS III
DSP
F-15
F-16
GLCM
IUS (SPACE SHUTTLE)
JSTARS
JTIDS
LANTIRN
MAVERICK (AGM-65G)
MILSTAR
MLS
NASP
NAVSTAR GPS
OTH-B
PEACEKEEPER
PEACEKEEPER RAIL GARRISON
SFW
SMALL ICBM
SRAM II
TACIT RAINBOW
TITAN IV (CELV)
TRI-TAC
WIS

DCA

DMS

NSA

AEPDS

OTHER

SDI/SDS

PROGRAMS UNDER DOT&E OVERSIGHT AS OF OCTOBER 1988

B. Programs Designated in Accordance with Section 138, Title 10, U.S.C.

ARMY

9MM PER DEF WEAPON
AFATADS
ALQ-136
APR-39
FOTL
HMMWV
M109A2 155MM (HIP)
M88A1
M9 ACE
M939A2 5-TON TRUCK
MCS
PERSHING II
REGENCY NET
UAV
ULCS

NAVY

ALR-67 (F-18)
AN/SWW-891 (IMPROV PROG)
ATA
BIGEYE (BLU-80B)
FFG-7
IMPROVED LINK II
MCM
MHC
N-ROSS
RAM (RIM-116A)
ROTH-R
RPVs
S-3B
SPY-1 B/D (AEGIS)
SUBMARINE LASER COMM
SWCM
TAOC/MCE
VERTICAL LAUNCH ASROC

AIR FORCE

ACM
AGM-130 (POWERED)
ALCM
ALQ-131 JAMMER R/P
ALQ-135 UPDATE
ALQ-161 (B1-B)
ALQ-172 (B-52H)
ALQ-184 JAMMER
ALR-56C (F-15E)
ALR-62I (F-111)
ALR-74/56M
ALS
ASAT
ATB
CSOC
E-3A
EF-111A (TJS)
EPW
MC-130H
MMIII PEN AIDS
NWS
SRAM T
WWABNCP

DCA

DDN

NSA

FSVS/STU-III

NATO COOPERATIVE

AIOS
LEGUAN BRIDGE
RAVEN UAV
SPRITE RPH

OTHER

AIRSHIP
MAISRC PROGRAM

PART II

POLICY AND RESOURCE MANAGEMENT

POLICY INITIATIVES

The Test and Evaluation Committee (TEC), chartered under DoD Instruction 5000.2 to identify and resolve resource and policy issues in the T&E arena, has provided the forum and expertise for focus and direction of T&E policy within DoD. The TEC addressed four sets of T&E policy issues presented by the Services in the TEC organizational meeting: live-fire and joint live-fire testing, realistic testing and modeling and simulation, T&E resources and budget, and contractor involvement in operational test and evaluation. The TEC also addressed additional issues as they surfaced during the year.

The Test and Evaluation Symposium conducted on June 1-2, 1988, jointly sponsored by DOT&E and DDDR&E (T&E), provided additional focus to T&E policy issues. Over 150 senior level OSD and Service personnel participated, as panels discussed a number of important test policy issues, including Test and Evaluation Master Plans (TEMPs), trends in range and facilities capabilities/T&E budget trends, live-fire testing, performance of Early Operational Assessments, the future of air defense threat simulators, and contractor involvement in operational testing.

Additional issues addressed here include establishment of the DOT&E Deputy for Strategic Systems, preparation of a plan for operational suitability assessments, formalization of the Foreign Weapons Evaluation and NATO Comparative Test programs, modeling and simulation in support of OT&E, responses to a wide variety of GAO concerns, and formulation and publication of numerous T&E guidance documents.

TEST AND EVALUATION COMMITTEE

The TEC is chartered under DoD instruction 5000.2 to identify and resolve resource and policy issues in the T&E arena. The DOT&E chairs the committee, and the DDDR&E (T&E) is vice-chairman. TEC panels were established to resolve the following four issues:

Live-fire and Joint Live-fire Testing. Policy implementing PL 99-661 as amended by the FY86, FY87, and FY88 DoD Authorization acts was promulgated with the publication of the "Live-Fire Test and Evaluation Guidelines" on June 1, 1988. These guidelines provide for a timely and thorough assessment of the vulnerability/lethality of a system as it progresses through its development and subsequent production phases. Live-fire test planning will be documented in program TEMPs.

Realistic Testing and Modeling and Simulation. The state of the art in simulation is still evolving and continues to be the subject of discussion and debate. It is clear, however, that the application of solidly validated modeling and simulation to operational test and evaluation is on the rise, especially where there are constraints placed on OT&E for reasons of cost, safety, security, limited assets, treaties, and concurrency. The need for Early Operational Assessments (EOAs) to support major milestone decisions prior to the availability of production-representative test articles also increases the importance of modeling and simulation. It is thus essential that the models and simulations employed and the results derived from them be both valid and credible.

For these reasons, the Secretary of Defense tasked this office to develop DoD-level guidance on the application of modeling and simulation to operational test and evaluation. In July 1988, we asked the Services and defense agencies to assist in the preparation of a draft guidance document on the application of modeling and simulation to OT&E, including guid-

ance on establishing credibility of those simulations. In August, we conducted a very successful two-day workshop (with representatives from all Services, other OSD offices and defense agencies, and private industry) to elicit and combine Service and DoD agency concerns, policy guidance, and methodologies, for the purpose of incorporating these into a draft "for comment" document. The draft guidance document was derived directly from the workshop output, and has been forwarded to the Services for formal comment. After formal comments have been gathered, we will conduct a follow-up workshop (in mid-January 1989) to reconcile the Service comments. Subsequently, formal guidance, will be published by the DOT&E. In the meantime, the draft document is serving as an interim guide to the Services, providing a framework to address the credibility and validation of weapon systems models and simulations.

T&E Resources and Budget. In accordance with House Report 100-410, which directed DoD to develop a management plan for the Major Range and Test Facility Base (MRTFB), the TEC established priorities and the mechanism for monitoring execution of the MRTFB Improvement and Modernization Program. The resource panel of the TEC was responsible for development of the management plan.

In April 1988 Congress was provided a report describing the concept for managing DoD test capabilities. This report provided a description of the MRTFB, history leading to its formation, management responsibilities, discussion of congressional concerns, and an outline of the OSD near and long-range concept for addressing congressional concerns. In September 1988, an additional report was submitted which detailed DoD implementation of the concept, including specific actions and milestones for accomplishing the activities identified in the concept report.

The TEC will provide the DoD a corporate mechanism to coordinate management of not only the currently defined MRTFB, but a new, broader concept embracing all elements necessary to establish a National Test Capability Base (NTCB). This NTCB will encompass the newly defined MRTFB, as well as elements from other government organizations, academia, and the private sector which can support DoD's testing needs. The submission of the management plan is a first step toward attaining this national capability.

Contractor Involvement in Operational Test and Evaluation. The restrictions with respect to system-contractor involvement in OT&E, as contained in 10 U.S.C. 2366, continue to generate significant interest in DoD and in the Congress. The interpretation of this law—specifically paragraphs (a)(1)(C) and (b)(2), which address system contractor involvement in OT&E—can and have had a major impact on the conduct of initial operational test and evaluation (IOT&E).

Clearly, a contractor whose system is being tested must not be allowed to influence the conduct or outcome of testing or the analysis and evaluation of test data. However, there is serious concern that the current law provisions are too sweeping and vague. As a result, the TEC is evaluating alternative approaches. It is expected that proposals will be forwarded to Congress for consideration early in 1989.

T&E SYMPOSIUM

The T&E Symposium, the second to be jointly sponsored by DOT&E and DDDR&E(T&E), was an excellent forum for discussion of T&E issues. Panel discussions provided a good format to review the previously mentioned policy issues be-

tool in making sound production decisions.

Air Defense Threat Simulators. OSD will accomplish its goals in air defense threat simulator development by expanding its role in three areas. The Executive Committee for Threat Simulators (EXCOM) will operate under a new charter and provide the guidance necessary to meet requirements while eliminating duplication. Work which has been done on future range improvements will be coordinated with the work of the EXCOM to insure that programs and budgets are synchronized. Finally, the TEC will serve as the focal point to give visibility to the requirements for realistic testing and provide discipline to avoid unnecessary duplication.

ADDITIONAL POLICY ISSUES

Strategic Systems Oversight. As reported in last year's Annual Report, at the direction of the Secretary of Defense, DOT&E began an initiative to facilitate the conduct of early operational assessments of the Strategic Defense System (SDS). Based on that direction and congressional language included in the Conference Report on the FY89 DoD Authorization Act, we established a deputy director responsible for oversight of those strategic and space systems programs under the cognizance of the Defense Acquisition Board's Strategic Systems Committee.

While the new Deputy for Strategic Systems actively pursues OT&E oversight of all strategic systems – e.g., B–1B, Small ICBM, and Anti–Satellite (ASAT) systems – he has begun a major effort to address OT&E concerns for the Strategic Defense System. The primary focus of this effort is to establish a capability to provide the Congress and the Defense Acquisition Board with timely independent assessments of the potential military usefulness of the Phase I Strategic Defense System. During FY88, we concentrated on establishing the requirements for OT&E–related resources and building organizational relationships and procedures which will facilitate the conduct of independent assessments of the SDS programs. We have developed institutional relationships with each Service OTA to ensure a thorough and comprehensive understanding of these complex national programs.

Our first contribution was to identify some disconnects in the SDS program for the DAB meeting held in September 1988. The thrust of our findings concerned the need for more attention in the targets area and differences between the proposed concept of operations and the evolving Phase I architecture.

The relationships forged between the Services and DOT&E which will be necessary to perform Early Operational Assessments of the SDS program have been spelled out in a memorandum of understanding (MOU) between the Service secretaries and the Director, OT&E. This MOU, which covers roles, missions, and responsibilities, will be signed and implemented in early 1989.

Operational Suitability Assessment. During the last few years, the DoD has increased its focus on the reliability, maintainability, and support aspects of new DoD systems. In the operational testing arena, the assessment area for these topics is operational suitability, that is, the ability to place a system satisfactorily into field use, considering reliability, maintainability, availability, and all of the required support elements. During FY88, DOT&E initiated an effort to place more directed attention on this aspect of OT&E activities. We added a specialist for operational suitability to our staff, and we developed a plan for operational suitability assessment

ing addressed by the TEC as well as the following T&E policy issues.

TEMPs. The TEMP was generally recognized as a valuable top-level document, suitable for overall program test planning throughout the acquisition cycle. Recommended changes in TEMP length, the review and approval process, update requirements and resource identification will be addressed in the revision of DoD 5000.3-M-1, "Test and Evaluation Master Plan Guidelines," which will be published in 1989.

Performance of Early Operational Assessments (EOAs). For many years the operational test community has been urged by both DoD and Congress to get involved earlier in the acquisition process. The traditional approach to OT&E, in which the tester takes a production-representative system and evaluates operational effectiveness and suitability in a realistic environment, under combat stress, with representative personnel operating and maintaining it, is still a valid, absolutely essential approach. It provides solid answers to questions of effectiveness in the field and extremely important input to the production/deployment decision process. However, the pressure for early OT&E community involvement stems from the decision makers' very real need for objective, operationally oriented information to make informed decisions during the concept demonstration/validation and full-scale development phases of acquisition. These decisions are concerned with determining whether or not the program is on the right track toward ultimately yielding an operationally effective and suitable system. The more integral development/production concurrency becomes a part of a system's acquisition strategy, the more critical these decisions become. From the decision maker's viewpoint, EOAs are extremely important because they can identify areas of risk before significant money has been spent and the program has gone down the wrong track for so long that it must be cancelled.

If traditional dedicated OT&E is the "final exam" for a preproduction decision, then EOAs should be viewed as "periodic quizzes" leading up to this exam. They provide a means of assuring decision makers that the system is being prepared for the final exam and that operational effectiveness and suitability shortfalls are being identified and corrected early on. EOAs are tools to "guide" not to "decide."

The C-17A was the first major acquisition program to present an EOA to this office as a decision-making tool. Using the Critical Operational Issues from the Test and Evaluation Master Plan as a "framework," the EOA highlighted areas of risk that could affect the overall operational capabilities of the C-17A. This was the first in a series of C-17A EOAs that will be updated and presented annually. Guidelines that can be used by the Service operational test agencies to standardize the format and content of Early Operational Assessments are being developed.

The System Maturity Matrix was developed as an adjunct to the EOA. This document outlines the testing/demonstrated capability available to support major production decisions. The maturity matrix is not intended to set pass/fail criteria, but rather to permit a qualitative assessment of a system's progress.

After several months of coordination between DOT&E and the Air Staff, the final iteration of the B-2 System Maturity Matrix was approved. This matrix addresses the aircraft's mission performance, low observability, vehicle performance, integrated logistics support, mission planning system, and training systems. This document will be an example for other acquisition systems to emulate, and should prove to be an extremely useful

which will guide our efforts to improve our work in this very important area.

Foreign Weapons Evaluation Program. The Foreign Weapons Evaluation (FWE) Program is designed to support the evaluation of a foreign nation's weapon systems, equipment, or technology in terms of its potential to meet a valid requirement of one or more of the US Armed Services. Goals of the FWE program include avoiding unnecessary duplication in development, enhancing standardization and interoperability, and promoting international technology exchanges. The FWE program is not intended for use in exploiting threat systems or for intelligence gathering purposes. The primary objective of the program is to reduce the costs of research and development, while leading to the acquisition of foreign equipment for US use. Policy and procedures for the execution of the FWE program are documented in DoD 5000.3-M-2.

Foreign weapons evaluation activities and responsibilities were assigned to the Director Defense Test and Evaluation (now Deputy Director Defense Research and Engineering (Test and Evaluation) (DDDR&E(T&E))) by direction of the Congress in 1980. Each year, sponsoring military services forward to the DDDR&E(T&E) candidate nomination proposals (CNPs) for systems to be evaluated under the FWE program.

The fundamental criterion for FWE program selection is the candidate system's potential to satisfy an existing or projected operational or training requirement or its possible contribution to the US technology base. Additional factors influencing candidate selection include the following: candidate maturity, available test data, multi-Service interest, existence of a statement of operational requirement need, potential for subsequent procurement, sponsorship by a US-based licensee, a realistic evaluation schedule, a DoD component cost-sharing proposal, and preprogrammed procurement funds. For technology evaluation programs within the FWE program, the candidate nomination proposal must address the specific arrangements under which the US and foreign participants (governments, armed forces, corporations) will operate. These may include government-to-government memoranda of agreement, private industry licensing agreements, data exchange agreements, and/or cooperative technology exchange programs.

Foreign weapons evaluation projects are funded by OSD and executed by the Services. Points of contact at the headquarters level in each of the Services monitor the conduct of the programs. Work is performed in laboratories and test centers throughout the country.

NATO Comparative Test Program. The NATO Comparative Test Program is similar to the FWE program. It was created by Congress in the FY86 Defense Authorization Act. The program supports the evaluation of NATO weapon systems, equipment, and technology and assesses their suitability for use by US forces. The selection criteria for the NATO Comparative Test Program are essentially the same as for the FWE program, with the exception that the equipment must be produced by a NATO member nation and be considered either as an alternative to a system in the late stage of development in the US, or to offer a cost, schedule, or performance advantage over US equipment. In addition, the program requires that notification be sent to the Armed Services and Appropriations committees of the House of Representatives and Senate before funds are obligated. With this exception, the program follows the same nomination process and administrative procedures as the Foreign Weapons Evaluation Program. Guidelines for the program are contained in DoD 5000.3-M-2. DoD

directive 2010.6 instructs the DoD in how to comply with the law.

This office has participated actively in the Foreign Weapons Evaluation and NATO Comparative Test programs during FY88 and during the FY89 selection process. Sixty-one projects were reviewed as potential candidates for these programs in FY89. A DOT&E staff specialist sits on the FWE/NCT Review and Selection Committee to determine which projects should be approved and which should be rejected.

Three FWE/NCT projects were elevated to the DOT&E oversight list: The Navy's Action Information System (AIOS), the USAF Sprite unmanned aerial vehicle (UAV) and the Army's evaluation of the Raven UAV. Both the Sprite and Raven evaluations are being evaluated within the framework of the UAV Joint Project Office.

Responses to GAO. During the past year, the GAO caseload of reviews, studies, and investigations has escalated geometrically. This has required the DOT&E staff to expend between 5200 and 7800 manhours on GAO and DoD Inspector General matters during FY88. This translates to nearly four DOT&E staff people (over 10% of our professional staff) working full time for a year for the GAO and DoDIG.

The Beyond Low-Rate Initial Production Report. The B-LRIP Report is one of the most important products of this office. It is necessary, therefore, to maintain a consistent methodology for producing the report. In response to this need, a "Guide to Preparing B-LRIP Reports" was developed to facilitate and standardize our B-LRIP report preparation and publication procedures. It contains specific guidance on considerations to be included in the body of every B-LRIP Report. Beginning with this edition, all B-LRIP reports will be included in an appendix to our Annual Report.

T&E Guidance. The following T&E guidance documents were coordinated and published during the past year:

- o DoD 5000.3-M-1, Change 1, "Test and Evaluation Master Plan (TEMP) Guidelines," February 5, 1988.
- o DoD 5000.3-M-2, "The Department of Defense Foreign Weapons Evaluation Program and NATO Comparative Test Program Procedures Manual," August 1988.
- o DoD 5000.3-M-4, "Joint Test and Evaluation Procedures Manual," August 1988.
- o "Live Fire Test and Evaluation Guidelines," June 1, 1988.
- o "Operational Test and Evaluation Staff Orientation and Information Guide," September 1988.
- o "Guide to Preparing B-LRIP Report," December 1988.

RESOURCE MANAGEMENT

INTRODUCTION

As much as the FY89 budget year was described as an off year in the biennial budget cycle, the FY90-91 cycle during FY88 was an "on year." Major forward looking management initiatives have been undertaken and resource decisions made. In contrast, congressional restrictions have significantly affected our ability to improve the lot of the operational tester and to improve realism in near term (FY89-90) operational tests.

The Test and Evaluation Management and Investment Initiative (TEMI), described in last year's report, has culminated in major resource management policy changes and a decision to add significant resources to an OSD program element (PE) for test investment. Resource management policy changes, originally discussed under TEMI, gathered new momentum as a result of the House Report 100-410 directing development of a management plan for the Major Range and Test Facility Base (MRTFB). In the Department's response, "Management Plan for the MRTFB," jointly developed by DOT&E and DDDR&E(T&E) and forwarded to the Congress on October 1, 1988, the Test and Evaluation Committee (TEC) of the Defense Acquisition Board was officially installed as the cornerstone of a new corporate T&E resource management approach, embracing the broader concept of a National Test Capability Base (NTCB). Key elements of the plan call for review and recomposition of the MRTFB, development of a T&E capabilities data base, uniform workload and utilization measurement, development of a test resource master plan, and formulation of zero-generation and follow-on corporate biennial T&E budgets. The TEMI requirements review that identified approximately $12 billion in T&E needs (capability shortfalls) over the FY88-94 period mentioned in last year's report transitioned to the "T&E Capabilities Issue," which was discussed during the FY90-91 program review, resulting in a Deputy Secretary of Defense decision to add $1.3 billion for test investment over the FY90-94 Five Year Defense Plan (FYDP).

The Space Systems Test Capability (SSTC) study and revalidation effort, referenced in our FY87 Annual Report, was captured as a part of the T&E Capabilities Issue. Therefore, the Deputy Secretary's decision was based on the broadest possible review of DoD test resource needs. Consequently, funding to design and provide the capability to support more rigorous and stressful testing of the next and current generation of aerospace system is included in the $1.3 billion line.

The Operational Test and Evaluation Capability Improvement Program (OT&E CIP) has enjoyed considerable success in its first execution year. This is measured not only in the attainment of operational test and evaluation capabilities, but also in the reinforcement of our ability to exercise certain managerial prerogatives which have enhanced substantially our ability to improve scheduled operational tests. That is, the acquisition of threat resources (ground and airborne) has provided added leverage to enforcement of our authority to direct improved fidelity and realism in a test. Before, we were dealing only with Service funds and test resources. Now, although we are just beginning, we can bring resources to the table.

All in all, FY 1988 has been a banner year for T&E resource management. The DoD has initiated the bold steps needed to manage T&E resources adequately into the 1990s and beyond.

TEST AND EVALUATION CAPABILITIES ISSUE

The requirements analysis conducted under the TEMI formed the basis for the subject issue paper, which was discussed during the Department's review of the FY90-91 budget by the Defense Resources Board (DRB) in June and July of 1988. As chairman of the TEC and the only T&E representative on the DRB, the Director presented the arguments for the issue. After hearing all views, pro and con, the Deputy Secretary directed the Services to revalidate the merits of the needs (all unfunded) submitted, particularly as they related to their funded budgets. This revalidation was completed in fall 1988, and a decision rendered by the Deputy Secretary on November 9, 1988, to establish a central (OSD-level) T&E investment program element (PE). The funding approved was added to an already existing OSD PE (060490D, Test Instrumentation Development) in the Deputy Director Defense Research and Engineering (Test and Evaluation) (DDDR&E(T&E)) appropriation. A brief discussion of the PE and the background and rationale for the central investment line follow.

In FY88, program element 060490D was established to consolidate funds for DoD-wide development, demonstration, and integration of GPS-based range instrumentation to provide interoperability and meet more stringent demands for increased accuracy in time, space, positioning information for testing. The Department's decision to centrally fund the most critical needs, derived from the analysis of current and projected T&E capability requirements, cited above and discussed below, builds upon the precedent established in FY88.

The increase in this overall program element (+$148 million in FY90, +$265 million in FY91) results from the completion of a two-and-one-half-year DoD-wide review and analysis of T&E capability needs and investment trends. It is the beginning of an OSD-level initiative to redress the most critical needs identified. The review (previously referred to as TEMI), directed by the Deputy Secretary of Defense in the summer of 1986, identified more than $15 billion in total requirements over the FY88-94 time period. When unwarranted duplication, clearly unexecutable investment proposals, and needs that could not be tied to programs or funded technology thrusts were eliminated, the result was a validated $12 billion T&E capability shortfall that touched virtually all areas of the DoD test capability base. In addition, analysis of investment trends over the past ten years showed no real growth in test investment when R&D in general and technology drivers (e.g., smart munitions, totally integrated systems, high speed computers, high resolution sensors, directed energy, increased nuclear hardening requirements, low observables, hypersonics, etc.) in particular experienced significant real growth. Clearly, the analysis demonstrated that test investment in the Department was "broken." These results were discussed by the DRB, and $1.5 billion was added to this PE over the F90-94 FYDP. Due to budget constraints, this level of funding does not represent a "get well" profile but only a "get started" effort that will address the highest priority shortfalls.

With this added funding, this program element will centrally fund test and evaluation (T&E) investments to provide critically needed test capabilities in the following functional areas:

- o Test mission command, control, communications, and instrumentation.
- o Electronic combat, threat, and computational simulation.
- o Space system test capabilities.

o Weapons effects test capabilities.

o Targets.

o Environmental and physical test capabilities.

This central funding approach is responsive to both congressional and DoD desires for more effective management of T&E investments needed to ensure adequate test capabilities for more realistic and rigorous evaluation of planned weapons acquisitions and to preclude unwarranted duplication of test investment. Moreover, it is responsive to the competing pressures resulting from (1) the convergence of a 25–30 year old test "plant" and significant new weapons technologies, and (2) limited overall DoD investment resources. This central line will also facilitate OSD's ability to ensure cost-effective investment, promote interoperability and commonality, and leverage test investment funding retained by the Services. Most important, this central program is not the domain of a single advocate, rather, it is managed by the DoD Test and Evaluation Committee (TEC). The TEC will provide the central forum for key representatives of the Office of the Secretary of Defense (OSD), the Services, and the Defense Agencies to establish corporate priorities through all phases of budget formulation and execution. With regard to priorities, the clear concentration of early investment is in instrumentation and electronic combat test capabilities, with continued heavy concentration on interoperable and transportable T&E assets. Priority has been given to increased realism of electronic combat testing, with increased application of validated simulation where it provides an effective evaluation tool. Major out-year investments are planned in space system test capabilities, including instrumentation, command and control, and threat and payload simulation, to allow adequate T&E for the next generation of aerospace systems currently in early development.

The central funding provided here, coupled with aggressive DoD-wide planning and stronger OSD-level management of investment resources will allow timely initial progress and continued comprehensive analysis of total requirements.

A functional breakdown of this central program is provided below:

	FY($M)						
PE 060494OD	**88**	**89**	**90**	**91**	**92**	**93**	**94**
Test Mission C3I	30.1	30.0	95.2	122.0	146.0	123.1	90.4
EC/Threat/ Comp Simulations	–	–	54.7	74.1	139.5	119.9	119.0
Space System Test Capabilities	–	–	3.5	16.0	34.0	66.6	77.0
Weapons Effects Test Capabilities	–	–	10.5	67.4	25.3	21.7	3.1
Targets	–	–	8.4	8.6	7.5	8.0	9.3
Environ/Physical Test Capabilities	–	–	3.0	5.8	19.6	9.0	25.0
*Total	30.1	30.0	175.2	293.9	371.9	348.3	324.4

*Any differences due to rounding.

OPERATIONAL TEST AND EVALUATION CAPABILITY IMPROVEMENT PROGRAM

The Operational Test and Evaluation Capability Improvement Program (OT&E CIP) was reduced to an appropriated level of $59 million from a request of $93 million for FY88, and to $59 million from a request of $121 million for FY89. The required restructuring of the program to accommodate reduced funding levels resulted in a realignment of program concepts and objectives. The original concept of replicating the Soviet air defense elements of a two motorized rifle regiment front satisfied many critical operational test and evaluation requirements and afforded critically required densities to stress US systems undergoing operational tests. However, reduced funding has significantly affected our ability to bring this capability on line in logical elements. Consequently, we have refocused the program to concentrate on reducing the risk and improving the fidelity of near-term OT&E programs.

The OT&E CIP realignment was directed at enhancing Service participation and implementing three critical phases to provide the DOT&E test information required to isolate and identify actions to ensure adequate operational test and evaluation within reduced funding constraints. The three phases are:

- o Functional analysis to determine near-term test resource shortfalls considering all DoD assets.

- o Resource management to fund shortfalls efficiently.

- o Creation of a Mobile Operational Test Force (MOTF) to augment Service operational testing through short-term interoperable procurements.

Prioritized scheduled operational tests are the prime driver in the identification of shortfalls to be addressed by the OT&E CIP. Solutions are primarily satisfied through short-term procurements. All battlefield environments (air, land, sea, and space) will be considered, with mobility and transportability of assets being paramount.

MOTF equipment will be utilized and operated based on annual prioritized operational test requirements. Items funded by the OT&E CIP will always fall under the management purview of OSD.

Service OT&E principals have been briefed on the realigned OT&E CIP, and all have formally expressed their full support.

A draft operating procedure for the OT&E CIP has been prepared and is undergoing Service review and coordination. A draft OT&E CIP Master Plan has been prepared and is undergoing service review and coordination. The Master Plan contains the mechanics of the program, complies with the guidance provided in DoD procedure, and serves as the program of record.

An OT&E CIP tri-service coordinating entity "Slingshot," has been established. Its membership includes representatives of the Service staffs and the Service operational test and evaluation organizations. It has been convened on several occasions to coordinate DoD-wide operational test and evaluation shortfalls related to scheduled operational tests.

FY88 OT&E CIP funds were expended to procure items of threat equipment to satisfy OT&E shortfalls. These items were demonstrated in late summer during the Mobile Integrated Threat Test (MITT).

The Operational Test and Evaluation Capability Improvement Program has matured to the point where actions are fully

coordinated throughout DoD to ensure the adequacy of scheduled operational tests.

MRTFB MANAGEMENT PLAN

The Management Plan for the Major Range and Test Facility Base (MRTFB) proposed by DDDR&E(T&E) and DOT&E, details the Department's implementation of the management concept approved by the Deputy Secretary of Defense and reported to Congress in April 1988. Simply stated, the Test and Evaluation Committee (TEC) of the Defense Acquisition Board (DAB) will be the DoD corporate mechanism that will coordinate management of not only the currently defined Major Range and Test Facility Base (MRTFB) but a new, broader concept embracing all elements necessary to establish a National Test Capability Base (NTCB). This NTCB will encompass a newly defined MRTFB, as well as elements from other government organizations, academia, and the private sector that can support DoD's testing needs. As the first step toward attaining this national capability, the Department presented the management plan for the MRTFB subset of the NTCB to Congress in the April 1988 report.

The TEC's approach is to first reassess the structure and composition of the MRTFB, while completing the already initiated T&E capabilities data base. Along with this, the TEC is addressing the establishment of uniform standards for the entire test community to measure facilities workload and utilization. Also being developed and implemented is a corporate near-term/long-term test investment master strategy considering test resources at a national level. This strategy encompasses planning for test resources in a completely unconstrained financial environment considering only validated future requirements reflecting DoD corporate priorities established by the TEC. Then, in the programming and budgeting phase, financial constraints will be overlaid on a resource plan to arrive at a DoD corporate budget and risk assessment.

First, the criteria and basis for DoD's MRTFB must be reassessed, considering facilities from a national perspective. Those activities not essential to DoD's ability to test current and future weapons systems should be dropped. Those activities not presently included, but key to future test capability, must be added. The new MRTFB will provide the building block for eventual definition of the NTCB. The TEC will address test support resource requirements from a national perspective. Test support asset compatibility and interoperability will be the cornerstones of a national system which will foster sharing of resources in order to level out the workload peaks and valleys that are inherent in the systems acquisition testing process.

With the effort already under way to consolidate and integrate a data base that will contain information on DoD's current test capability, we can begin to add information on capabilities from outside the DoD. Knowledge of those capabilities available to DoD from other sources will enable investment strategies to be developed that focus on filling national voids. This data base will be multi-tiered and include MRTFB facilities, laboratory facilities, training facilities, private sector facilities, other non-DoD government agency facilities, and all other facilities and assets which might be suitable in supporting DoD testing. This data base will be a constantly evolving set of information on the NTCB that will be updated regularly as new facilities and capabilities come into existence.

As a necessary adjunct to its understanding of the test capabilities resident within DoD, the TEC will pursue the development of methods that will allow measurement of utilization of current capacity to test. This will make it possible

to know when efficiencies can be achieved by shifting workload and sharing assets.

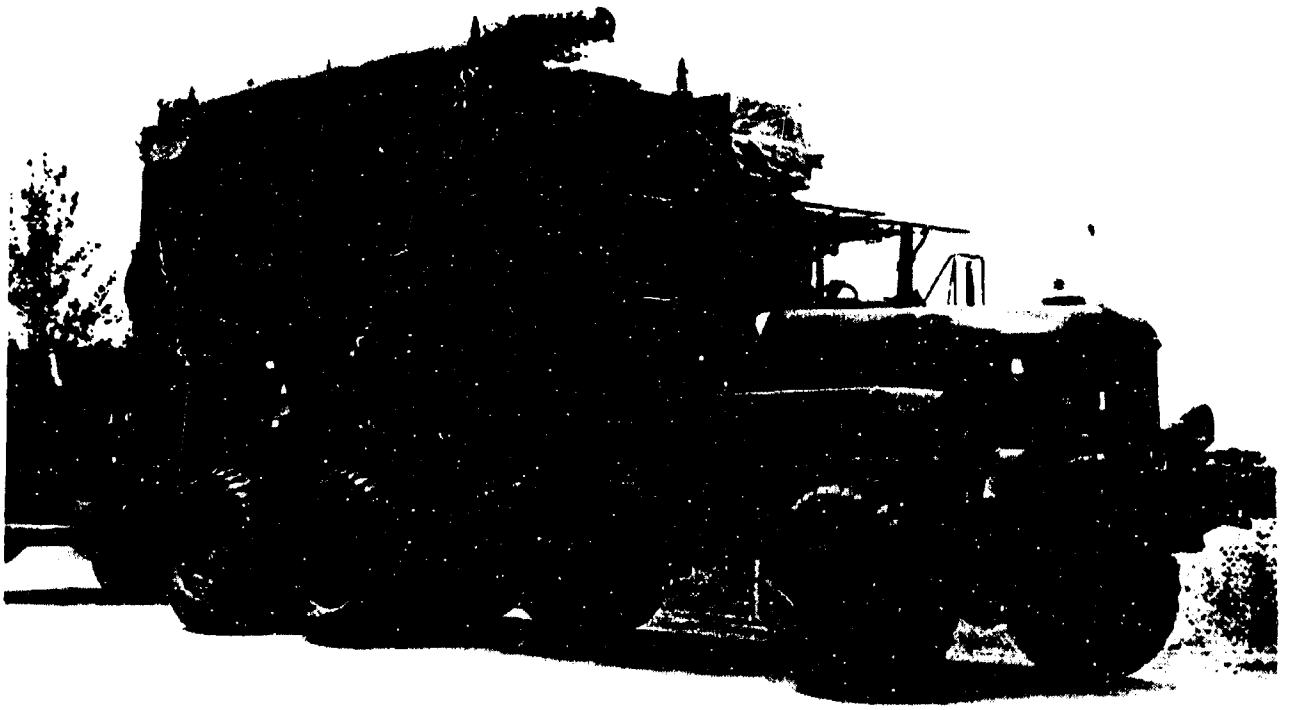
With a clearer understanding of the capabilities available to DoD to support its testing requirements and a knowledge of the level of utilization of current capabilities, integrated long-range planning can more accurately identify future needs. Using proposed requirements developed by each military Service, a validation and prioritization process will generate DoD-wide requirements to be coordinated through the TEC. Once endorsed by the TEC, these requirements will be converted into a master plan for investments to enhance the Department's ability to test future systems. The Services will be responsible for executing the programs approved for the master plan.

With anticipated tighter constraints on future funding levels, programming and budgeting actions will require better coordination. Through the TEC, corporate strategies will be developed that make clear the priorities within the master plan and the level of investment needed each fiscal year to execute the approved strategy. The TEC process will be integrated with the Department's planning, programming and budgeting system to arrive at T&E's final position in the DoD budget.

PART III

ARMY OT&E

ARMY ALL SOURCE ANALYSIS SYSTEM (ASAS)
AND
AIR FORCE ENEMY SITUATION CORRELATION ELEMENT (ENSCE)
OF THE
JOINT TACTICAL FUSION PROGRAM (JTFP)



SYSTEM DESCRIPTION

The Joint Tactical Fusion Program (JTFP) is a joint Army and Air Force program to develop an automated system to analyze, fuse, and report in near real time high volumes of time-sensitive intelligence data and disseminate the results to tactical battlefield commanders. It is intended to provide battlefield commanders a detailed picture of the enemy situation and target nominations to guide employment of maneuver forces and weapon systems in the execution of the air-land battle. If the system performs as expected, only minutes rather than days will be required to analyze the fuzed information and disseminate it to field commanders.

The major JTFP components are the Army's All Source Analysis System (ASAS) and the Air Force's Enemy Situation Correlation Element (ENSCE). ASAS is the control node for the intelligence electronic warfare (IEW) portion of the Army Command and Control System

(ACCS) and is the focal point for exchange of information between ACCS and other Services, allied forces, and intelligence resources. ENSCE is the focal point for exchange of information between the Air Force Tactical Air Control Center (TACC)/Tactical Air Control System (TACS) and other Services, allied forces, and theater and national intelligence resources. ASAS/ENSCE manages tasking for intelligence collection resources and will operate at levels up to Top Secret/Sensitive Compartmented Information (TS/SCI). A multilevel security information processing capability is required.

ASAS/ENSCE comprises hardware modules, software packages, work stations, and mobile tactical shelters. The hardware modules will be interconnected by a local area network (LAN). Five types of hardware modules include: (1) the intelligence data processing (IDP) module to process intelligence data in future system designs; (2) the ASAS/ENSCE interface module (AIM) to interface ASAS and ENSCE and process intelligence data; (3) the communication processor and interface (CPI) module, which interfaces data processing modules with all other intelligence sources through the area communications network in future system designs; (4) the forward sensor interface and control (FSIC) module, which relays data from ground-based intelligence sources in forward areas to the division data processing modules and extracts perishable combat information from the message flow for brigade commanders; and (5) a radio module (the AN/TRC-113, which is already in the Army inventory).

Software is being developed with time-phased releases. The first production design release (Release 1) is to provide the basic system and communications software to support an Army tactical operations center (TOC) operationally. The second release is to build on Release 1 and provide operational support to the Army TOC, and the Army combat electronic warfare intelligence (CEWI) operations, and the Air Force Tactical Air Control Center (TACC). Because of differences in the deployment of hardware for the Army and Air Force which affect the software build process, the second software release is being designated as Release 2 for the Army and Release 3 for the Air Force. Other releases have been deferred to a preplanned product improvement (P3I) phase.

A portable ASAS/ENSCE workstation (PAWS) provides the user system interface. A tactical simulation (TACSIM) will provide a capability to drive the system for training and testing activities.

A limited capability configuration (LCC), which comprises AIM modules, FSIC modules, and PAWS, is now being developed for fielding before completion of full system development of the objective system design. This LCC is a production system that will provide the hardware and Release 1 of the ASAS software for field testing. Field testing of the LCC will provide feedback for Release 2 ASAS/ENSCE software development.

BACKGROUND

In 1980, the House Committee on Appropriations and the House Permanent Select Committee on Intelligence directed DoD to consolidate separate Army and Air Force efforts to automate intelligence fusion systems. In turn, DoD established the Joint Tactical Fusion Program Management Office (JTFPMO) to develop a single automated system. A letter of instruction (LOI) and joint program charter were signed by the secretaries of the Air Force and Army in 1982, with the Army as executive agent. A Joint Oversight Group (JOG), chaired by the Vice Chief of Staff of the Army, provides guidance and exercises ASARC/AFSARC authority. In 1984, Congress expressed concerns about the cost of the program and the need for

smaller automated intelligence analysis systems for rapid deployment units. Congressional guidance was given in December 1985 to emphasize repackaging and downsizing of the hardware to fit Army light division S-250 (7-foot) shelters. Development of S-250 sheltered modules was conducted in FY86 and FY87. Development of 12-foot S-280 sheltered modules, downsized from the 20-foot International Standards Organization (ISO) shelters, was conducted during FY86 and FY87.

OT&E ISSUES

The ASAS/ENSCE program is proceeding without an approved test and evaluation master plan (TEMP) or operational test (OT) plan. A draft TEMP, dated April 1, 1987, received Service approval in January 1988 and has been received by OSD. ASAS/ENSCE is defined by the Army as an evolving program and system that cannot be fully measured against requirements until stable, mature software has been verified, potentially after system initial operational capability (IOC) is declared. The Army also refers to the hardware modules as non-developmental items (NDIs). A limited capability configuration (LCC), which comprises AIM, FSIC modules, and PAWS, is being planned for procurement and fielding before completion of full system development and testing. The Army's Operational Test and Evaluation Agency (OTEA) has concluded from field trials on the AIM and FSIC that more time must be allowed for developmental testing to verify software maturity, and that force development test and experimentation (FDT&E) must be conducted to refine concepts and doctrine. Operational and security requirements will require security accreditation by the Defense Intelligence Agency (DIA). The plan to resolve these issues and others critical to operational effectiveness and suitability has not yet been resolved in the TEMP and OT plan approval process.

OT&E ACTIVITY

Test and evaluation of ASAS/ ENSCE has included AIM brassboard evaluation at the 9th Infantry Division (Motorized), Fort Lewis, Washington, in March 1985, and a PAWS field evaluation at the 2nd Armored Division during June 1987. Air Force testing of ENSCE in 1988 consisted of software integration with the intelligence correlation element (ICE) and the intelligence work station (IWS). Demonstration of these systems has been underway at Goodfellow AFB, Texas, since March 1988. The all-source portion of Release 1 software was converted to IBM language, and in July 1988 it passed the SRVT for future use on host computers in USAFE and PACAF. No reports have been provided to DOT&E on these activities.

OTEA conducted field trials of AIM(6) and FSIC modules from November 17, through December 19, 1986 at Fort Hood, Texas. These were early user investigations of system operational concepts and were designed to aid development of operational test methodology, instrumentation, and resources requirements for realistic operational testing of ASAS/ENSCE. OTEA issued a test report on these field trials in February 1987 and followed with a June 25, 1987 independent operational assessment (IOA) report. The IOA report was forwarded to the defense committees of Congress by the Army on August 19, 1987. Our office did not observe the field trials because they were not approved realistic operational tests of the system planned for procurement and fielding. We will witness the testing currently scheduled for FY89.

OSD returned the ASAS/ENSCE TEMP to the Army unapproved on April 7, 1988. Submission of a revised multi-Service approved TEMP was requested prior to initiation of Phase 3 of the program scheduled for October 1988. The Army submitted two supplements to

the unapproved TEMP. An "Independent Operational Evaluation Concept (IOEC) for ASAS" document dated June 1988 was submitted July 11, 1988 and referred to as a Master Evaluation Plan (MEP) to be appended to the TEMP. A one-page matrix of technical information was later provided for addition to the TEMP.

OT&E ASSESSMENT

OTEA assessed results of the AIM(6) and FISC field trials in its IOA report dated June 25, 1987. OTEA's conclusions included these findings: performance was as expected for this stage of development; FISC modules demonstrated significant capability to relay information to nodes and extract information from message traffic; ASAS organizational and operational concepts require refinement; the requirement document needs clarification; system survivability/vulnerability is an issue; better methods and more time are required to verify software maturity and fix hardware faults; and test data collection and processing must be automated.

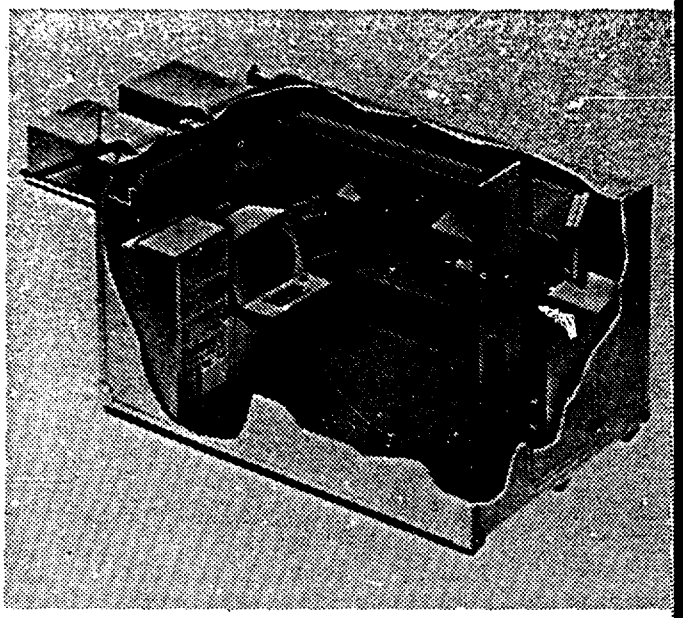
Our assessment is that test planning to date has not been adequate to provide test results of sufficient quality to permit informed procurement decisions. Procurement began in FY87. Evolutionary development, NDI procurement, phased testing, and interim fielding strategies of ASAS still require adequate OT&E and reports to support beyond-LRIP decisions. Milestone IIIA has passed and LRIP is in progress, although not shown in the TEMP. Milestone IIIB is not clearly shown in the TEMP.

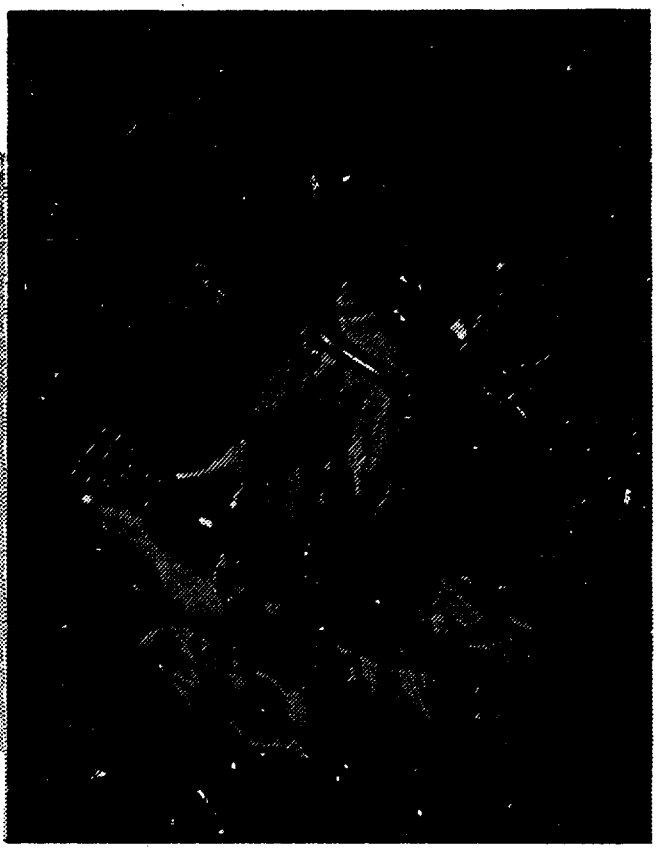
The Army-planned Force Developmental Test and Experimentation (FDT&E) is not an adequate OT&E to support beyond-LRIP decisions. It does not include quantitative operational results being reported to either confirm operational effectiveness and suitability in the field or to support future procurement decisions of either hardware or software releases. The funding and hardware-item (AIM, FISC, PAWS, etc.) procurement quantities are not clear. Air Force participation is not clear. Validated threat, quantifiable mission effectiveness goals and thresholds, and simulator validations are still not addressed. Procurement is continuing on this major DoD program without approval of adequate OT&E to support the procurement and program milestone decisions.

SUMMARY

The unapproved TEMP is almost two years old. During the last year it was not revised or resubmitted as a multi-Service approved TEMP as called for by OSD. A TEMP and an OT plan approved by OSD are required before this office can approve testing adequate to support procurement decisions.

ENHANCED POSITION LOCATION REPORTING SYSTEM (EPLRS)





SYSTEM DESCRIPTION

The Position Location Reporting System (PLRS) is a computer-based system which is intended to provide secure and jam-resistant navigation, position location, identification, and automatic reporting to the Net Control Station (NCS) for subsequent recall by authorized PLRS equipped units. The Enhanced PLRS (EPLRS) system permits increased (up to 1200-bit-per-second) direct data communications between EPLRS equipped units after the NCS establishes the communications path between the units. The NCS allocates the EPLRS communications resource based upon predetermined need-line requirements. Communications paths which experience poor communications reliability are automatically reported to the NCS. The NCS automatically searches for and assigns alternate routes to improve connectivity. EPLRS consists of three basic components: the Net Control Station (NCS), which controls and manages the network; three or more EPLRS Grid Reference Units (EGRUs), which are located at known reference points and establish ground reference for EPLRS relative navigation capability; and a number of EPLRS User Units (EPUUs), which can be located on vehicles, aircraft, or individual soldiers. The EPUUs provide data interface ports for sending and receiving data. Each user unit can serve as a communications relay. The distribution of the EPUUs on the battlefield and the ability of each EPUU to relay information is expected to

provide connectivity between the forward deployed units and the NCS.

In 1972 the Marine Corps began development of the PLRS. The Army joined the program in 1973 and established the joint program office at Fort Monmouth, New Jersey. Following a competitive development, Hughes Aircraft Company was selected to complete development in 1976. A combined DT/OT was conducted in 1981 and 1982. In 1983 a joint production contract was awarded. In 1982, prior to the contract award, the Army Systems Acquisition Review council (ASARC) approved the concurrent five-phased development of the PLRS/JTIDS Hybrid (PJH). PJH was intended to respond to Army Data Distribution System (ADDS) requirements. EPLRS has evolved from the PJH development, and a portion of the Army PLRS equipment has been converted to EPLRS. In 1987 the Army decided to enter low-rate initial production (LRIP) of EPLRS by converting the PLRS equipment procured in 1983. This decision was reconfirmed by the Army in 1988, and the first two phases of the EPLRS LRIP were awarded in February and June 1988. The decision to convert the remaining PLRS units to EPLRS under the LRIP program is scheduled for 1989 following the completion of EPLRS technical testing (TT) on the engineering development models (EDMs). Technical testing began in May 1988 and was completed in September 1988. However, problems identified during technical testing are expected to extend the test into CY 1989. The Technical Test and an Army Operational Test and Evaluation Agency (OTEA) Operational Assessment (OA) are to be provided to DOT&E prior to the final LRIP decision.

OT&E ISSUES

The Army plans to make a sole-source production decision following an initial operational test and evaluation (IOT&E) currently scheduled for April-May 1990 at Fort Hood, Texas. DOT&E considers this milestone to constitute a Beyond LRIP (BLRIP) decision point.

Operational test issues include the operational effectiveness and suitability of EPLRS to support mobile operations under full load conditions (460 EPUUs) in the expected electronic warfare (EW) environment. Previous testing of the PLRS system indicated performance degradations under EW conditions and under less than full load (360 EPUUs) conditions. Critical performance measures are considered to be: adequacy and accuracy of the position location information; adequacy of the EPLRS data communication capacity to support Army Data Distribution System (ADDS) requirements; adequacy of the EPLRS communications connectivity; the ability of EPLRS to support time sensitive requirements for data communications in support of highly mobile operations in an EW environment; and the ability of an NCS to accept and manage an adjacent brigade EPLRS network during a relocation or disruption of the adjacent brigade's NCS.

OT&E ASSESSMENT

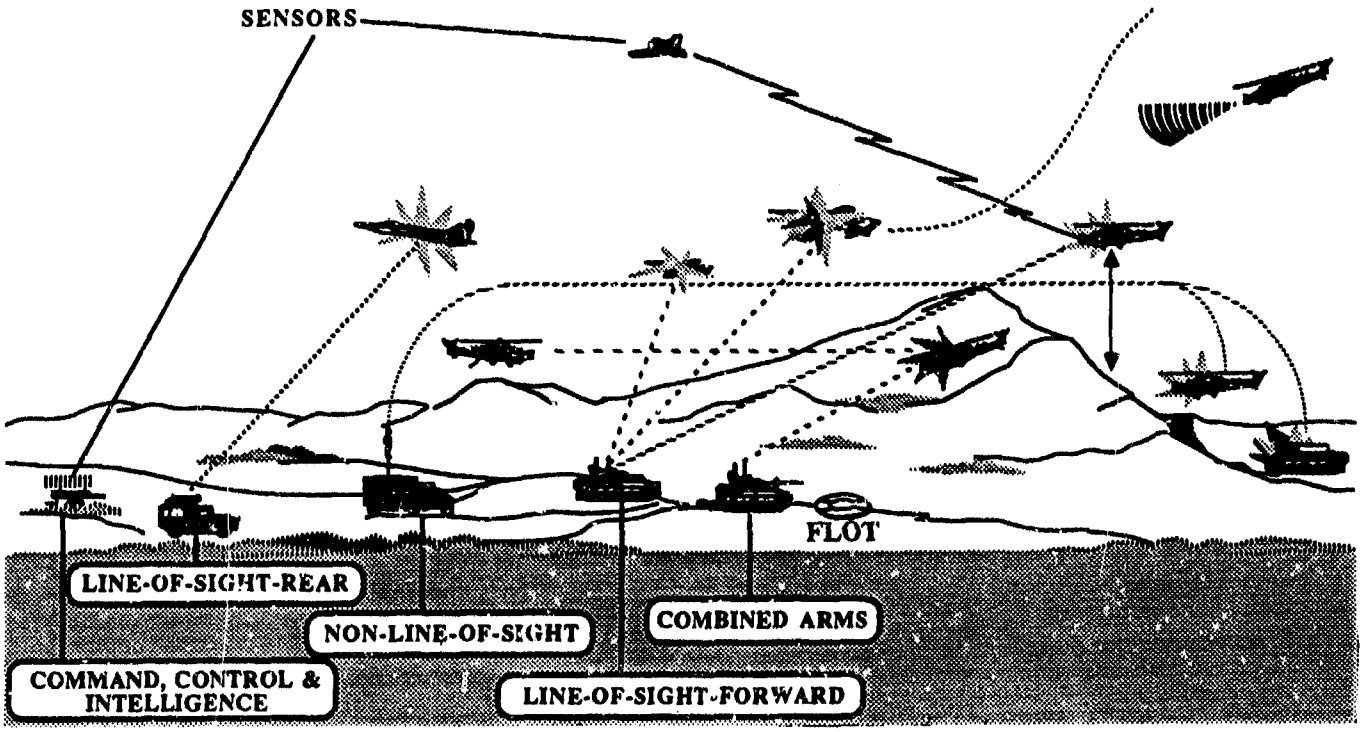
No operational testing has been performed on EPLRS. PLRS operational testing in 1982 and in 1988 both revealed system deficiencies which, unless corrected, are expected to adversely affect EPLRS performance. Technical testing of EPLRS has identified additional problems, to include: (1) a less than full ability to transmit and receive TACFIRE data; (2) slow activation of communications links in support of established need-line requirements; (3) slow reconstruction of the EPLRS network following a disruption; and (4) slow data transfer between users. The first three problems have been isolated and corrective actions have been identified. The fourth problem has not been isolated and is expected to cause additional delays in the completion of technical testing. Resolution of the above problems are planned

to be demonstrated during Phase 2 of the Technical Test.

SUMMARY

The EPLRS system represents a significant change from the PLRS design and has not been operationally tested. An OTEA operational assessment of the technical testing is required prior to a decision to complete the conversion of the remaining Army PLRS equipment to EPLRS. A full operational test is required prior to proceeding beyond LRIP.

FORWARD AREA AIR DEFENSE (FAAD)



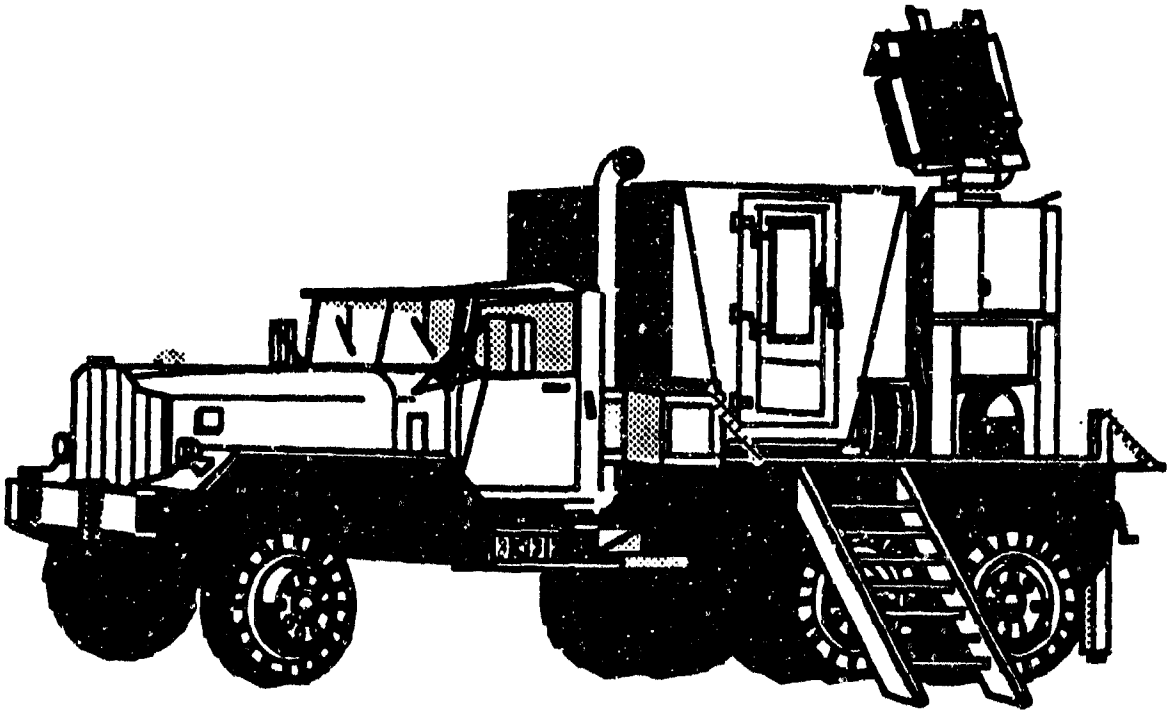
SYSTEM DESCRIPTION

The air threat to forward area US combat elements consists of enemy helicopters and fixed-wing aircraft. Previous testing with the DIVAD (Sgt. York) system has made clear that the threat, particularly that from hovering helicopters using standoff missile systems, will be significant and difficult to counter. To accomplish this, the Army Forward Area Air Defense (FAAD) system is being developed. FAAD is an aggregation of five elements: a line-of-sight forward heavy system (LOS-F-H); a non-line-of-sight system (NLOS); the Pedestal Mounted Stinger (PMS); a command, control, and intelligence system (C2I); and a combined arms initiative (CAI) to improve the counter-air capability of mechanized forces (M-1 and Bradley) and to develop an air-to-air capability.

In July 1987 the Army completed testing for the selection of the system to fill the PMS role, the Avenger. In November 1988 the Army completed testing for the LOS-F-H role, the Air Defense Anti-Tank System (ADATS). Neither system will enter full-scale production until successful conclusion of the Initial Operational Test and Evaluation (IOT&E) scheduled for mid to late 1989. A series of technical tests under operational conditions are now being conducted at White Sands Missile Range, New Mexico, to assess the ability of the single candidate sensor to meet the requirements for the FAAD C2I ground based sensor. In October 1988, the NLOS system (the Fiber Op-

tic Guided Missile, or FOG-M) entered into an initial operational evaluation on a prototype system at Redstone Arsenal, Alabama, with subsequent testing scheduled for White Sands Missile Range, New Mexico in 1989.

FORWARD AREA AIR DEFENSE (FAAD) GROUND BASED SENSOR (GBS)



POTENTIAL SYSTEM DESCRIPTION

A system has not been selected for the FAAD C2I ground based sensor (GBS). However, it is likely that the system will be a highly mobile, wheel-mounted radar with minimum operator interface. Its function will be to detect and cue hostile targets for the FAAD weapon systems and provide airspace coverage over and beyond the division's airspace, enhancing friendly aircraft protection. The radars will be netted through a command and control network and will share information among each other within the division. The current plans call for six radars per division.

BACKGROUND

The GBS is the first piece of the FAAD C2I system to be tested. It is necessary to determine what system will fill this role in order to provide the hardware component to the contractor responsible for developing the air defense software (Build I) for the FAAD C2I system. Selection of the system was structured as a non-developmental item (NDI) solution, and a request for proposal was released in April 1988. Only one proposal was received by the Army. However, the test, originally a competitive candidate evaluation, remained as scheduled and is currently underway at White Sands Missile Range, New Mexico.

OT&E ISSUES

The test is a combined technical and operational test, with emphasis on technical testing. The objectives are to test the sensor system equitably under simulated conditions, using approved threat flight profiles to collect and assess field data on which to base an independent evaluation, and to provide data to the Proposal Evaluation Team. Specifically, the Army has stated that the test program is intended to characterize the maturity and capabilities of the GBS sensor system with respect to its technical, operational, and suitability requirements in the following areas:

- o System mission performance;
- o Survivability and vulnerability; and
- o Reliability, availability, and maintainability (RAM).

The DOT&E has approved this test plan contingent upon the implementation of a number of modifications to make it more operationally realistic and fair. Among the required changes were the inclusion of the currently fielded FAAR radar to serve as a baseline for comparison, addition of ground vehicles in the radar field of view, mobility testing, adjustment to threat profiles, and the switching of the candidate system and the FAAR baseline system between radar sites. Of particular interest was the requirement for a follow-on test to determine adequateiy the effectiveness of the GBS to cue the FAAD weapon systems in an accurate and timely manner. This test must include a comparison with a modern 2D radar, versus the 3D candidate system, and must be completed early enough to provide data for the decision to support procurement of the first low-rate production systems (11 total).

OT&E ACTIVITY

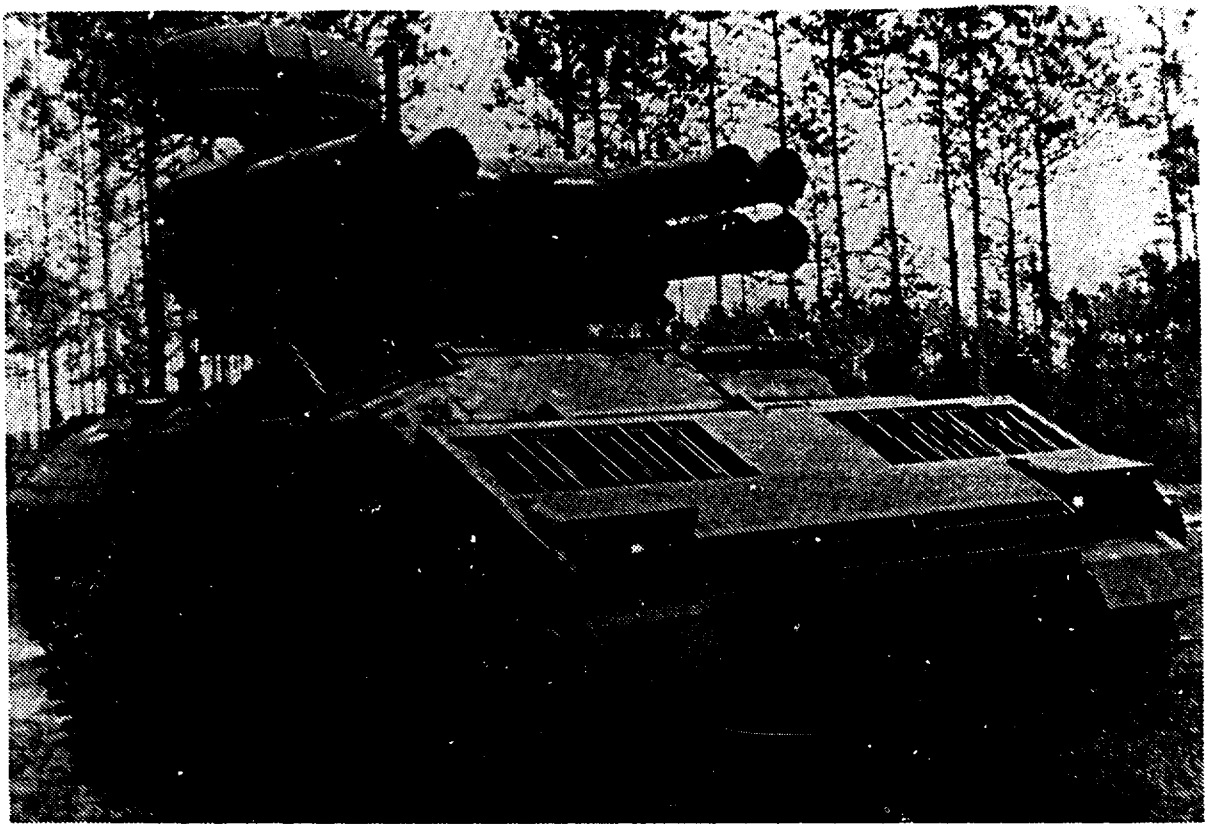
No testing on this system has been conducted previously. The first test, described above, is currently underway at White Sands Missile Range, New Mexico. However, no substantive data has been made available in this early part of the program.

SUMMARY

The GBS is a key first element of the FAAD C2I program. This test, the first of several the GBS must undergo prior to full-scale production, will provide valuable data on the operational effectiveness and suitability of the sensor. However, the overall effectiveness will not be known until the total FAAD C2I architecture (hardware and software) is available for testing. This is currently scheduled for FY90.

LINE-OF-SIGHT-FORWARD-HEAVY (LOS-F-H)

AIR DEFENSE ANTI-TANK SYSTEM (ADATS)



SYSTEM DESCRIPTION

The Air Defense Anti-Tank System (ADATS) is a highly mobile and transportable air defense weapon system that mounts eight laser-beam riding missiles on a Bradley Fighting Vehicle (M3A2) chassis. The system also includes a search radar, television optics, a forward looking infrared receiver (FLIR), and a laser range-finder. An ADATS crew consists of the fire-unit commander, the gunner, and the driver. ADATS is an international system; its major components are supplied by contractors from the United States, Canada, Switzerland, and Italy.

BACKGROUND

ADATS is expected to provide low-altitude air defense to the forward division area, especially the forward maneuvering units such as M1 Abrams tanks and Bradley Fighting Vehicles. In addition, ADATS must maneuver, fight, and survive while providing support to the forward maneuvering units. Standoff hovering helicopters as well as attacking fixed wing aircraft will comprise the primary threat to ADATS, which will be deployed in heavy divisions, separate heavy brigades (armored and mechanized infantry), and armored cavalry regiments.

Following the Non-Developmental Item Candidate Evaluation Test in November 1987, the Army selected ADATS as the most effective system. However, since the proposed system will be changed somewhat from the prototype presented for testing, only four systems were procured to support further testing.

OT&E ACTIVITY

No operational testing was conducted on this system in 1988. However, this office was directly responsible for influencing a number of key events significantly affecting the progress of this program.

Issues and Criteria. This office approved the Army's critical operational issues and criteria and notified the Congress of the same in September 1988. This certification was required by Congress before the Army could obligate FY88 funds earmarked for advance procurement. As a result of our negotiations with the Army, the criteria were expanded to provide for a more operationally realistic platoon figure in addition to individual fire unit performance figures. These figures were for evaluation planning purposes only and will be refined prior to initial operational test and evaluation.

Smoke Week Testing. This office monitored the participation of ADATS in the Army's annual Smoke Week testing during September 1988. Data to determine the ability of the system to provide command guidance to the missile through obscuration will not be available for analysis until January 1989.

Force Development Test and Experimentation (FDTE I). Force Development Test and Experimentation I (FDTE I) was conducted in June and July 1988, at Fort Bliss, Texas. The purpose of FDTE I was to facilitate the development of training, tactics, techniques, procedures, and organizational concepts for the LOS-F-H weapon system. In addition, limited logistical information on equipment failures, time to repair, and operator preventive maintenance checks and services was collected. The issues for the FDTE I were:

o Do the individual and collective tasks, battle drills, and tactics, techniques, and procedures prepare LOS-F-H crewmen to optimize the system's performance?

o Are the correct numbers and types of personnel and equipment provided at the squad level to support the LOS-F-H mission?

FDTE I was conducted using the ADATS selected by the Army as a result of candidate evaluation (July-November 1987). The ADATS system was mounted on a M113 chassis. Soldiers were used as operators, but all maintenance above operator level was performed by the contractor. The operational environment consisted of the approved air threat against a single fire unit, simulated nuclear, biological, chemical threat, flares, chaff, electronic jamming, and smoke. All areas of MANPRINT were investigated. A test-fix-test philosophy was applied to the training, tactics, organization, logistics, and threat baseline package.

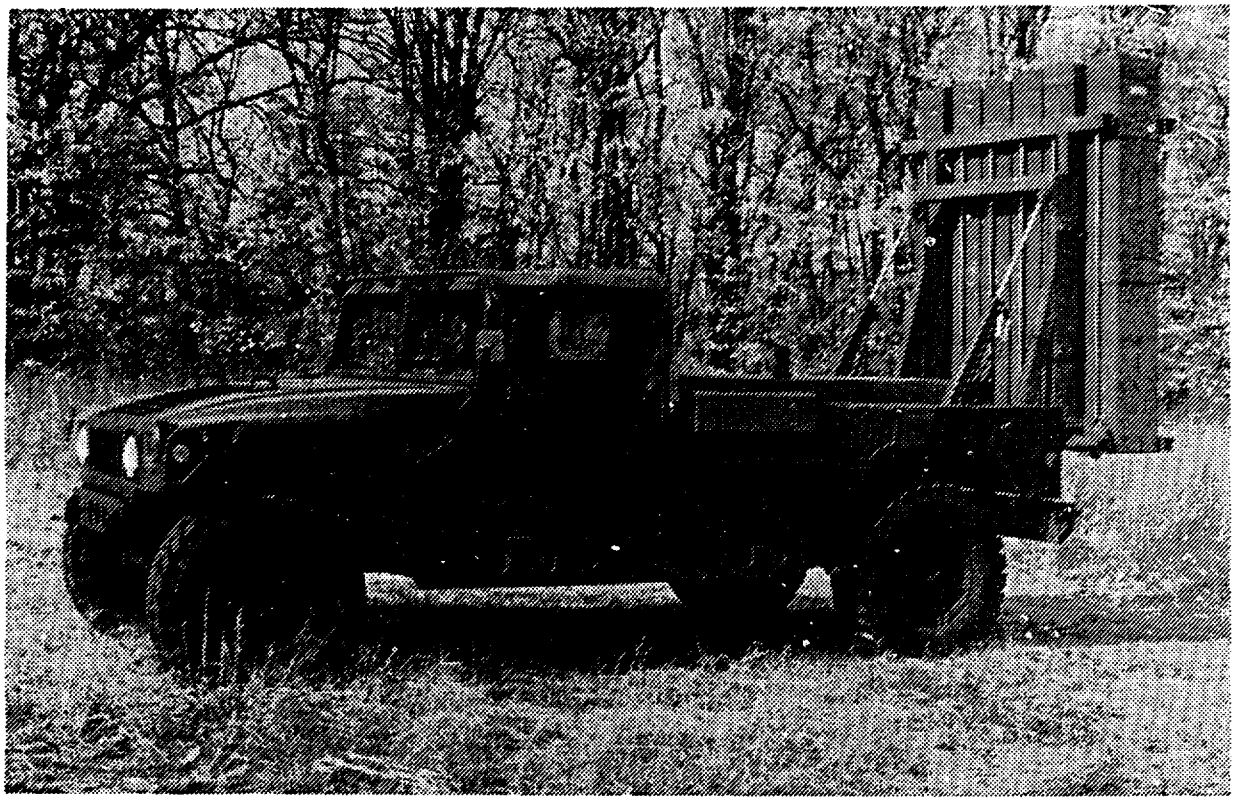
FDTE I identified needed changes to the training, tactics, and logistical considerations necessary to increase the squad's fire unit performance. It also provided the user a foundation for the FDTE II and initial operational test and evaluation scheduled for 1989.

SUMMARY

The majority of operational testing for ADATS is scheduled for 1989. However, this office has monitored and will continue to monitor the overall evaluation of the operational effectiveness and suitability of this system. In addition to the activities mentioned above, DOT&E will report to

Congress on the adequacy of qualification and operational test plans prior to the Army's obligation of funds appropriated for FY89. We will monitor contractor and government missile firings and government technical testing and prepare an Early Operational Assessment after the conduct of the Field Training Exercise scheduled for April 1989.

NON-LINE-OF-SIGHT SYSTEM (NLOS)



SYSTEM DESCRIPTION

The NLOS Fiber Optic Guided Missile, or FOG-M, tactical system will be available in two variants, light and heavy. Each type consists of a launcher, missiles (6 on light, 24 on heavy), gunner's console, and land navigator, and will be placed on a suitable vehicle (light on wheels, heavy on tracks). The FOG-M system is designed to engage stationary or moving targets masked by terrain or vegetation at extended ranges. FOG-M system missiles are launched and flown by the crew using an on-board TV camera or imaging infrared (IIR) sensor linked to the gunner's console via a fiber optic cable. FOG-M fire units are organic to batteries of the divisional area FAAD battalion and will be deployed in light and heavy divisions as well as in FAAD elements of separate brigades and armored cavalry regiments.

BACKGROUND

The FOG-M system was selected for development as the NLOS element of FAAD. The NLOS element has the responsibility of engaging slow moving helicopter and armor targets before they have reached ranges where they can attack friendly assets. These targets can be hidden from view from friendly lines. A semitactical prototype system has been developed and designated as the initial operational evaluation (IOE) system. At one time, this prototype was to have been converted into an initial system through a further maturation process for limited production in small quantities, while a

more capable objective system was being developed. Congressional direction now dictates that the IOE system is not to be produced and that the more capable Block I objective system will undergo accelerated development and fielding. The IOE system is to be tested for lessons learned toward a better objective system and to evaluate the performance and human interoperability of the existing prototype.

OT&E ISSUES

Fourteen FOG-M firing tests were conducted at Redstone Arsenal, Alabama, between February 1984 and May 1987. These tests demonstrated the early prototype missile's capability to engage hovering and maneuvering helicopters as well as moving and stationary tanks. The initial operational evaluation of this semitactical prototype system will be the first test to address some operational aspects of the system. Specifically, the Army has identified the following objectives for this test:

- To collect limited operational and technical data on the semitactical prototype IOE system to assess system performance and interoperability with the C2I system.
- To assess the impact of the C2I system on mission performance.
- To evaluate the soldier's ability to detect, identify, track, and engage targets in both the benign and dirty battlefield, using the semitactical prototype IOE system.
- To gather information about the operation of the semitactical prototype IOE system in Mission Oriented Protective Posture gear which can be used to improve the design of the Block I objective system.

After recommendations to the Army for the improvement of the operational realism of the test were implemented, the DOT&E approved the plan for this test. It is a combined operational and technical test conducted by the Army Test and Evaluation Command in conjunction with the Army Air Defense Artillery Board. It will be conducted at both Redstone Arsenal, Alabama, and White Sands Missile Range, New Mexico.

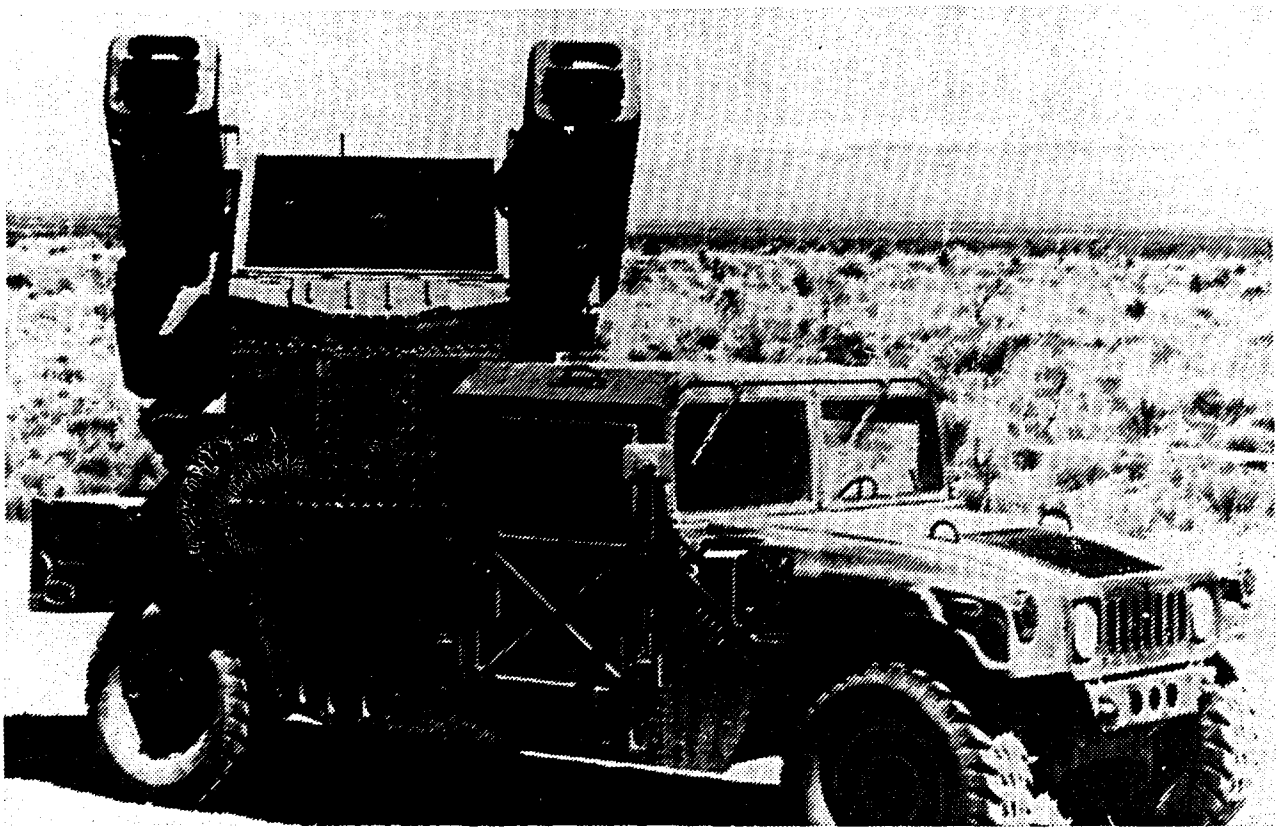
OT&E ACTIVITY

The IOE is currently underway at Redstone Arsenal, Alabama. However, it is too early in the process to provide any definitive test results. This is the first of several test and evaluation opportunities prior to the proposed low-rate production buy currently planned for FY90.

SUMMARY

The IOE is not a test of the objective system. However, the test will provide lessons learned to permit development of a better Block I objective system. This is the first of several tests which will eventually determine the operational effectiveness and suitability of this system prior to full-scale production.

PEDESTAL MOUNTED STINGER (PMS)



SYSTEM DESCRIPTION

The Pedestal Mounted Stinger (PMS) consists of a High Mobility Multipurpose Wheeled Vehicle (HMMWV), radio, identification friend or foe (IFF) system, a standard vehicle-mounted launcher, and a weapons platform pedestal consisting of a fire-prediction system and operator station. The system includes eight Stinger missiles and a 50-caliber machine gun. The Stingers may be individually removed, fitted with a gripstock, and fired as a man-portable air defense system (MANPADS) weapon.

BACKGROUND

The PMS concept was believed to have the potential to (1) extend the capability of the Stinger missile to night and adverse weather operations, (2) decrease out-of-range engagements, (3) provide a self-protection capability, (4) have a shoot-on-the-move capability and (5) have the capability to engage targets in rapid succession. During the acquisition/tracking and live-fire phases of testing these potential capabilities were tested and compared to MANPADS. Following the Non-Developmental Item Candidate Evaluation (NDICE) Test in July 1987, the Army selected the Avenger as the most effective PMS system. Further operational tests are planned for mid-1989 to address the operational effectiveness and suitability of the system for use on the battlefield prior to a full-scale production decision.

OT&E ACTIVITY

No operational testing was conducted on this system in 1988. However, this office monitored the Force Development Test and Experimentation I (FDT&E I) conducted by the Air Defense School June-July 1988. The purpose of FDT&E I was to facilitate the development of training, tactics, techniques, procedures, and organizational concepts. It also provided limited logistical information concerning such matters as equipment failure, time to repair, and operator preventative maintenance checks and services. The issues for FDT&E I were:

o Do the individual and collective tasks, battle drills and tactics, techniques, and procedures prepare PMS crew members to optimize system performance?

o Are the correct numbers and types of personnel and equipment provided at the squad level to support the PMS mission?

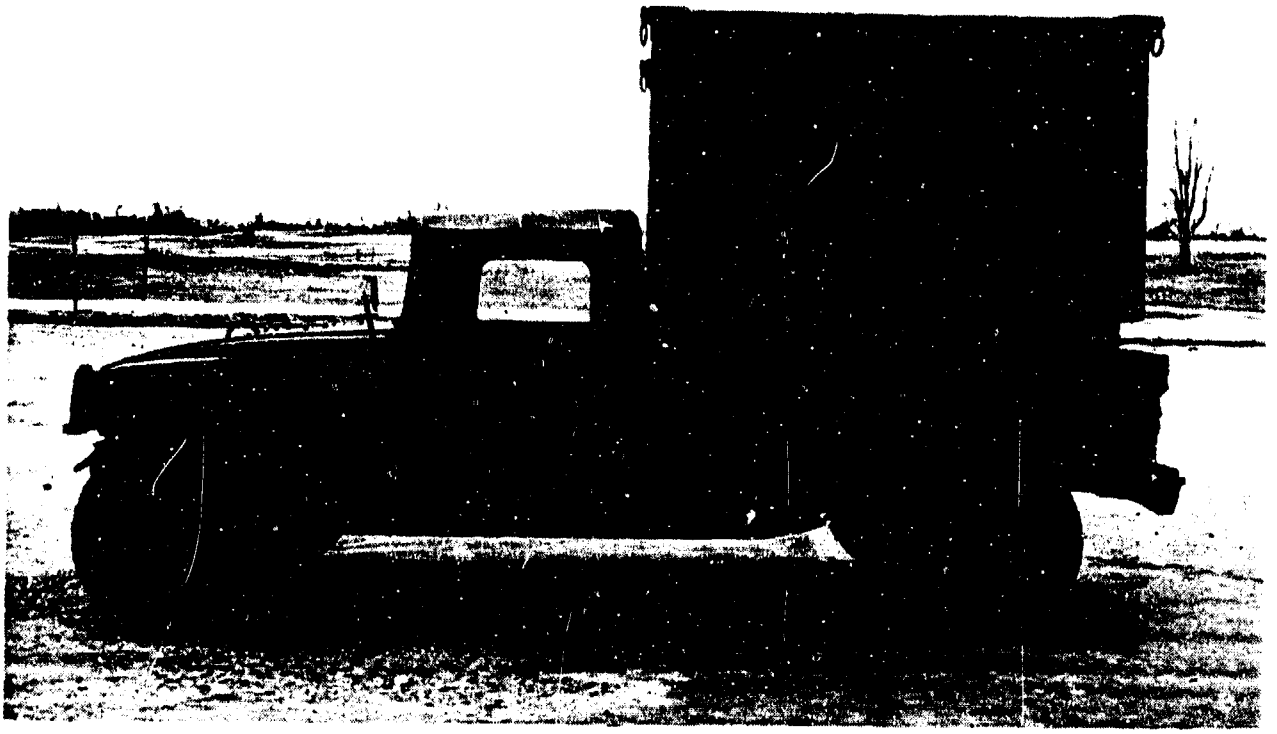
OT&E ASSESSMENT

The FDT&E I was conducted using one prototype system (the NDICE system), with nine operators. The operational environment consisted of the approved air threat against a single fire unit, simulated NBC, flares, chaff and smoke. MANPRINT was also investigated. The test-fix-test philosophy was applied to the training, tactics, organization, logistics, and threat baseline packages.

SUMMARY

The FDT&E I identified needed changes to the training, tactics, and logistical considerations necessary to increase the squad's fire unit performance. It also provided the user a foundation for the FDT&E II and initial operational test and evaluation scheduled for 1989.

HIGH MOBILITY MULTI-PURPOSE WHEELED VEHICLE (HMMWV)



SYSTEM DESCRIPTION

The HMMWV is a wheeled vehicle using a common chassis to accommodate payloads in the 1/4 ton to 1 1/4-ton range in combat, combat support, and combat service support roles. It is a full-time four-wheel drive vehicle incorporating a V-8, 6.2 liter diesel engine, a 3-speed automatic transmission, a 2-speed transfer case, power steering, and independent front and rear suspension. The initial HMMWV Group I variant included vehicles with a gross vehicle weight (GVW) of 7,700-8,200 pounds. Group II variants have a GVW of 8,660-9,100 pounds. The Army is also evaluating a 9,400 pound variant (M1069) to be used as a prime mover for the towed lightweight M119 howitzer and the M167A1 towed Vulcan air defense weapon system.

In the combat role, the HMMWV is used for anti-armor, reconnaissance, rear area combat operations, base defense and close air support control. In the combat support role, the shelter carrier and cargo versions of the HMMWV are used in command, control, communications, and intelligence (C3I); fire support team; target acquisition; naval gunfire control; air defense; battlefield obscuration; and nuclear, biological, and chemical (NBC) reconnaissance operations. In the combat service support role, the HMMWV cargo and ambulance versions support logistics,

cargo carrier, and medical evacuation operations.

BACKGROUND

The HMMWV program is an outgrowth of three previous programs: the combat support vehicle program in the late 1960s, which was to serve as a wheeled vehicle carrier for the TOW weapon system; the 3/4 to 1 1/4-ton Expanded Mobility Tactical Truck (EMIT) program, which was to develop a replacement for the Gama Goat; and the High Mobility Weapons Carrier (HMWC) program, which was intended to develop a weapons platform for the TOW and other armament systems.

In July 1980, the joint mission element need statement (JMENS) for the HMMWV was approved. The HMMWV is programmed as a replacement for selected M151 jeeps, M274 mules, M561 Gama Goats, and M792 1 1/4-ton ambulances. The total acquisition cycle for the HMMWV has been expedited to replace these aging vehicles. A concurrent developmental test II and operational test II (DT II and OT II) was concluded in September 1982. Follow-on evaluation for the initial HMMWV variants (Group I vehicles—HMMWV-TOW and HMMWV-Utility) was completed in December 1984. The first unit was equipped in September 1985. The Group II variants (HMMWV S-250 shelter carrier (M1037)), 4-litter ambulance (M997), and 2-litter ambulance (M996) are to replace the M561 Gama Goat shelter carrier, the M718 front line ambulance, and M792 Gama Goat Ambulance.

Basic testing of the Group II variants included an operational assessment (OA) conducted by USAOTEA at Fort Lewis and Yakima Firing Range, Washington, from July through October 1987, and a Marine Corps amphibious compatibility test conducted at the Naval Amphibious Base, Coronado, California, from October 1987 to March 1988. DOT&E approved the Test Design Plan for the OA in January 1987. OSD approved the HMMWV M1069 Test and Evaluation Master Plan in November 1987.

In our last Annual Report we stated that we would provide a DOT&E assessment of the HMMWV Group II variants to Congress prior to the upcoming production decision. Earlier, in our approval of the Test Design Plan, we stated that a production decision could not be made until OT results were considered and a USAOTEA assessment was made. In both cases we understood that a Group II production decision was pending. This understanding came into question when we learned that the Commander, US Army Materiel Command had approved conditional release of over 3000 vehicles. The Director requested and, on July 25, 1988, received an Army briefing on the program. We discussed the specifics of the HMMWV as well as the broader category of programs in which an acquisition decision is made within the Army when the program is on the DOT&E oversight list. For HMMWV, the production decision and contract award had been made in early 1983, prior to passage of 10 USC 138. The decision being made was therefore considered by the Army to be for fielding, not production. It was agreed that the program needed to resolve the remaining concerns on the Group II vehicles and implement necessary corrective actions to include applying the necessary changes to vehicles already produced. It was agreed that USAOTEA would provide DOT&E a status report on the four specific concerns in mid-September and a final Independent Evaluation Report in November 1988. For the broader category, DOT&E agreed to provide an explanatory memorandum, suitable for broad distribution to all levels within the material acquisition process, regarding DOT&E oversight

of systems and attendant responsibilities and requirements.

OT&E ISSUES

The OT&E issues for the HMMWV Group II variant were: mission performance; reliability, availability, and maintainability (RAM); logistical support-ability; human factors and safety; training; and transportability. Evaluation of these issues in April 1988 led USAOTEA to specify four concerns regarding identified deficiencies. The concerns were: deep-water fording; lack of restraining devices in ambulances; sharp and abrading edges in ambulances; and dust conditions in the rear of the ambulances.

The OT&E issues for the HMMWV M1069 are: operational mobility while towing the light howitzer or towed vulcan, RAM, and transportability.

OT&E ACTIVITY

Testing of the HMMWV Group II included the following: an Operational Assessment (OA) at the Fort Lewis and Yakima Firing Center from July through October 1987; First Article/Initial Production Test (FA/IPT) at Aberdeen Proving Ground, Maryland, from March 1987 through February 1988; an amphibious compatibility test at the Naval Amphibious Base, Coronado, California, from October 1987 through March 1988 and a retest at the same location in September 1988; and an ambulance dust test at Yuma Proving Ground, Arizona in October 1988. USAOTEA obtained additional data at the contractor plant in Mishawaka, Indiana, in July 1988.

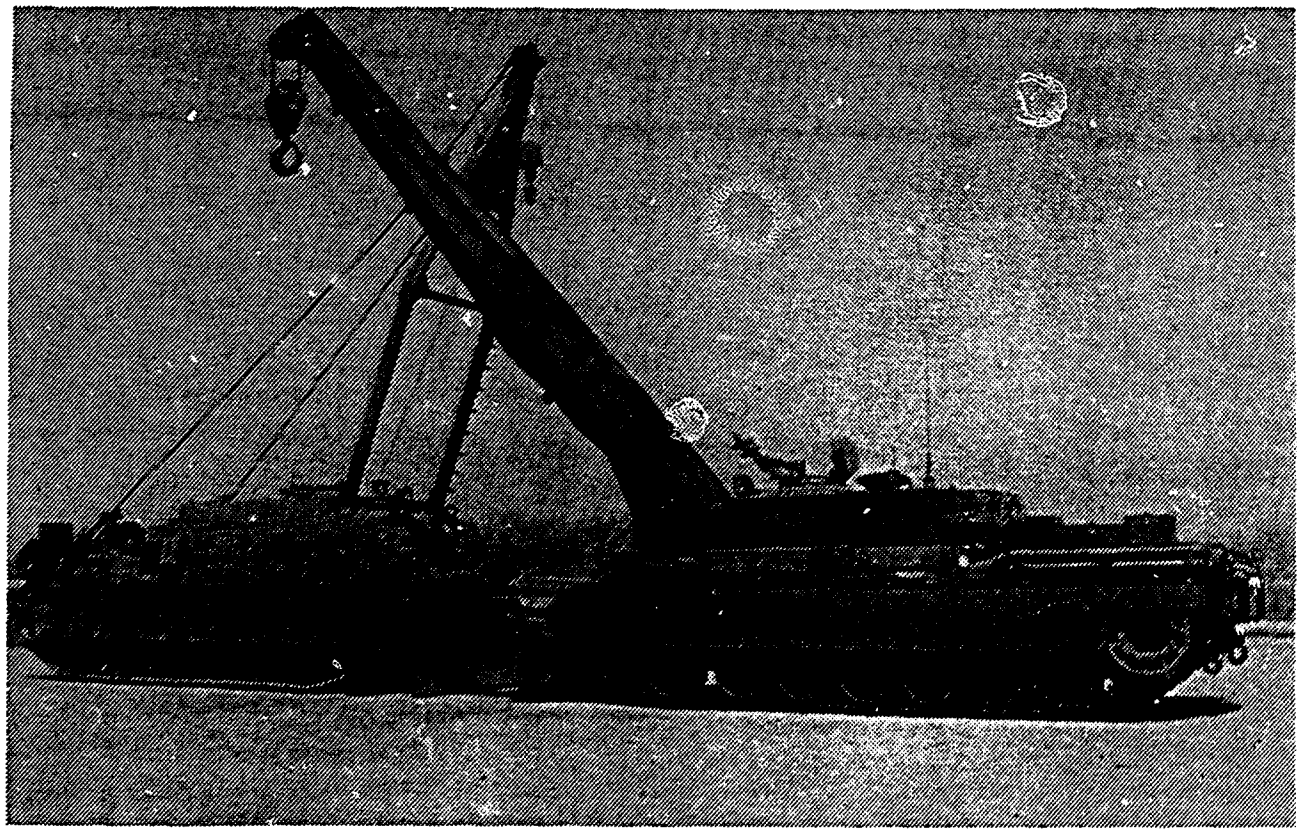
Testing of the HMMWV M1069 began at Aberdeen Proving Ground, Maryland in January 1988 and is underway at this writing. It is to be completed in December 1988. This testing has been and will continue to be observed by DOT&E.

OT&E ASSESSMENT

The USAOTEA Interim Independent Evaluation Report on the HMMWV Group II variant dated April 8, 1988, identified four concerns. It recommended further assessment of these areas and an evaluation of the adequacy of corrections to vehicles prior to fielding the Group II variant HMMWVs. At a meeting between the DOT&E and Army personnel in July 1988, the Director requested that USAOTEA provide an interim report on the four areas of concern by mid-September 1988.

The USAOTEA-published reassessment report dated September 19, 1988 recommended: (1) that corrections be implemented; (2) that all four areas of concern be reviewed after fielding to units; and (3) that, with the project manager ensuring all corrective actions contained within the report are being applied to production vehicles prior to release and to those already fielded, there was no reason to delay the fielding. We concur with those recommendations for the Group II variant. Our next Annual Report will address the assessment of the M1069 HMMWV.

IMPROVED RECOVERY VEHICLE (IRV)



SYSTEM DESCRIPTION

The Improved Recovery Vehicle (IRV) program includes two competing candidates: (1) The M88A1E1, produced by BMY, is a product-improved version of the current M88A1 tank recovery vehicle. It has an upgraded powerpack, increased winch and tow capabilities, increased vehicle weight, an upgraded suspension system, and increased armor protection. It also possesses an auxiliary power unit for ancillary tools. (2) The Abrams Recovery Vehicle (ARV), produced by the General Dynamics Land Systems Division (GDLS), is a new design which is based on the M1A1 tank chassis and includes a 270-degree rotational crane, an automatic fire detection and suppression system, and an NBC overpressure and protection system.

BACKGROUND

A fixed-price, sole-source contract was awarded to BMY in January 1987 to provide five prototype M88A1E1 vehicles purchased to a purchase description based on the M88A1E1 Required Operational Capability (ROC). The government accepted an offer from GDLS to provide a prototype ARV for test and evaluation against the M88A1E1 ROC. A one-dollar contract was awarded in June, 1987 to GDLS for one prototype to be delivered for test no later than May 15, 1988. The acquisition strategy and test and evaluation program were modified to conduct a comparative test of one M88A1E1 and the one ARV. During the test plan review process, DOT&E inserted the requirement that an M88A1 be included as a calibration of test

difficulty. To provide familiarization with recovery operations, DOT&E requested and the US Army Ordnance Center and School provided a special one-day, hands-on, in-the-field course. Regular school personnel provided instruction at their training facility at Aberdeen Proving Ground, Maryland. The DOT&E science advisor and two DOT&E staff assistants attended the course, along with others from OSD and USAOTEA.

OT&E ISSUES

The following are OT&E critical issues for IRV, as contained in the IRV Test and Evaluation Master Plan (TEMP), approved by OSD on July 25, 1988: (1) Does the IRV safely tow the M1A1 in an operational environment? (2) Does the IRV properly perform recovery and maintenance assistance mission tasks (winch, lift/winch, lift) in an operational environment? (3) Does the IRV demonstrate reliability, availability, and maintainability (RAM) characteristics required for mission accomplishment?

OT&E ACTIVITY

A side-by-side Early User Test and Experimentation (EUT&E) was conducted by the US Army Armor and Engineer Board at Aberdeen Proving Ground, (July 5-29, 1988) in accordance with a test design approved by DOT&E. The purpose of the test was to provide user test data and information required to support the source selection between the M88A1E1 and the ARV. One prototype of each and a current M88A1 baseline recovery vehicle were tested. Four military crews conducted recovery operations encompassing the winch, lift, and tow functions. All recoveries were of M1A1 tanks, upweighted to 70 tons, which is the Army's declared weight growth limit for the M1A1. The test focused on areas of operational effectiveness; it was not sufficient to address operational suitability nor was it expected to do so. Testing was observed by DOT&E.

OT&E ASSESSMENT

The results of EUT&E, in conjunction with the safety release limitations, are sufficient to determine that neither candidate is operationally effective in the tested configuration. Both have problems with main and auxiliary winches, neither meets the requirement for towing up 30 degree slopes, and the ARV has exhaust heat and towbar interference problems.

SUMMARY

An Army Source Selection Evaluation Board met during August and September 1988 to evaluate both IRV candidates. The Army has not announced a decision on the direction of the program at the time of this writing. DOT&E is an active participant in the preparation of the OT&E-based portions of a congressionally mandated Secretary of Defense certification that the tests were adequate, the results are accurate, and the chosen system is the more cost effective one.

M1A1 ABRAMS MAIN BATTLE TANK



SYSTEM DESCRIPTION

The M1A1 tank is a product improvement of the M1 tank. It incorporates a 120 millimeter gun system, a microclimate cooling system with integrated nuclear, biological, chemical (NBC) protection, a modified power and drive train, and increased armor protection. Two types of 120mm ammunition are used by the M1A1: the M829 kinetic-energy round, which uses a depleted uranium penetrator; and the M830 high explosive anti-tank, shaped-charge round. The 120mm ammunition is semicombustible, leaving only a stub metal case in the breech after firing. The German manufactured tungsten alloy penetrator round (DM23) can also be fired by the M1A1.

BACKGROUND

The operational test was managed by the Army's Operational Test and Evaluation Agency (OTEA) and executed by the Training and Doctrine Command Combined Arms Test Activity at Fort Hood, Texas, beginning in October 1983 and concluding in April 1984. At the request of the DOT&E, a live-firing test by soldiers of production-like service ammunition was added. This added phase was conducted at Aberdeen Proving Ground in November and December 1984. The tests were adequate for assessing the battlefield performance of the full-scale engineering development model tank. DOT&E reported that the M1A1 tank offered significant improvements over the M1 tank, with

increased firepower and added armor protection, and found it to be operationally effective and suitable. However, we also concluded that a continuing program of follow-on operational test and evaluation (FOT&E) would be required. A follow-on evaluation (FOE) of the M1A1 was conducted by OTEA during the period January 12 - June 30, 1987 at Fort Bliss, Texas, with the 3rd Squadron, 3rd Armored Cavalry Regiment. The purpose of the FOE was to determine if the M1A1 could be calibrated using the procedures prescribed in Field Circular (FC) 17-12-1A1, Tank Combat Tables; that materiel deficiencies disclosed during the M1A1 Operational Test (OT) II had been corrected; that the M1A1 tank could be supported with planned logistic concepts; and that M1A1 tank crews could effectively use the on-board NBC system. As a result of the test plan review by this office, the Army revised the FOE test design plan (TDP) to change the nature of the test from one of noninterference with the 3rd Armored Cavalry Regiment training activities to one of minimal interference to facilitate testing. In addition, the test command structure was changed to place the Commander OTEA clearly in charge, with authority to interfere with the unit's activities if necessary in order to complete all test requirements in a timely manner.

OT&E ASSESSMENT

Review and analyses of FOE results show that the testing was adequate and that many old problems have been fixed, some old problems remain, and new problems emerged. This is a pattern common to such tests. Problems or concerns that were satisfactorily resolved include main gun calibration, previous pattern failures, and crew use of the on-board NBC system.

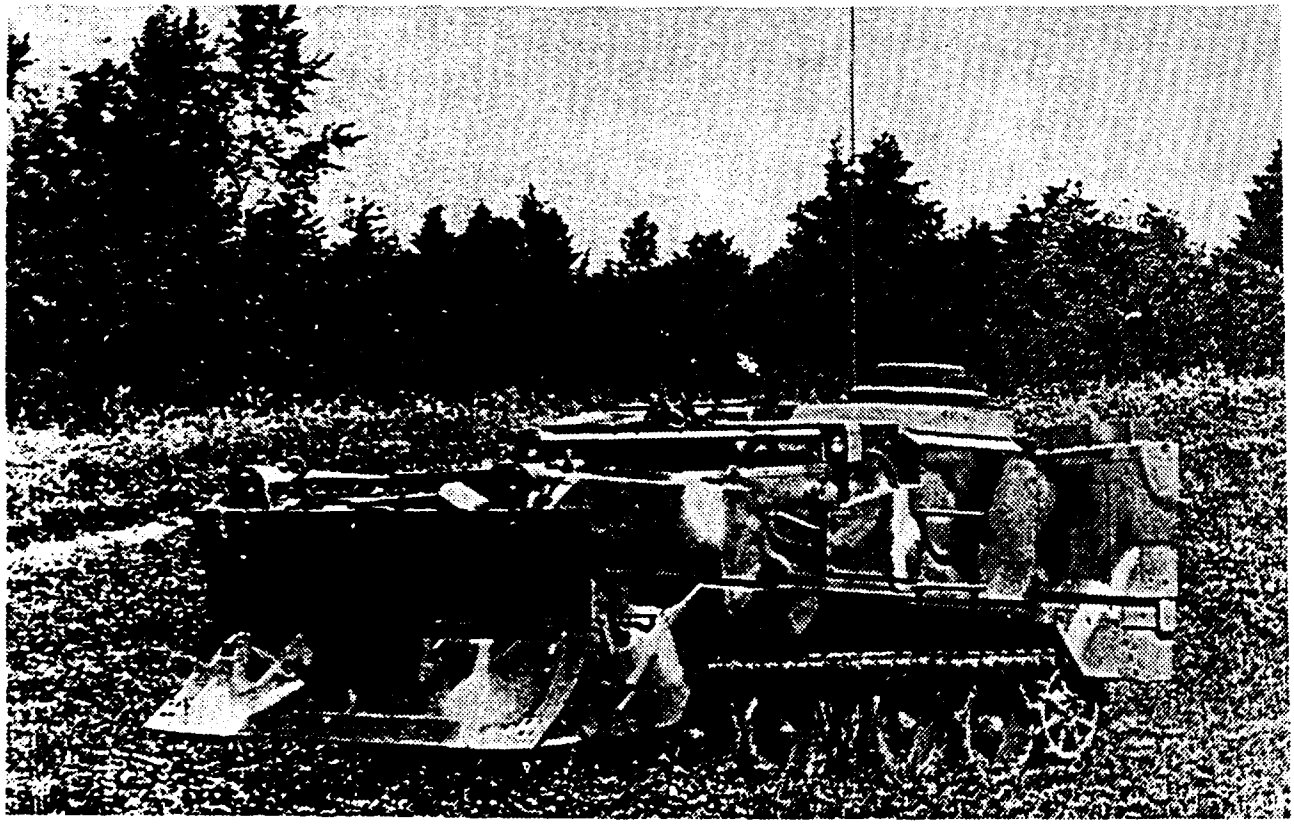
Continuing problems were encountered in maintenance and logistical support. The special test measurement and diagnostic equipment known as Support and Test Equipment (STE-M1A1) is a particular longstanding problem. It comprises seven boxes of equipment, cables, and adapters. Usually, more than one soldier is needed to run any given test effectively. The equipment cannot continue from an interrupt, but must restart tests from the beginning. It requires numerous manuals and, during FOE, required an average hook-up time of over 35 minutes. The return for this investment is measured in two ways. First, half the soldiers said they thought the STE-M1A1 correctly isolated a faulty component between 75 and 80 percent of the time; the other half thought it was 30 percent of the time or less. Second, in a sample of 32 instances of fault isolation in the laser range finder, hull network box, and turret network box where STE-M1A1 at organizational level indicated bad components, direct support level agreed that 12 were bad; for the laser range finder, direct support level did not agree with any of the 9 that organization level, using STE-M1A1, declared bad. There seems to be little hope of improvement until a new generation of built-in-test-equipment is developed. In summary, trouble shooting is expected to remain difficult, time consuming, and uncertain. In other areas of logistical support, the FOE showed that current recovery and transport capabilities are severely challenged by the weight of the M1A1 tank. The weight of the as-tested (64 ton) tank has been projected to increase to a maximum of 70 tons. The Army has programs in place to improve both recovery and transport, but developmental problems remain in both. Finally, resupply of the tested squadron was tenuous in terms of fuel handlers and repair parts vehicles as assigned under the Table of Organization and Equipment (TOE). The de-facto but not authorized TOE five-ton trucks permitted the organization to work. The logistical tail currently authorized will not

support the M1A1 squadron and needs to be increased.

New problems that have been identified include engine recuperator cracks, generator failures, loader's seat pins, and personnel heaters. From a materiel point of view, the most serious is the recuperator. Fixes have been developed by the project manager's office and are being examined in technical power-train durability testing. It is reported that the rest have been solved, but test results are not yet available. We will continue to pursue and address this subject in our next Annual Report.

Finally, our last Annual Report contained a preliminary assessment that long-range gunnery should be tested. We are now satisfied that sufficient testing has been accomplished in the 2500-to-3000 meter range band and that additional long-range engagements need not be subjected to operational testing.

M9 ARMORED COMBAT EARTHMOVER (M9 ACE)



SYSTEM DESCRIPTION

The M9 Armored Combat Earthmover (M9 ACE) is a tracked, lightly armored, amphibious, combat engineer vehicle capable of performing dozing, scraping, rough grading, towing, and limited hauling missions. It was developed to perform the engineer tasks of survivability (e.g., prepare fighting positions for tanks), mobility (e.g., breach antitank ditches), and countermobility (e.g., dig antitank ditches).

The M9 ACE has a hydraulic suspension that operates in two modes: sprung, for use for travelling; and unsprung, which allows the vehicle to be raised, lowered, or tilted for working. The front portion of the vehicle is an open-top box known as the scraper bowl, or ballast compartment. The front of the bowl is opened or closed by raising or lowering the apron with its integral dozer blade. The bowl is filled with earth by raising the apron and moving forward while scraping. Dropping the apron retains the earth in the bowl for use as ballast to improve dozing capability. The ballast is emptied by raising the apron and pushing forward with a hydraulic ejector which forms the rear wall of the bowl.

The M9 ACE can negotiate cross-country terrain, attain 29 miles per hour road speed, swim at three miles per hour, and be air transported in C-130 and larger aircraft. It provides radio communication, chemical and biological protection for the

operator, and a smoke obscuration capability.

BACKGROUND

M9 ACE development started in 1958 under the program name Universal Engineer Tractor; the current name was adopted in 1980. Following an extended series of tests, reviews, and changes, 15 M9 ACEs were built under a 1982 contract. In 1983 the Department of the Army directed that in a scheduled Initial Production Test (IPT) at Aberdeen Proving Ground be expanded to include a concurrent Force Development Test and Experimentation (FDT&E). This was the first operational test conducted on the system. In August 1984 the Vice Chief of Staff of the Army directed that a side-by-side comparison of the M9 ACE and the D7 dozer system be conducted to resolve uncertainties remaining after the IPT/FDT&E described above. The D7 system includes the standard medium crawler tractor, the M916 truck tractor, and the M172A2 lowbed semitrailer. The FOE conducted at Fort Hood, Texas, by the US Army Training and Doctrine Command Combined Arms Test Activity, employed seven of each system. The results of this test led to DOT&E expression of remaining concerns as listed under "OT&E Issues," below. Testing to address these concerns is described under "OT&E Activity," below.

OT&E ISSUES

Operational testing addressed six critical operational issues: mission performance; survivability; reliability, availability, and maintainability (RAM); logistical support; human factors; and safety. In addition, DOT&E concerns remaining following the 1985 FOE were addressed specifically in the operational phase of the 1988 IPT. These concerns were: operator hatch, RAM, productivity, transition to production from the technical data package, and effectiveness of engineering changes.

OT&E ACTIVITY

The initial production test operational phase was conducted from June to August 1988 at Aberdeen Proving Ground under the control of USAOTEA and the US Army Test and Evaluation Command Combat Systems Test Activity. Six M9 ACE vehicles were operated and maintained through the direct support level by soldiers of proper military occupational specialty. A total of 1805.8 operating hours were attained under approved operational mode summary/mission profile conditions. The purpose of the test was to address remaining concerns identified above.

OT&E ASSESSMENT

DOT&E finds the M9 ACE to be operationally effective and suitable. However, it will not be fielded until a suitable test is performed to prove that required fixes are adequate and are applied to all produced vehicles. The remaining items to be fixed are: drain valve durability; steer unit torquelink durability; steer unit bolt durability; parking brake cable durability; brake chamber bracket durability; and hatch durability. All of these can be adequately addressed by a modest expansion of the already planned and contractually required comparison test of M9 ACE vehicles' performance versus contractual requirements. This comparison test is to be monitored by USAOTEA under their continuous and comprehensive evaluation (C2E) methodology and results reported to DOT&E by means of a C2E update report. Produced M9 ACE vehicles may be allocated to and used by the Engineer Center and School for training purposes. All

fixes must be certified effective by USAOTEA prior to fielding to line units.

SUMMARY

A Beyond Low-Rate Initial Production Report was submitted by DOT&E on December 14, 1988.

M939A2 FIVE-TON TRUCK



SYSTEM DESCRIPTION

The M939A2 5-ton truck series has 17 variants, with a single forward axle and tandem rear axles, a diesel engine, an automatic transmission, a central tire inflation system (CTIS), chemical agent resistant coating paint, and super single tires. The most common of the variants are the M931A2 tractor, the M923A2 cargo truck, and the M936 wrecker. The CTIS control assembly is mounted on the shift column of the truck and allows the operator to adjust the tire pressures on the truck to four preset positions. Three of these are normally used operational positions: highway, cross-country, and sand. Each lower position decreases the tire pressure for increased mobility. The fourth position is the emergency mode and is a "last resort" when the vehicle becomes stuck. It lowers the tire pressure to the lowest the tire will allow without breaking the bead. There is also a run-flat mode that pumps pressure into the system constantly to make up for a punctured tire. It can keep a punctured tire inflated long enough to get the vehicle to a safe place to change tires.

BACKGROUND

The M939A2 is the current development in a series of trucks that began with the M809, which was fielded in 1951. The M809/M939 Product Improvement Program led to type classification of the M939 in 1981. The M939A1 introduced the use of super single tires in 1985. The M939A2 uses a new, lighter engine than

previous trucks in the series. The M939 trucks have not previously been operationally tested.

OT&E ISSUES

The issues for operational test and evaluation are: (1) Does the M939A2 meet user transport requirements in an operational environment? (2) Does the M939A2 meet reliability, availability, and maintainability (RAM) requirements in an operational environment? (3) Does the logistics support of the M939A2 meet established requirements for supply and maintenance in an operational environment? (4) Does the design of the M939A2 provide for transportability (deployment) that meets mission requirements? (5) Does the M939A2 meet or exceed human factors engineering, safety, and health requirements?

OT&E ACTIVITY

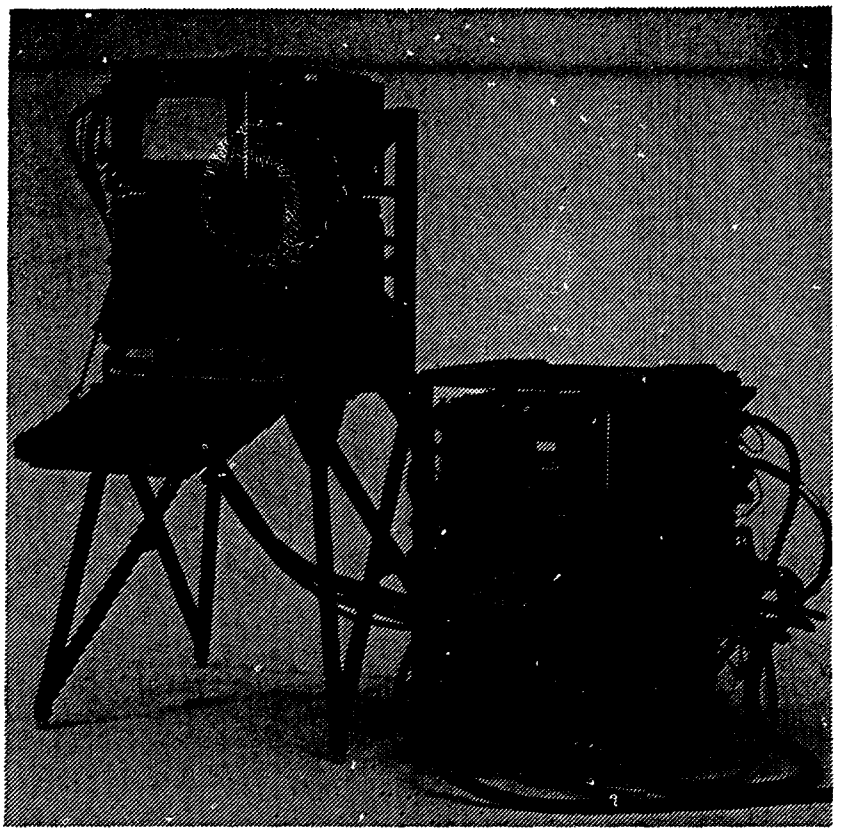
Initial operational test and evaluation was scheduled to be conducted by the US Army Armor and Engineer Board at Fort Knox, Kentucky, from July 25, through September 30, 1988. On July 14, 1988, having received neither the test design plan nor the Test and Evaluation Master Plan, DOT&E requested that the Army stop spending money on the operational test for the M939A2 until we had approved both plans. On July 15 the Army provided a test design plan which we reviewed. We found the plan to be inadequate and we required changes. The Test and Evaluation Master Plan was provided on July 25; however, it required modification to track the changed test design plan. The Army cooperated fully with changes and rewrites to ensure an adequate test, and on August 5, 1988, DOT&E gave verbal approval to start testing. Actual testing, which was observed by DOT&E, began on August 6 and continued through October 13.

The test was designed for conduct with two cargo variants, each of which was to be run a minimum of 2200 miles in accordance with a defined distribution of road types and loads. One tractor variant was to accumulate 2600 miles with various trailers, and one wrecker variant, also to accumulate 2600 miles. The cargo variants achieved 5765 miles, whereas the tractor variant was driven 2633 miles. The test report is not available, but the mileage is expected to be adequate to assess operational effectiveness and operational suitability. The wrecker, however, arrived late and, because of safety release limitations, was not completely tested. It was precluded from winching, and this eliminated testing for recovery capability, a major part of wrecker operations. Lift capacity for the boom was designed to be 20,000 pounds, but safety considerations limited test operations to 10,000 pounds or less. Attempts to conduct lift-tow operations clearly demonstrated instability, with incipient front wheel lift-off and accompanying uncertainty in directional control. Although final data are not available, the wrecker variant will require a substantial design review, modification, and retest.

OT&E ASSESSMENT

At the time of this writing, final data and evaluation are not available. Emerging results suggest that variants other than the wrecker must go through a series of corrective actions and check testing. The wrecker variant will require a substantial design review, modification, and retest.

MANEUVER CONTROL SYSTEM (MCS)



SYSTEM DESCRIPTION

The Army Maneuver Control System (MCS) is a command and control system to aid in the effective employment and operational control of the tactical maneuver force, as part of the overall force level and maneuver control system. Automated transmittal, storage, retrieval and display of battlefield information is intended to improve handling of message traffic loads and reaction times and demonstrate the potential for automatic interaction with information systems. Echelons from maneuver battalion through corps are planned to have such assistance in the form of the MCS computer network.

MCS has been programmatically and technically restructured several times, with the latest system structure being an umbrella MCS system consisting of a mixture of various separate computer systems and technologies. These include a military specification system known as the Tactical Computer Terminal (TCT) and the TCT Prime (TCT with bubble memory) in the production and limited field use phase; a later ruggedized commercial system known as the Tactical Computer Processor (TCP) and Analyst Console (AC) which recently proceeded beyond the low-rate initial production (LRIP) phase (in fact, a total buy-out) and referred to as non-development items (NDIs); and future common hardware and software which is in the development and LRIP phase under the Army Command and Control System (ACCS) program.

Earlier system structures that included military specification versions of the Tactical Operations System (TOS) and Tactical Computer System (TCS) have been terminated. Militarized computers and peripheral devices are to occupy critical or severe nodes within the netted MCS system, while NDI computers and peripheral equipment are being considered for less critical stations. TCT, TCT Prime, TCP, and AC procurements address brigade to corps levels (except battalion) and are currently structured to transfer to the reserves when the ACCS hardware is available, tested, and integrated into the system. MCS applications programs are written in Ada software language.

BACKGROUND

Development of the TCS and TCT started in 1975 as part of the TOS program. TOS was terminated in 1979 and MCS initiated, consisting of the TCS and TCT. Prototype devices were deployed to Europe in 1980 and 1981. The Army approved the required operational capability (ROC) for the MCS on June 30, 1982. In a May 1983 Army Systems Acquisition Review Council (ASARC) the MCS was type classified as standard and the TCTs and TCS entered full-scale production. In addition, the investigation of a NDI development to parallel the military specification item development was directed, with excessive cost being the driving factor. This led to October 1983 guidance to provide a limited quantity of the military specification equipment to the entire active force and to supplement it with NDI hardware in those locations where enhanced survivability was not absolutely essential. The TCP was selected as an NDI surrogate to the TCT in 1984.

In February 1986, the Army determined that the operational value of the TCS did not justify its cost, leading to termination of TCS procurement and transfer of its bubble memory to some TCTs (called TCT Prime) to replace the TCS and a decision to initiate procurement of NDI TCPs. Related guidance was provided by the Vice Chief of Staff of the Army in February and May 1986 to conduct adequate testing to support future decisions. Based on this guidance, agreements between Army test and evaluation and combat development communities identified three test requirements: successful completion of a follow-on evaluation I (FOE-I) to support TCT/TCT Prime fielding decisions; successful completion of an operational assessment (OA) to support FY87 procurement orders of NDI TCPs; and successful completion of an FOE-II of the full-up MCS system with all military specification and NDI components to support FY88 NDI orders.

The FY88 Appropriations Act contained a tasking for Army and DoD to report on an innovative strategy for operational test and evaluation of MCS to permit evolutionary development and fielding. An Army strategy was forwarded to the Chairman of the House Committee on Appropriations on June 7, 1988. DOT&E agreed in general with this strategy, which required more detail to ensure that both MCS operational suitability testing and sufficient operational realism of the full-up MCS were incorporated into testing to permit adequate evaluation. DOT&E approved a Maneuver Control Evaluation (MCE) plan for providing early equipment and equipment operator information to support an evolutionary development and testing of MCS with the understanding that it was not an adequate OT&E to confirm operational effectiveness and suitability of the system for missions in typical combat. This July 11, 1988, approval was with the understanding that additional details would be included in the MCE effort prior to FY88 procurement decisions, and that adequate follow-on operational test and evaluation (FOT&E) would be planned and conducted.

OT&E ISSUES

The MCS has passed through various systems engineering phases and decisions since 1975. These phases have not been supported with results from traditional operational test and evaluation (OT&E). Attempts have been made to obtain results from these various systems being deployed to VII Corps since 1981 for field experience and feedback to support development and procurement decisions. The MCS hardware has been procured and is partially fielded without mature supporting software to provide effective operational combat capability or support capability to provide operational suitability. Availability of sufficient memory for incorporation of functional software and current plans to pass responsibility for accreditation of the system to process classified information to the using field commander are of concern.

NDI equipment procurement became two-phased, with the first phase awarded in July 1987 as an LRIP which constituted about 45 percent of the total planned NDI program. FOT&E-II for the full-up MCS system with military specification and NDI components was first delayed from FY88 to FY89, and has subsequently been replaced by ACCS testing in the third quarter of FY91 in a TEMP submitted in July 1988. The innovative NDI component MCE was completed without inclusion of a mission-commander-level assessment of the benefits and utility of MCS hardware with Segment 10 software functions in realistic combat missions. The July 1988 TEMP proposes an operational assessment based on tests at III Corp in the fourth quarter of FY89 to support Army Materiel Release decisions for MCS.

On September 29, 1988, the Army proceeded to expend FY88 funding for the NDI full-rate production order (actually a total buy of all MCS hardware prior to the availability of ACCS) without adequate operational test and evaluation, without a determination of operational effectiveness and suitability, without OSD approval of the TEMP for adequate FOT&E, and without the DOT&E beyond low-rate initial production report to the Secretary of Defense and the Congress.

OT&E ACTIVITY

In March 1981 the Vice Chief of Staff of the Army approved fielding of engineering development versions of the TCS and TCT to VII Corps and judgement of their performance in a number of field exercises in place of traditional OT&E. These field exercises have included: VII Corps Command Post Exercise (CPX) in May and September 1981; Field Training Exercise (FTX) in September 1982; CPX in March 1983; and FTX in September 1984. The Army's Training and Doctrine Command (TRADOC) Combined Arms Test Activity (TCATA) was designated as the test organization and conducted evaluations of MCS during these exercises. TCATA conducted the TCP OA at Fort Carson, Colorado, from July 28 to August 1, 1986, and the TCT/TCT Prime FOT&E-I in Europe, April 25-29, 1987, issuing test reports in September 1986 (TCP OA) and September 1987 (TCT/TCT Prime FOT&E-I). OTEA directed the OA and FOT&E-I and issued its independent operational assessment (IOA) reports in April 24, 1987 (TCP OA), June 1987 (interim draft TCT/TCT Prime FOT&E-I), and March 1988 (final assessment report on FOT&E I).

This office did not observe either the OA or the FOT&E-I because the TEMP and OT plan were not approved for adequacy of OT&E to determine operational effectiveness and suitability. We and OTEA outlined improvements required to the TEMP on September 11, 1987. The Army did not proceed with this test strategy, but did seek congressional direction in the FY88 budget appropriations process to require an Army and DoD report on an innovative operational test strategy to

permit evolutionary development and fielding of MCS.

A summary of the Army test strategy was forwarded to the Chairman of the House Committee on Appropriations in May 1988. The DOT&E agreed in general with this strategy, with additional detail being required in the TEMP and OT Plan to ensure that operational suitability testing and sufficient operational realism would be incorporated into the Maneuver Control Evaluation (MCE) phase to permit adequate evaluation. The Army was also advised that the OT Plan must be approved prior to commencement of the MCE phase, and the TEMP, prior to the FY88 NDI option. The Army submitted a MCE plan to execute a controlled experiment without the additional details required to permit adequate evaluation. DOT&E approval of the MCE was based on inclusion and completion of details outlined in an attachment to a July 11, 1988 memorandum. These details included: assessments will consider both the hardware and Segment 10 software utility for realistic combat missions; the operators will assess the benefits and utility of MCS hardware with Segment 10 software functions; a mission-commander-level assessment of the benefits and utility of MCS hardware with Segment 10 software functions in realistic combat missions will be provided; a DOT&E report will be submitted prior to the FY88 NDI option award and will consider the MCE results, MCE assessment reports by the Army's OTEA, and details outlined above for inclusion in the MCE.

The MCE was executed as a program manager/contractor controlled field experiment in August 1988 at Fort Lewis, Washington. The MCE did not include the details called for in the July 11, 1988, DOT&E memorandum. Representatives from DOT&E observed portions of the MCE. The program manager/contractor report was issued on September 15, 1988, and an AMSAA report was issued on September 26, 1988. The OTEA report was issued in November 1988. A DOT&E report is being prepared.

OT&E ASSESSMENT

OTEA concluded that the NDI TCP provided for the July 1986 OA has the potential to emulate some of the functions and capabilities of the military specification TCT. However, the usefulness and functionality of the complete MCS could not be evaluated due to communication interface failures, the lack of a full complement of TCT/TCT Primes, and the immaturity of the software.

OTEA found that the TCT/TCT Prime as fielded during the April 1987 FOT&E-I made a marginal contribution to operational effectiveness. OTEA reported that the results of FOT&E-I would not support the fielding or materiel release of the fully militarized (TCT/TCT Prime) equipments at this time. OTEA has also suggested a force development test and experimentation (FDT&E) to learn how to develop and use MCS in the field.

OTEA found that the NDI TCP and AC could be powered by tactical power and netted with the military specification TCT/TCT Prime, a local area network, and selected military communications equipments during the August 1988 MCE. The NDI could be transported in tactical wheeled vehicles and operated by military operators in accordance with the MCE controlled experiment plan. Software was not mature and simply provided a means for passing messages.

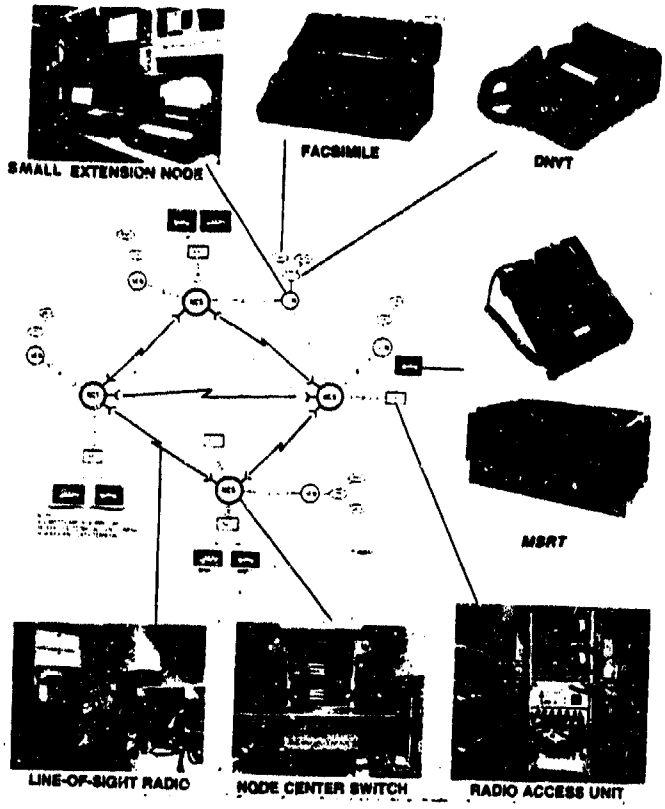
The DOT&E assessment is that adequate operational test and evaluation has not been performed on MCS and that results of past test and evaluation activity do not confirm the operational effectiveness and suitability of either the military or the NDI equipment. An innovative test strategy such as FDT&E with functional soft-

ware may aid in development of an effective and suitable system, and a realistic mission level FOT&E will be required to provide test results necessary to support informed decisions on any additional procurement or fielding decisions of MCS or ACCS.

SUMMARY

MCS has not been adequately tested in the field and has not demonstrated operational effectiveness or operational suitability for typical users in typical combat scenarios. Additional system-level OT&E, to include a mission-commander-level and a combat mission oriented test, is required. An approved TEMP and an approved OT plan are required to plan clearly and provide the necessary resources to confirm MCS operational effectiveness and suitability.

MOBILE SUBSCRIBER EQUIPMENT (MSE) SYSTEM



SYSTEM DESCRIPTION

The Mobile Subscriber Equipment (MSE) system is a complete tactical communications system that is designed to satisfy the essential area communications at division and corps levels throughout the Army. The purpose of the system is to provide highly mobile secure digital communications capable of providing users with voice, data, and facsimile service. The system is automatic, self-organizing, and uses flood search routing to enable subscribers to retain their telephone number and enter the network regardless of their location on the battlefield. MSE is intended to provide commanders and their staff with a much needed mobile communications capability not available with present systems. It consists of five functional areas which interoperate with each other, providing a grid, or backbone, network of communications nodes deployed throughout the corps and division areas of operations.

BACKGROUND

The MSE program used a competitive non-developmental item (NDI) acquisition strategy which was designed to take advantage of available technology and avoid a lengthy developmental period. The key to the acquisition strategy is the total-system concept: a turn-key operation which includes the communications system equipment, generators, vehicles, and support equipment. This is the first time that the Army has ever purchased a totally integrated/turn-key tactical communications system from one contractor. In November

1982, the Under Secretary of the Army provided the initial guidance to implement the NDI approach toward acquiring the MSE system. In July 1984 the Army released a solicitation package to industry which supported the NDI approach. A source selection evaluation board was convened to evaluate the industrial proposals. The MSE contract was subsequently awarded to General Telephone and Electronics (GTE) and signed in December 1985. The Army exercised its Option Year 1 decision coincidentally with its decision to let the basic contract. Option Year 2 was awarded in February 1987. Option 3 was awarded on December 6, 1988, based upon the results of an FOT&E conducted August 9 through October 25, 1988. The next milestone is award of contract Option 4, scheduled for March 1989.

Throughout the past year DOT&E has been actively involved in the test planning process, including review of the Test and Evaluation Master Plan (TEMP), the Test Design Plan (TDP), and on-site observations of the preparatory testing accomplished at the contractors facilities and at Fort Hood, Texas. DOT&E also attended numerous test planning meetings and conducted on-site observations during the FOT&E. DOT&E required the inclusion of operational testing as part of the MSE acquisition strategy prior to the execution of the MSE Option 3 award. DOT&E's review of the test plans resulted in the inclusion of a limited baseline comparison and a limited assessment of the MSE performance under EW conditions. DOT&E reviewed the FOT&E results and the Army's Interim Independent Evaluation Report (IER) and published an assessment which was forwarded to Congress on December 7, 1988.

OT&E ISSUES

The Army identified three critical operational issues and a series of supporting issues. The critical operational issues addressed the following areas: provision of a division and corps communications network that will meet the required grade of service (GOS), the ability of the system to be restored or to reestablish communications after an outage or destruction of a node, and the ability of MSE subscribers to communicate with echelons above corps (EAC), commercial networks, other US forces, and NATO units.

OT&E ASSESSMENT

The first complete division set of MSE equipment was delivered to Fort Hood in February 1988 and began destination and final acceptance testing (DFAT). Follow-on operational test and evaluation (FOT&E) of the MSE system began August 9, 1988, and was completed October 25, 1988. The FOT&E was originally scheduled to begin in May 1988, but was delayed due to unanticipated problems which surfaced during the pre-FOT&E activities when the MSE system went to the field as a complete system. All contractor testing prior to fielding had been successful, and all features had been demonstrated in individual components as well as in a limited system configuration. The three-month delay was used to isolate and fix problems that surfaced during the fielding process. DOT&E encouraged the Army to delay FOT&E until the Army was confident that the MSE system could satisfy the FOT&E test requirements. Prior to the start of FOT&E, the test unit conducted a division-level command post exercise to verify the fixes and ensure the system was ready.

The Army published an evaluation report on November 8, 1988, based on the FOT&E and judged the system to be operationally effective and suitable. DOT&E considers the FOT&E adequate to support an assessment of MSE effectiveness and suitability to perform its mission of providing a division-area communications system. In a relatively short period of time, the MSE non-developmental item

(NDI) strategy has fielded a complete division set of equipment. DOT&E considers the operational suitability and effectiveness of MSE to be adequate at this level of maturity. However, the FOT&E recorded areas of concern where criteria were not met. The failure to achieve the required call completion rate (CCR), switch failures, and apparent software problems are three of the most serious concerns. Based upon the deficiencies noted during FOT&E and the necessity to ensure system effectiveness at the corps level in an EW environment, DOT&E has insisted that the Army conduct a series of verification tests and operational assessments to ensure that identified problems are corrected and appropriate means are in place to withhold funds if the corrections are not accomplished satisfactorily.

SUMMARY

The Army has initiated a corrective action plan to correct the deficiencies identified during and prior to the FOT&E. Also, appropriate draft TEMP changes have been prepared. In addition, the MSE contractor, GTE, has agreed to the corrective action plan and has signed a contract modification which incorporates this plan. DOT&E will monitor the progress of the corrective actions to ensure progress toward the identification and resolution of known problems.

OH-58D SCOUT HELICOPTER (AHIP)



SYSTEM DESCRIPTION

The Army Helicopter Improvement Program (AHIP) developed the OH-58D Scout Helicopter through major modification of existing OH-58A helicopters. The OH-58D Scout was designed to provide a day/night limited adverse weather command and control, surveillance, and target acquisition capability, and a capability to designate targets for laser homing munitions. The mast-mounted sight is intended to enhance OH-58D survivability by allowing surveillance, target acquisition and target designation from extended stand-off ranges with minimal exposure of the helicopter to enemy radar and electro-optical detection devices.

BACKGROUND

An operational test II (OT II) was conducted at Fort Hunter Liggett, California, from September 1984 to February 1985 to provide the information necessary to assess operational effectiveness and suitability. Overall, the testing was conducted in as realistic an operational environment as could be obtained within time and safety constraints.

On the basis of our assessment of the results of OT II, this office concluded that: the OH-58D demonstrated an operation-

ally effective capability in the field artillery aerial observer role. However, in the attack and air cavalry roles, the OH-58D offered no statistically significant advantage in combat effectiveness over the existing OH-58C helicopter. Due to observed shortcomings in tactical employment, training and doctrine, further operational tests were required to support use of OH-58D in these two roles. We further concluded that, while the OH-58D is generally suitable for use, improvement to the mast-mounted sight and control data system designation accuracy, reliability, and fault detection and isolation were required.

In view of the DOT&E assessment, the Defense Systems Acquisition Review Council (DSARC) recommended production of the OH-58D for the field artillery aerial observer role only. The Secretary of Defense Decision Memorandum dated October 8, 1985 directed the Army to procure sufficient OH-58D helicopters to support the field artillery aerial observer role only. It also directed the Army to proceed immediately to plan for the conduct of a follow-on operational test to establish the effectiveness and suitability of the OH-58D in the attack and air cavalry roles. Planning for this test was underway when the Army determined it could no longer afford the OH-58D, and in early 1987 the Army Chief of Staff terminated the program and the planned test. However, recognizing that air cavalry units need scout aircraft, and responding to congressional interest, the Army decided to redesign and redesignate the test from the OH-58D FOT&E to the Army Aerial Scout Test (AAST), Phase I and II. The purpose of these tests was to compare alternative systems (OH-58C, OH-58C+, AH-64A, AH-1S(MC) and AH-1S C-Nite) to the baseline OH-58D. Phase I was to be concerned with the scout/reconnaissance role; and Phase II, with the attack team role.

As the focus of the Phase I test evolved from the OH-58D to the more general "candidate evaluation," Army plans eliminated some elements of the issues identified by DOT&E; these included live-fire and AHIP readiness and suitability for sustained operations. These elements were scheduled to be examined in the Phase II test. The Army originally intended to conduct the AAST, Phase II, during 1988; however, it has not yet funded this test.

The Army officially notified OSD on June 28, 1988, of its intention to reinstate the OH-58D program. Thus, this office prepared its report (September 9, 1988) supplementing the 1985 report submitted in fulfillment of the provisions of Title 10, USC 138.

OT&E ISSUES

Phase I of the AAST was conducted March through May of 1987 at Fort Hunter Liggett by the US Army Operational Test and Evaluation Agency (OTEA). The test was designed to provide the basis for the Army to determine the best interim aeroscout, prior to Light Helicopter Experimental (LHX). The candidates were OH-58C, OH-58C+, AH-1S (Modernized Cobra) (MC), AH-64A, and the OH-58D, which was considered the baseline. Another candidate, the prototype AH-1S C-Nite, was added for the tactical obscuration subtest only. The test was preceded by a comprehensive train-up and validation period and an exploratory/validation effort. The helicopters were operated and maintained at the unit level by military personnel. Maintenance above Aviation Unit Maintenance (AVUM) level for all aircraft was provided by contract

personnel from Sikorsky Support Services, Inc.

The AAST addressed this single test issue: In the scout/reconnaissance role, what is the capability of the available candidates (OH-58C, OH-58C+, AH-1S (MC), AH-64A) to perform Army aeroscout functions as compared to the baseline OH-58D?

The planned testing was approved by this office, and members of the DOT&E staff observed the conduct of the test and the processing and analysis of the data by the Army.

There were numerous test limitations. However, they do not invalidate the measured results, since they were generally consistent for each of the candidates evaluated. The exact degree to which observed individual aeroscout performance values are affected by the various limitations is, however, unknown. The specific limitations are in the classified final report.

OT&E ASSESSMENT

The record trials for the AAST, Phase I consisted of navigation trials, reconnaissance trials, and the tactical obscuration subtest trials. Each trial contained day and night missions.

NAVIGATION TRIALS

The ability to navigate and get to points on the battlefield quickly and reliably is a prerequisite to beginning a mission in enemy territory. The time to traverse the specific distance directly influences the responsiveness to mission orders. The fuel consumed influences the length of time available for the remainder of the mission. Because the space and instrumentation at Fort Hunter Liggett are limited, separate trials were designed to test the navigation capabilities of the helicopters.

During the navigation trials, candidate aeroscout helicopters were required to navigate tactically over predetermined routes/courses. The OH-58C+ and the AH-1S C-Nite, which incorporate no navigation improvements beyond their less sophisticated counterparts, were not tested.

Within the confines of Fort Hunter Liggett, four different navigation routes were established over terrain covered by instrumentation. The routes were designed to avoid major valley areas where ridge lines, roads, stream beds, and other distinguishing terrain features could become familiar to crews over time. Each course consisted of a start point, at least five checkpoints, and a release point. The course distance between the start point and the release point varied from 38 to 53 kilometers. Each crew was required to report as the scout aircraft flew over any check point.

Fifty-two validated navigation trials were run and, in general, they were run before each reconnaissance trail. They do not include three OH-58C trails for which the navigation course was not completed.

The navigation trials were to ascertain which scout could best do the following: (1) successfully complete (i.e., transit from start point to each checkpoint to release point) navigation routes; (2) minimize the flight time required to complete navigation routes; and (3) accurately adhere to navigation routes.

In general, there is a trade-off between speed and accuracy in that the additional accuracy can be obtained by sacrificing speed. The tactical significance of these subissues can be interpreted from the perspective of an end-to-end scout mission involving an initial navigation portion followed by a reconnaissance portion. The scout will not be able to fulfill its mission unless it actually reaches the reconnais-

sance area. The longer the scout takes to fly to the reconnaissance area, the less time will be available for reconnaissance. Finally, flying outside the prescribed navigation corridor could expose the scout to hostile fire.

The OH-58C's performance in the navigation trials would be expected to be hampered by the absence of an on-board inertial navigation system. The remaining participants all possessed various versions of a Doppler navigation system. In addition, the OH-58C was the only participating scout that relied solely on NVGs as a night flying aid.

With the exception of three OH-58C trials (one day trial and two night trials), all attempts to navigate the prescribed courses were successfully completed. Three OH-58C trials were terminated by test control either because the scout was lost or because of time limitations (i.e., persistent wandering requires too much time to recover and finish the course).

Our conclusions from the analysis of the navigation trials can be summarized as follows: (1) the OH-58C, the only participant scout lacking a Doppler navigation system, failed to complete three navigation trials. All other scout types completed every trial. (2) Even when the OH-58C completed a navigation trial, it took significantly more time than any of the other scout types. (3) No statistically significant differences in time to complete courses were detected between the OH-58D, AH-1S(MC), and AH-64A.

Post-test interviews with the crews indicated that the observed differences in performance in this portion of the test may, in part, result from differences in crew attitudes and experiences. Crews that had been scouts previously (i.e., prior to training for the AAST, Phase I) indicated that they spent more time on preparation and precise mission planning (for example, by adding additional checkpoints to the navigation routes) than crews with attack helicopter experience.

RECONNAISSANCE TRIALS

An aeroscout must survive on the battlefield. In order to provide useful reconnaissance information to the battlefield commander, the aeroscout must detect, identify, and locate the enemy and communicate that information in a timely manner. The reconnaissance trials of the AAST, Phase I, tested the ability of various scout candidates to determine which one could best perform these tasks. Some candidates might have been good detectors of targets, but could not survive, while others might have been good survivors but could not detect many targets.

A scout team, composed of a scout helicopter and an escort attack helicopter, was required to reconnoiter a section of territory suspected to be occupied by the enemy. They were given approximately one hour to perform their reconnaissance. The enemy consisted of five different target arrays (clusters of individual targets/vehicles), a total of approximately 30 vehicles. The test scenario and the scope and ratio of opposing forces were selected from the then current SCORES scenario for the defense of Central Europe in the 1991 time frame. Smoke and camouflage of threat arrays were not employed during reconnaissance trails because of a belief that they would have seriously degraded the performance of instrumentation equipment considered critical to developing data on detection, recognition and survivability measures of performance.

To minimize the effects of learning and familiarization with routes through the terrain, eight different tactical target laydowns of threat force ground target arrays were presented to Blue Force reconnaissance teams. The combination of terrain vegetation along with clever selection of the general location of the array made

target detection by the scout teams a very difficult task.

Day and night counterattack missions were chosen for the test. The mission for the tested teams was to determine and report on enemy strengths and distributions without becoming engaged. A secondary mission was to destroy any priority targets (enemy air defense and tactical operation centers) encountered.

The assigned mission required the aeroscout to cross the test start point, orient on the general area in which the first target array was located, and initiate reconnaissance. After detection and reporting tasks were completed for an array or upon order of the task force operations officer, the aeroscout shifted its attention to the next array. The scout and its attack helicopter could simulate engaging enemy ground defenses through direct or indirect fire to facilitate continuing to the next array.

Similarly, the enemy ground weapon systems could simulate engagement of the scout or attack helicopter. A probability of hit for each engagement of scout helicopters by ground air defenses was calculated. These probabilities were used to determine the survivability of a helicopter during its mission.

The scout team received credit for each target correctly reported and acknowledged. The reported target location and type were compared to actual target location and type. The report was scored as correct only if both attributes were accurately reported. The scout received credit for the report only if its higher headquarters acknowledged receipt of the report.

The analyses of reconnaissance trials include only those recorded engagements for which all parameters satisfied the weapons methodology for employment. Engagements scored as "multiple" (i.e., occurring within 15 seconds of an initial engagement or a preceding multiple engagement of a specific Red defense system against a specific Blue helicopter) were not included in the analyses, either because of a lack of realistic weapon engagement signatures or because of incompatibility with combat capabilities. The conclusions reported do not change if all multiple engagements are incorporated into the analyses. Only the particular values of the measure of performance would change.

Overall, the OH-58D detections and reportings per trial were considerably higher than the OH-58C. For the early trials. the two candidates reported about the same number of targets per trial. After trial 10, there was a sharp increase in the detection and reporting rate (per trial) for the OH-58D. The point at which the increase began corresponds to the trial in which the OH-58D crews and maintenance personnel first learned to adjust the FLIR correctly. Deletion of the early trials would have enhanced the OH-58D performance relative to the other candidates.

The AH-1S(MC) reported fewer targets per trial, then the OH-58D and OH-58C and the AH-64A and OH-58C+ reported even fewer targets per trial.

While the total number of targets reported is a useful measure of battlefield information, a commander might also be interested in the depth to which targets are deployed. The average number of target arrays reported is a measure of how "deep" into the enemy's position a scout can penetrate. After trial 10, the OH-58D was able to penetrate deepest with the OH-58C second. The other candidates reported far fewer arrays per trial.

Reporting targets is only part of the story, since some candidates may have had to assume relatively more risk than others to achieve a given report rate per

trial. For a single trial, the scout survival probability is the product of the individual survival probabilities associated with each engagement against the scout. The OH-58D had the highest survival probability of any of the candidates.

Although the confidence intervals were large, there was little overlap of those intervals between the OH-58D and the other candidates. The histogram of survival probability for each candidate was bimodal, with modes near zero and one. This explains why the confidence intervals are large and means that, in most cases, scout candidates on a reconnaissance trial were either engaged quite often or not at all.

The limited number of engagements against the OH-58D may have been partly attributable to its ability to detect targets at longer standoff ranges. The OH-58D, equipped with a mast-mounted FLIR, detected targets further out than any of the other candidate aeroscouts.

As previously noted, certain test conditions/limitations may have contributed to the performance exhibited by the candidates. First, there was no Blue ground force to distract the FST and BMP gunners (highest number of engagements). Consequently, these gunners were able to concentrate on searching for Blue helicopters. Second, the Red threat included more FSTs and BMPs than other systems. Finally, scouts did not often penetrate very deeply into the laydown of target arrays. Since the Red air defense systems were generally deployed in the rear arrays, (fewest engagements) they may not have had comparable numbers of opportunities to engage the Blue helicopters.

The OH-58D has the highest average report probability. The ability of all the candidates to report additional targets and arrays may have been restricted by the one hour trial limit.

The OH-58D performed reconnaissance more effectively during the day and night than the OH-58C and the OPH-58C+.

In order to isolate the potential influence of a lack of flash simulators in night trials (flashes would ordinarily accompany engagements), analyses focused on aeroscout target reporting performance during the time periods, beginning with trial start and ending with first engagement by the defense. During these periods, on the average, the OH-58D reported twice as many target arrays than either the OH-58C or the AH-64A, and more than three times as many target arrays as the OH-58C or the AH-64A, and more than three times as many target arrays as the OH-58C+ or the AH-1S(MC). Similarly, in terms of individual targets, on the average, the OH-58D reported more than 3.5 times as many targets as either the OH-58C or the AH-64A, and nearly five times as many targets as either the OH-58C+ or the AH-1S(MC).

In conclusion, the OH-58D had the highest target and array reporting rates per trial, the highest chance of surviving the reconnaissance mission, and the best chance of both surviving and reporting targets or arrays. All the other candidates performed less effectively than the OH-58D. Except for the comparison between the average number of arrays reported by the OH-58D versus the OH-58C, all of these differences were statistically significant, with 90 percent confidence. The OH-58D was engaged far fewer times than any of the other aeroscout candidates. This may be due to its ability to detect targets from longer standoff ranges and the mast-mounted sight. An addi-

tional factor was that the average Pk per engagement was lowest for the OH-58D.

TACTICAL OBSCURATION SUBTEST

To provide a measure of the effects of obscurants, a subtest was conducted. Both day and night trials were run, each under benign (i.e., no smoke) and obscured (i.e., smoke) conditions.

There were three different positions from which aircrews were allowed to detect, recognize, and locate targets within five different target arrays. The ranges to the arrays varied between 2000 and 4500 meters. The altitude of the aircraft was just high enough to permit direct line-of-sight over the intervening ridge line into the target arrays.

Target arrays were rotated among seven different locations in the valley. This rotation of target arrays was done between sets of trials so that each tested crew would observe the same target arrangement. After all crews had seen an arrangement, the targets were relocated for the next set. One array was always camouflaged. Each crew was allowed five minutes of observation time per trial.

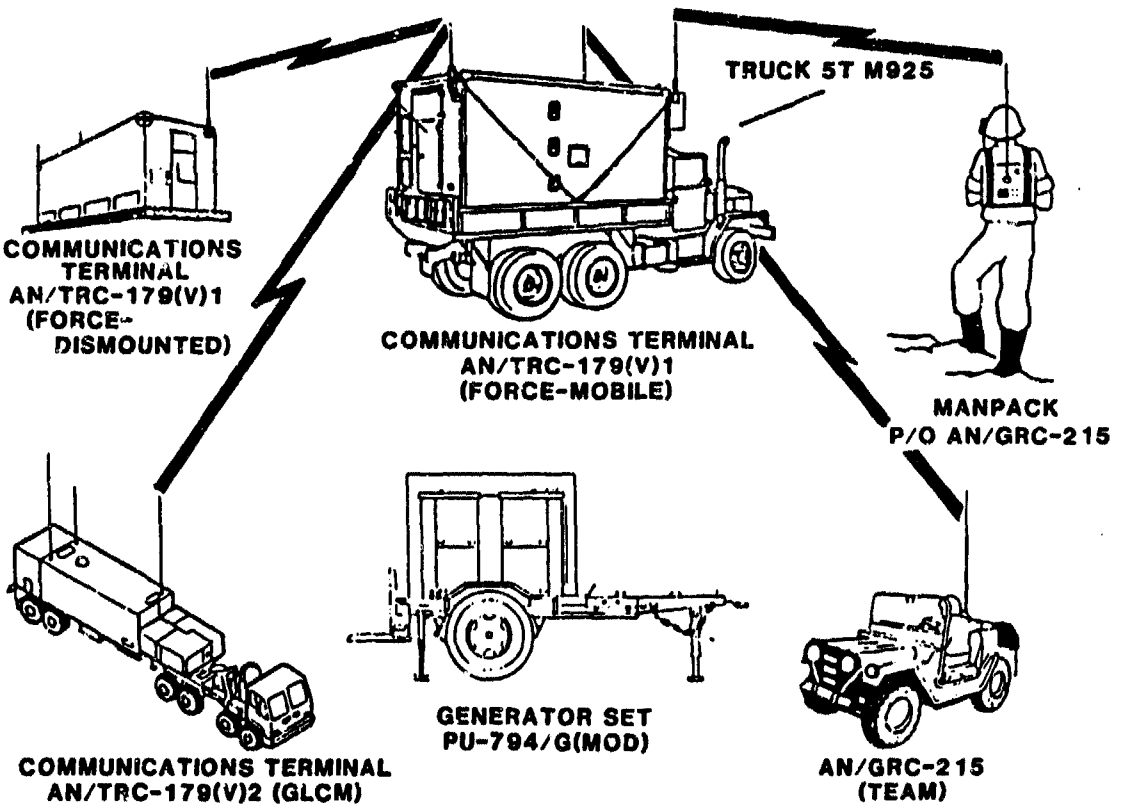
The OH-58D generally performed most effectively across all tested conditions during the tactical obscuration subtest trials. The only exception was the AH-64A in day obscured trials. The other FLIR-equipped aeroscouts (the AH-1S C-Nite, OH-58C+, and AH-64A) performed better than the AH-1S(MC) and the OH-58C, neither of which possesses a FLIR. These rankings held for both day and night trials. Since smoke and camouflage were not played during the reconnaissance trials, the results and analyses of these trials are biased in favor of the non-FLIR-equipped scouts, i.e., in favor of the OH-58C and the AH-1S(MC) relative to the OH-58D, AH-64A, and OH-58C+.

The climate at Fort Hunter Liggett did not challenge the candidates under hign altitude hot conditions. The flight envelopes for the AH-64A and the OH-58D generally exceed those of the AH-1S and the OH-58C. Neither the AH-1S nor the OH-58C can readily conduct extremely low level terrain following missions. Only the OH-58D and the AH-64A have a hover and vertical climb capability under high/hot conditions. Thus, only these two aircraft are capable of conducting operational missions in all areas of the world.

SUMMARY

The OH-58D demonstrated a clear superiority over the other candidates for the scout/reconnaissance role. In the reconnaissance trials, it located and reported more enemy targets per trial while simultaneously maintaining the highest mission survivability rate. The OH-58D also detected the greatest number of targets per trial for each of the conditions examined in the tactical observation subtest, and during navigation trials its performance either exceeded or equaled that of the other candidates. Reliability, availability, and maintainability (RAM) data and supportability data were not collected during the Phase I test. Recent congressional direction that all future purchases of the OH-58D have the structural and electrical modifications to accommodate the armed reconnaissance configuration, will require a reassessment of aircraft operational suitability issues.

REGENCY NET



SYSTEM DESCRIPTION

Regency Net includes a new secure and anti-jam high-frequency (HF) radio communication system to replace an existing system. The intent is to provide a new system with the required security, survivability, flexibility, control, reliability, maintainability, and capability to counter jamming threats. The primary purpose of Regency Net is to provide the US Commander-in-Chief Europe (CINCEUR) and his tri-Service commanders with a secure, survivable, flexible, and fully supportable HF radio communications system for voice and data in a stressing wartime environment. The secondary purpose is to provide HF communications capability for internal CINCEUR and supporting-Service command requirements on a noninterference basis. Interoperability across Service lines was an intended capability.

BACKGROUND

The Regency Net program was initiated as a non-developmental item (NDI) program by the Army in 1983. This decision was based on several statements of need and urgency. The Army awarded the Regency Net contract in December 1983.

Contractor testing, known as Pilot Network System Test-1 (PNST-1), was included in the contract. PNST-1 was to be completed prior to exercise of production options which were included in the fixed price contract and scheduled for completion in 39 months. The program was not reviewed at Army Systems Acquisition Review Council (ASARC) level for milestone

decisions and did not include independent operational test and evaluation (OT&E) by the Army Operational Test and Evaluation Agency (OTEA). Regency Net is not a major DoD acquisition program, but on April 23, 1986, was designated by the DOT&E for oversight in accordance with 10 USC 138. Problems experienced during developmental efforts led to schedule delays. DOT&E and OTEA met with the Regency Net program manager and contractor at the contractor plant on July 22, 1986, to explain the policy and requirements of DOT&E oversight. The Army restructured the contract in March 1987, almost a year after DOT&E designation of Regency Net for oversight, and provided for concurrent completion of developmental efforts and award of production options beyond low-rate initial production (LRIP) without results of PNST-1 or OT&E to support the decision.

PNST-1 was conducted August 29 to September 29, 1987, after award of the production options. PNST-1 was unsuccessful in demonstrating compliance with the contract and operational effectiveness. The contractor test report of results was rejected by the Army in December 1987 and a CURE notice issued. It is understood that the contractor responded to the CURE notice in May 1988. Details of test results and additional test plans have not been provided to OSD for review and appropriate approval or guidance.

OT&E ISSUES

The Army proceeded beyond LRIP after designation of the Regency Net program for DOT&E oversight and without conduct of approved OT&E to support the procurement actions. This office was not consulted or advised concerning program changes or contract restructuring with award of production orders beyond the LRIP. It is understood that OTEA and the Deputy Under Secretary of the Army (Operations Research) have discussed conduct of an independent OT&E. However, the required Test and Evaluation Master Plan (TEMP), OT&E concept brief, and operational test (OT) plan have not been provided to OSD.

Requirements are still being reviewed for Service agreement and JCS approval of HF interoperability for voice and data communications in a jamming environment. Each Service continues with separate programs.

OT&E ACTIVITY

No OT&E was planned, conducted, or reported during FY87 or FY88. A draft TEMP was provided to this office informally, and comments were returned, including an expression of the requirement for independent OT&E.

A meeting was chaired by the DOT&E in May 1987 at which the Army was reminded OT&E is required for Regency Net and is to be preceded by an approved TEMP, an OT&E concept brief, and a DOT&E-approved OT plan. OTEA subsequently prepared an outline OT plan for Army review and projected OT&E to be conducted in FY88. However, the Army has made no attempt to provide this office with an Army-approved TEMP, OT concept brief, and an OT plan; and results from PNST-1, the development test which was conducted in 1987. Our last understanding is that a PNST-1A would start no earlier than October 1988, and an Army OT&E is now being planned in FY89.

OT&E ASSESSMENT

This office provided OT&E policy, procedures, guidance, and consultation to the Army, including the Regency Net program manager. OT&E has not been conducted to support procurement beyond LRIP. OT&E has not been adequate and results are not available to confirm that Regency

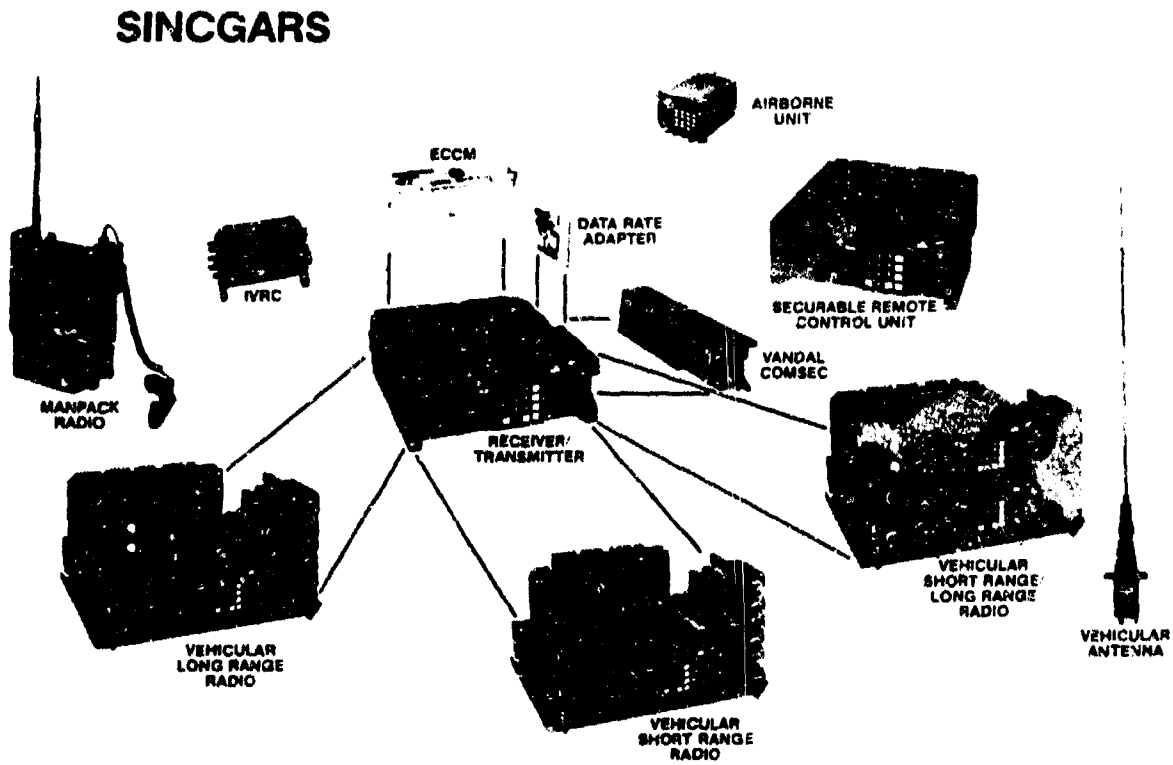
Net items are effective and suitable for combat.

Informal indications that reports of past test results and plans for future testing in a TEMP would be forwarded to DOT&E were encouraging. It appears that an Army Material Release decision (to field the system or not) is the primary remaining Regency Net program decision which can be influenced by operational test and evaluation. Operational test and evaluation should be completed to assure completion of Service interoperability requirements formulation and execution for continuing HF communications system programs.

SUMMARY

Regency Net development efforts are not complete. The Regency Net contract was restructured in 1987, and production options beyond LRIP were exercised before conduct of PNST-1 or OT&E. Results from PNST-1, PNST-1A, and any potential operational test and evaluation activity must be reported and evaluated. Regency Net OT&E has not been adequately planned or initiated to date. A TEMP, an OT concept brief, and OT plan are still required to provide adequate OT&E results for assessment and reporting of Regency Net operational effectiveness and suitability.

SINGLE CHANNEL GROUND AND AIRBORNE RADIO SYSTEM (SINCGARS)



SYSTEM DESCRIPTION

The Army Single Channel Ground and Airborne Radio System (SINCGARS) is a major DoD acquisition program in the low-rate initial production (LRIP) phase for the original design from the first production contractor. SINCGARS is a VHF-FM combat net radio communications system to provide secure and anti-jam command and control communications capability for infantry, artillery and armor units critical to the conduct of land battle. The SINCGARS family of radios is intended to be capable of transmitting voice, tactical data, and record traffic in a frequency hopping or single channel (frequency) mode.

The primary role of SINCGARS is to provide for a more reliable secure voice transmission for the maneuver force commander to use in command and control. A secondary responsibility is to provide for data transmission while maintaining voice message priority on the network. Exceptions to this data transmission application are use of SINCGARS with the existing Tactical Fire Direction System (TACFIRE) and with the projected Army

Field Artillery Tactical Data System (AFATDS) on exclusive data networks.

BACKGROUND

Different configurations of SINCGARS are being provided to replace the current AN/VRC-12 family of standard vehicular radios and the AN/PRC-77 manpack radio series. Army development and LRIP of an airborne SINCGARS radio is also underway to replace the AN/ARC-54/131 family, AN/ARC-114 and AN/ARC-186 (FM only) airborne radios in Army aircraft. The Air Force and Navy are proceeding with separate developments of SINCGARS-interoperable airborne and shipboard radio systems. Army development to integrate the National Security Agency (NSA) communications security (COMSEC) function into SINCGARS is called ICOM (for Integrated COMSEC) and nearing completion. Decisions to produce the ICOM configuration began with an engineering change proposal (ECP) to change 2000 of the Option 2 LRIP radios from the original to an ICM design. ICOM is now the Army's objective system design. A second source has been selected to build ICOM configurations that will fit and function interchangeable and interoperable with the first-source design.

A limited operational test (LOT) was conducted by the Army Operational Test and Evaluation Agency (OTEA) using four advanced development model SINCGARS radios from the two competing contractors in November 1982. These test results were used to support the Army decision to accelerate from advanced development to selection of an LRIP design in an attempt to provide a 1985 initial operational capability (IOC). A maturity operational test (MOT) was conducted at Fort Riley, Kansas, from October through December 1983 by OTEA to provide information to validate the Army LRIP decision. Operational reliability demonstrated during MOT was less than 400 hours mean time between failure (MTBF) against a requirement for 1250 hours MTBF. Operational performance deficiencies during MOT included complex operations to establish and maintain communications nets, loss of variables (hopset, lockouts, net identification, time/day, and security), and built-in-test. The contractor made some radio modifications which were retested during an operational assessment (OA) conducted from August through September 1984 at Fort Huachuca, Arizona. Additional data were gathered from emerging results of development tests conducted at Fort Huachuca and Fort Sill, Oklahoma. Based on these OA and emerging results the Army awarded LRIP Options 1 and 2, respectively 3200 (FY84 funded) and 8250 (FY85 funded) SINCGARS radios.

The contractor experienced reliability and other problems in transferring from advanced development to production, which led to an extensive reliability-growth and problem-fixing effort. The contractor completed this extended reliability growth program and production reliability assurance testing (PRAT) in November 1987. PRAT and the quarterly reliability award fee test (RAFT) has demonstrated a MTBF of over 2000 hours compared to the 1250 hour MTBF requirement. Delivery of the LRIP ground radios began in January 1988 for FOT&E, operational use in Korea, and other uses. Delays in completion of PRAT and other first-article tests required prior to delivery of LRIP radios resulted in the loss of procurement funds in the FY86 and FY87 budget processes, and the FY86 requirement for a Secretary of Defense certification of need to continue the program.

The LRIP radio reliability and other problems resulted in an FY86 Army survey of available industry radios and later comparison to the available SINCGARS radio. OTEA conducted an assessment of nine NDI candidate radios and the avail-

able SINCGARS production design radios from August 25 to October 24, 1986, at Fort Riley and prepared a report (May 7, 1987). The SINCGARS contractor also conducted exercises with soldiers at Fort Gordon, Georgia. According to the Army, the current SINCGARS production design exhibited the highest reliability of 10 radios in the NDI operational assessment at Fort Riley. The Army also assessed the SINCGARS as one of the three best performers of the ten radios. In the Army's view, unless SINCGARS requirements are reduced, a major development effort would be required to make any of the NDI candidates suitable for an interim/replacement VHF-FM combat net radio.

OT&E ISSUES

The Army was advised by OSD in December 1984 that a comprehensive follow-on operational test and evaluation (FOT&E) of production radios would be required prior to the planned award of the original contract Option 3 for 16,000 radios, which was defined to constitute proceeding beyond LRIP. The Army was also directed to discontinue multi-year procurement plans and to submit a test and evaluation master plan (TEMP) to OSD for approval, including reliability and built-in-test (BIT) thresholds. OSD reviewed the program with the Army in December 1986, and an OSD decision memorandum (February 12, 1987) requested quick resolution of the testing issues by Army submittal of the approved TEMP by March 15, 1987, and by Army submittal of an operational test (OT) plan for approval. The Army has prepared various versions of a SINCGARS TEMP, the latest dated August 19, 1988, and without validation of the threat section. To date, there is no OSD-approved SINCGARS TEMP.

The Army has restructured the original production contract to minimize production of the LRIP design and transfer the new ICOM development design into production by engineering change proposal (ECP) applied to 2000 of 8250 radios previously ordered on Option 2 (LRIP), over 9000 of 16,000 radios yet to be ordered on Option 3 (full-rate production), and all 16,000 radios yet to be ordered on Option 4 (continuing full-rate production) of the original production contract. The Army has also awarded a second-source contract to build form, fit, and function interchangeable and interoperable versions (versus build to print) of the ICOM radio. Both sources are using the same front panel switches, displays, and operating procedures which have not completed development by the first development/production contractor. OT&E of the ICOM system has not been conducted to support these decisions.

Interoperability of the separately developed SINCGARS-capable systems (SINCGARS LRIP design, SINCGARS ICOM system design, second source SINCGARS ICOM design, Air Force airborne HAVE SYNC design, and Navy developments) has not been demonstrated, nor has NATO interoperability. Specific testing of the Air Force, Navy, and NATO interoperability has not been included in any SINCGARS TEMP so far provided for OSD approval, even though requested by DOT&E.

OT&E ACTIVITY

The Follow-on Operational Test and Evaluation (FOT&E) of over 80 non-ICOM SINCGARS ground radios and an Early User Test and Experimentation (EUT&E) of six non-ICOM SINCGARS airborne radios was conducted at Fort Sill, Oklahoma from April 11 to May 10, 1988. Army reports are still being prepared to support the planned January 1989 Defense Acquisition Board (DAB) decision on Option 3.

A Mutual Interference (MINT) investigation of one hundred non-ICOM ground radios was also conducted at Fort Sill in

SINGLE CHANNEL GROUND AND AIRBORNE RADIO SYSTEM (SINCGARS)

June 1988 following FOT&E. Army reports are being prepared to support future MINT predictions.

Additional field operational reliability testing was conducted in Korea from July 23 to September 30, 1988, using 25 non-ICOM ground radios. The Army report still is being prepared.

A concept was initiated to conduct a user field experiment with SINCGARS ICOM advanced developmental radios at Fort Hood, Texas. TEXCOM is the tester, OTEA the independent evaluator, and the Marine Corps is an observer. This experiment will permit observation of the field interoperability of non-ICOM with ICOM, user ease of operations, and ICOM additional capability features. An Army report is expected to support the planned January 1989 DAB decision on option 3.

OT&E ASSESSMENT

Laboratory and field testing results demonstrate significant growth in non-ICOM ground radio hardware reliability above the 1250 hours MTBF goal. Operational reliability in the field is diminished by operator error due to complexity of SINCGARS radio operations to establish, maintain, and change network communications. BIT design appears inadequate and ineffective.

The SINCGARS ground radios operations and performance was investigated in various threat portrayals during FOT&E. DIA is reviewing Army threat projections for validation, reflection in the August 19, 1988, TEMP, and OSD review in support of the planned January 1989 DAB decisions on the Option 3 award.

The DOT&E assessment is that data from realistic user operations of the ICOM radios plus assessments of results from non-ICOM testing in 1988 should constitute an acceptable level of evidence to proceed to the planned January 1989 DAB for decisions on Option 3 for 16,000 radios from the first source. The Army is completing the reports on this data from the contractor test, FOT&E of the ground non-ICOM, EUT&E of the airborne non-ICOM, MINT investigations, operational reliability tests of the non-ICOM in Korea, and EUT&E of the ground ICOM, all on the first-source contractor system designs.

The immaturity of ICOM designs, the controlled and experimental nature of EUT&E, the need for additional data concerning complexity of net operations, the continuing investigations of various impacts on range and quality of communications, and the continuing requirement to review performance against current DIA validated threats, require an initial operational test and evaluation (IOT&E) of both the first-and second-source ICOM radios prior to release of FY91 funds. IOT&E of production representative items for the newly developed ICOM systems should be conducted before proceeding beyond LRIP with the system designs. IOT&E of the second source ICOM will be required to confirm interoperability, operational effectiveness, and operational suitability of the interchangeable form, fit, function design.

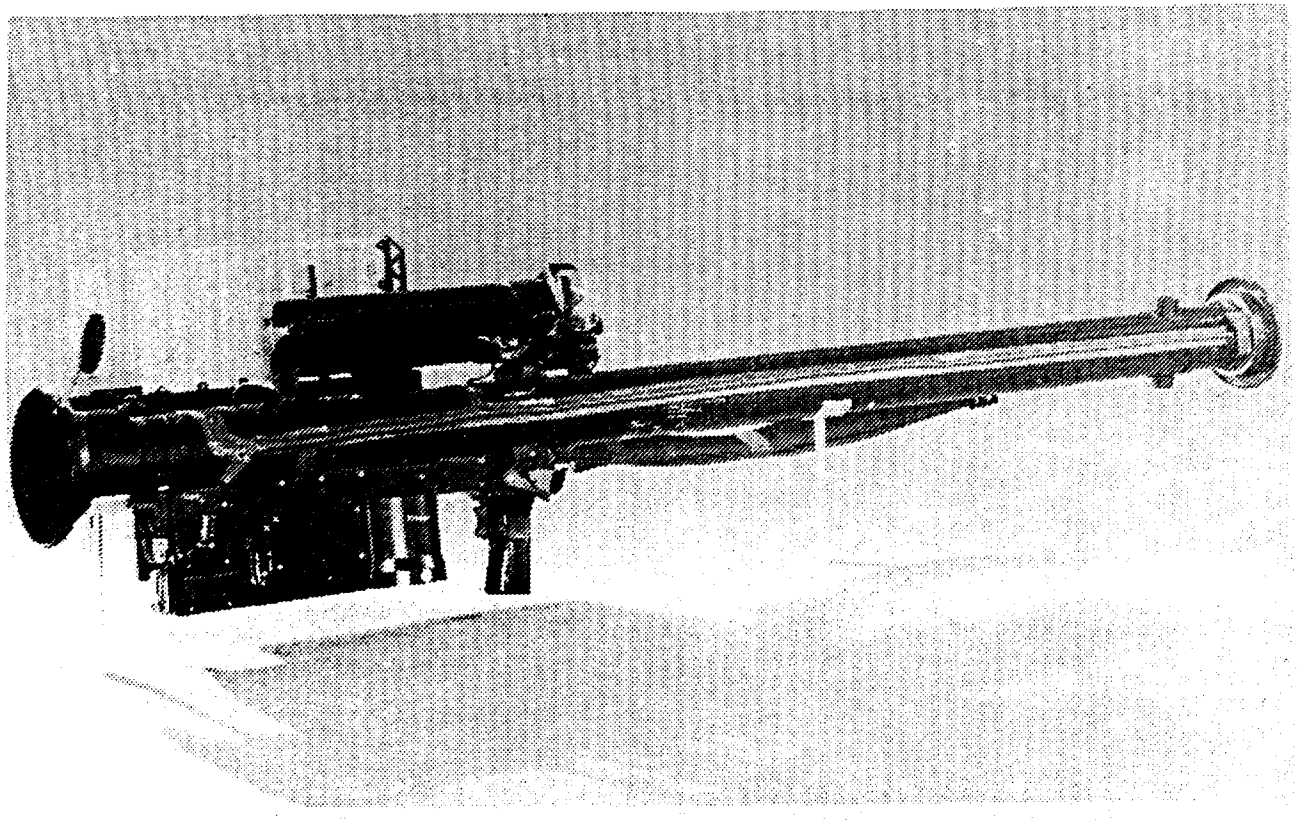
SUMMARY

Significant improvements to SINC-GARS have been demonstrated in FY88. Decisions are required in FY89 for proceeding with SINCGARS production. Final decisions for release of FY89 funds for proceeding beyond existing first-source Option 2 LRIP contract orders should be preceded by Army reports on FY88 testing of non-ICOM and ICOM radios, an OSD-approved TEMP for future testing, and a DOT&E report providing an independent assessment of the adequacy of testing and the operational effectiveness and operational suitability of the systems actually

tested. Confirmation of multi-Service and NATO interoperability is required.

Final decisions for release of FY91 funds should be preceded by Army reports on IOT&E of both the first-and second-source ICOM radios, Service reports on operational testing of multi-Service interoperability, and a DOT&E report providing an independent assessment of the adequacy of testing and the operational effectiveness and operational suitability of the systems actually tested.

STINGER REPROGRAMMABLE MICRO PROCESSOR (RMP)



SYSTEM DESCRIPTION

The Stinger–RMP guided missile system is a single–operator, shoulder–fired weapon system with an all–aspect engagement capability against low–altitude observation and attack aircraft. It differs from the Stinger–Basic weapon system only in the guidance assembly and launcher front window. The differences from Stinger–POST (Passive Optical Seeker Technique) are that the guidance and Infrared Counter–Counter Measures functions are reprogrammable by external means. The Stinger–RMP weapon round consists of a guided missile round and a separable gripstock. It is also intended to be used with the FAADS Pedestal Mounted Stinger system, the Army Aviation Air–to–Air Stinger, and the shoulder–fired, man–portable Stinger described above.

BACKGROUND

The Stinger system has gone through several improvement programs, beginning with Stinger Basic production in 1978. Immediately following production of the Stinger Basic, Development Test and Evaluation (DT&E) began on the next generation Stinger, the Stinger–POST. This was a preplanned product improvement to the Stinger–Basic seeker head assembly and guidance electronics assembly which significantly increased the missile's capability. However, production in FY83–84 was limited. In September 1984, the development contract was awarded for the next generation missile, the Stinger–RMP

to provide a capability against advanced threats. Unique to the RMP is the capability to make software changes as the threat evolves. Limited technical testing and no operational testing was done on this system prior to production in 1985. In November 1987, the Stinger-RMP Production Verification Test/Pilot Lot Test program began. Results indicated that the Stinger-RMP had some technical problems and required further testing. It was not released for deployment pending completion of planned additional testing.

OT&E ISSUES

In early 1989 another series of missile firing tests will take place to determine if the missile improvements have been made. This office reviewed the testing program and insisted that an operational baseline be established as well as for other technical areas verified for Stinger-RMP before the system is released to the field. Specifically, DOT&E is requiring the following operational conditions be present during the next series of tests: (1) advanced threat countermeasures; (2) threat-representative target altitudes and profiles with a clutter background; (3) a correctly characterized "dirty" battlefield, and; (4) soldiers conducting the operational firings.

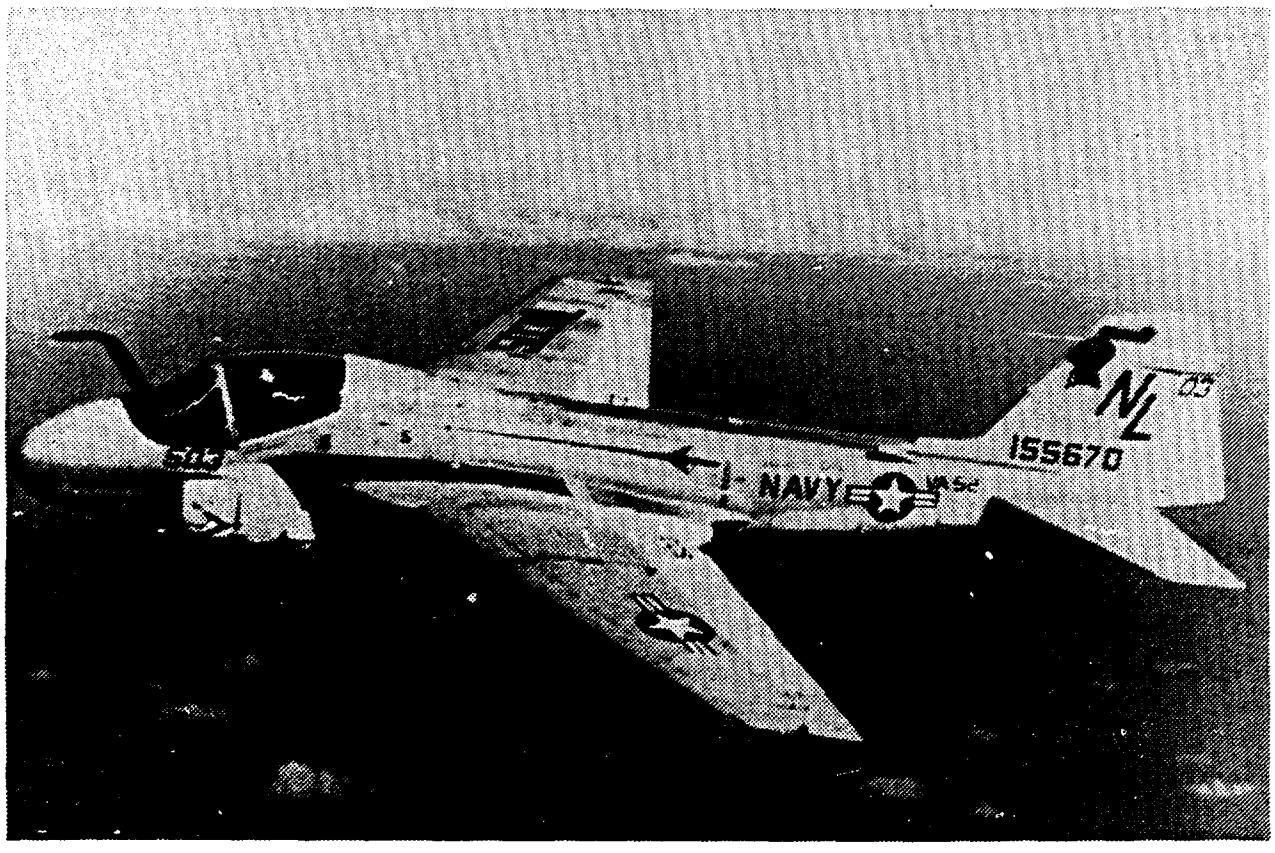
SUMMARY

The next series of missile firing tests, beginning in early 1989, will determine if the Stinger-RMP has overcome its technical difficulties and achieved the operational effectiveness desired of the system. This office will approve the test plan only if it includes the operational conditions described above. We will monitor the test to ensure that it meets the requirements as stated.

PART IV

NAVY OT&E

A-6E INTRUDER



SYSTEM DESCRIPTION

The A-6E Intruder, the only Navy and Marine Corps all-weather attack aircraft, is a long-range, twin-engine, carrier-based, medium attack aircraft capable of very accurate navigation and delivery of nuclear and nonnuclear weapons from five external stores stations. Its avionics system includes a microminiaturized digital computer, a solid-state weapon release system, a single integrated track and search radar and a carrier airborne inertial navigation system (CAINS). An added capability, the target recognition and attack multisensor (TRAM), has been procured under a multiyear production contract since FY76. This major subsystem includes an infrared sensor, laser ranger/designator, and laser receiver. It provides the capability for night surveillance, target identification and the delivery of laser-guided weapons. The A-6E system/weapons integration program (SWIP) aircraft is an upgrade of the A-6E TRAM aircraft. It includes an updated electronic warfare (EW) suite (ALR-67 and ALQ-126B), an improved weapons management and control system (the avionics interface set (AIS)) for an increased standoff weapons capability, a high-speed anti-radiation missile (HARM) command launch computer (CLC), and a new operational flight

program (OFP), E-240, to integrate and manage the hardware upgrades.

BACKGROUND

The A-6E prototype aircraft first flew in March 1970. It was introduced to the fleet in December 1971 and first deployed in September 1972. The first full TRAM aircraft was delivered in September 1979, with an IOC of December 1979. The A-6E SWIP achieved IOC with the deployment of VA-75 in August 1988.

OT&E ISSUES

The issues to be addressed during A-6E SWIP testing include evaluation of the operational effectiveness and suitability of OFP E-240, the new avionics, the upgraded EW suite, the standoff weapons capabilities, and the effect of SWIP on aircraft survivability. The testing of the aircraft's survivability was discussed in detail by DOT&E and OPTEVFOR during the OT-IIB test plan briefing and approval process (approved October 26, 1987).

OT&E ASSESSMENT

Operational testing (OT-IIA) of the A-6E SWIP, which commenced in July 1987 and was completed in November 1987, was conducted concurrently with TECHEVAL (DT-IIC). Test objectives were planned to assess the weapons delivery accuracy (WDA) for unguided weapons, navigation accuracy, effectiveness of the EW suite, and A-6E SWIP integration with the HARM weapon system. A-6E SWIP OPEVAL (OT-IIB) began in November 1987 and was completed in May 1988. Planned test objectives were the A-6E SWIP integration with the Harpoon 1C, Laser and IIR Maverick weapons systems, the validity of the WDA findings from OT-IIA, weapons employment envelopes and their impact on A-6E SWIP survivability, and the effect of various countermeasures. Both OT-IIA and OT-IIB examined the suitability issues of reliability, maintainability, availability, logistic supportability, technical documentation, compatibility, interoperability, training, human factors, safety, and built-in test (BIT) reliability.

Testing was conducted at various ranges in California, Nevada, and Florida. Carrier-based operations were conducted while embarked in USS *Carl Vinson* (CVN-70) and USS *Enterprise* (CVN-65). Test personnel included aircrews from VX-5 and VA-75, with maintenance personnel from VX-5, VA-75, and VA-145. Testing consisted of 327 sorties and 561.5 flight hours, with 20 types of ordnance bein expended. Limitations to test included: no Laser or IIR Maverick missiles were fired; not all ordnance cleared for carriage and release was available; not all modes of launch for the ordnance that was available were tested; the types of threat simulators available for HARM testing were limited; the limited number of emitters available at any one test facility prevented an evaluation of the EW suite's capability to handle maximum signal density; ground-based jammers were not available; EW effectiveness at sea could not be tested due to the nonavailability of instrumented sea-based threats; no intermediate-level maintenance; supply support system was not at full maturation - most A-6E SWIP peculiar hardware items were preproduction and had to be procured from the contractor; fleet-supported reprogrammability was not tested-due to lack of facilities and equipment.

The operational effectiveness test objectives were resolved as follows. *Weapons delivery accuracy* (WDA): Although the A-6E SWIP met the circular error probable (CEP) threshold requirements, the aircraft's WDA is far behind current generation aircraft. *Navigation accuracy*: The A-6E SWIP met all drift-rate threshold requirements for the different type alignments and demonstrated a satisfactory

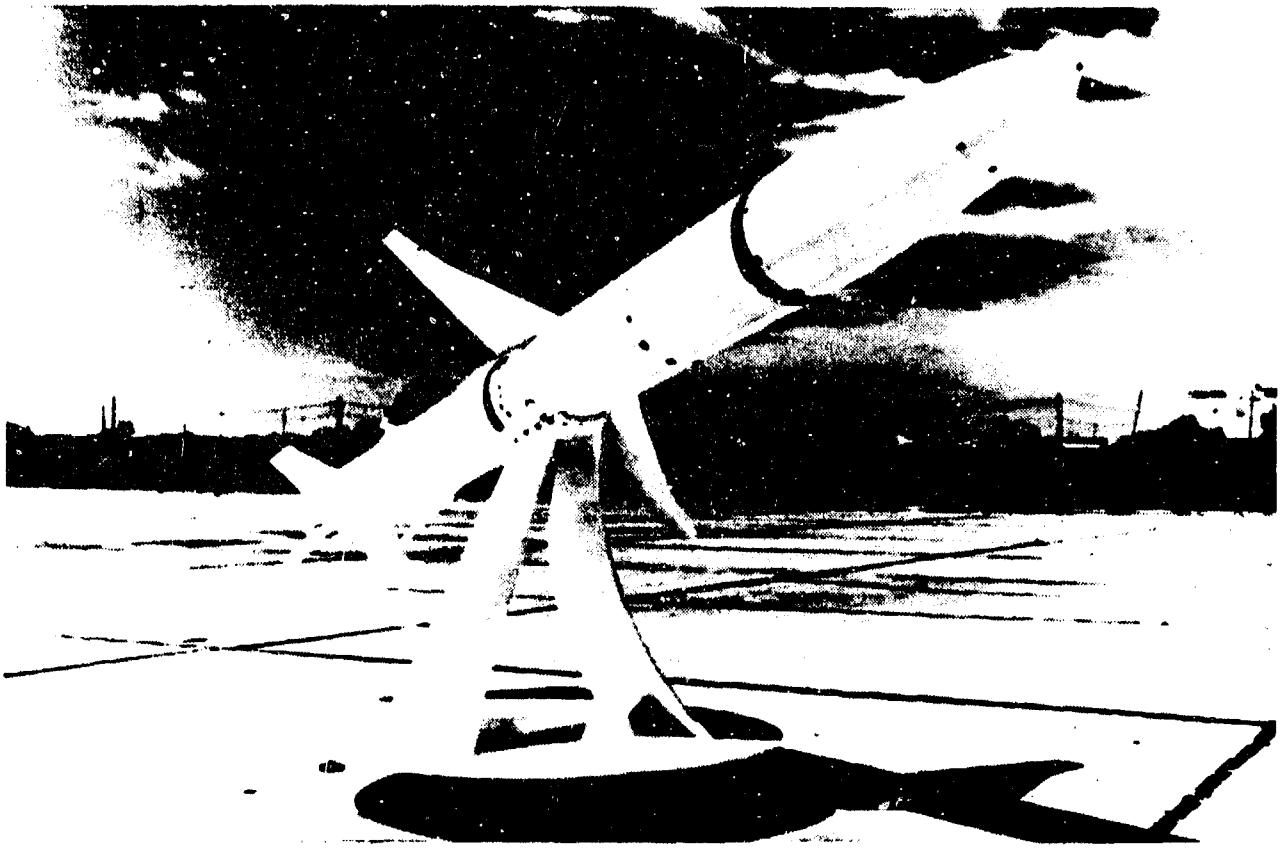
enroute navigation and first pass attack capability. *Effectiveness of EW suite*: The SWIP EW suite demonstrated a significant improvement over the previous A-6E EW suite (ALR-45D/50 and ALQ-126A). [material deleted] *HARM weapon system integration*: The A-6E SWIP successfully launched all three HARMs in the three different modes of employment off thee different aircraft stations. *Maverick weapon system integration*: This test objective was not resolved (see limitations to test). *Harpoon 1C weapon system integration*: The A-6E SWIP successfully completed a Harpoon captive-carry program, followed by a successful launch of a Harpoon Block 1C fired in the range and bearing launch mode using the waypoint capability. *Survivability*: The incorporation of the new EW suite, HARM, and Harpoon increased the A-6E SWIP aircraft's standoff detection and weapons employment ranges over the A-6E TRAM, which improved the aircraft's survivability. However, the following total system deficiencies were noted during survivability testing. (In some cases a particular subsystem did not meet the test criteria versus a specific threat, whereas the A-6E SWIP was still demonstrated to be survivable against that threat.) *Effect of countermeasures*: This test objective was not resolved (see limitations to test).

The operational suitability test objectives were resolved as follows: *Reliability, maintainability, availability (RMA) of the A-6E SWIP avionics system*: All avionics interface set (AIS) RMA criterion were met. The maintainability of the ALR-67 and ALQ-126B did not meet threshold requirements. *Logistic supportability*: The technical logistics data and squadron maintenance planning, packaging, handling, storage and transportation of the A-6E SWIP system were assessed as adequate. Minor disrepancies were associated with a lack of adequate numbers of memory loader verifiers for the OFP and the high failure rates of the AWM-92 test set required to load the HARM and Maverick missiles. *Technical documentation*: One minor documentation discrepancy was discovered. *Training*: The planned training for aircrew and maintenance personnel was adequate, with no deficiencies noted. *Human factors:* The location of the integrated missile panel (IMP) on the cockpit center console was judged to be unsatisfactory because it created a tendency for either one or both crewmembers to be heads down in the cockpit for prolonged periods of time. *Safety*: The excessive amount of time required to interface with the IMP can lead to unsafe situations, in particular at low altitude or night. *BIT*: The AIS BIT provided accurate fault detection and isolation, meeting all threshold requirements.

SUMMARY

The results of testing indicated that the A-6E SWIP was potentially operationally effective and potentially operationally suitable. The major areas identified for correction and verification through additional OT&E were: (1) conduct OT&E of the A-6E SWIP with Laser and IIR Maverick missiles; and (2) relocate the IMP or redesign the information display format to lessen the amount of time required for aircrew to be head-down in the cockpit.

AGM-88A HARM (NAVY)



SYSTEM DESCRIPTION

The High Speed Anti-Radiation Missile (HARM) is an air-to-surface missile designed to suppress or destroy land- and sea-based radars which direct enemy air defense systems. HARM was a design evolution of the existing ARM weapons (Shrike and Standard ARM) and replaces them in the Navy inventory. HARM has been integrated and successfully deployed on the A-7E, F/A-18, and EA-6B aircraft. It is being integrated into the Navy's A-6E aircraft and in the future will be integrated on the F-14. Performance characteristics include: high speed, large footprint, high sensitivity to weak signals, and software adaptability to the constantly changing threat. HARM weighs 807 pounds. It is 164 inches long and 10 inches in diameter.

BACKGROUND

Joint US Navy (lead Service)/US Air Force initial operational testing of HARM began in 1979 and resulted in full production and approval for HARM's introduction into the fleet on A-7E aircraft in April 1983. Outstanding deficiencies have been addressed through a missile performance upgrade program. In June-July 1984, the stand alone HARM weapon system was assessed as being potentially operationally effective when employed on the F/A-18 aircraft. During the period December 1984-July 1985, follow-on operational test and

evaluation (FOT&E) of the HARM integrated electronic warfare (EW) suite on the F/A-18 was conducted, and the HARM was approved for operation on the F/A-18. Two OT firings were conducted in FY86 in conjunction with an interim EA-6B HARM. The firings were successful in all phases of EA-6B integration and the EA-6B/HARM was approved for limited fleet introduction in August 1986. Current integration efforts will provide full HARM capability for the EA-6B, followed by the A-6E. The version of HARM currently in the fleet is Block II. The Block III version, with improved software, is presently in developmental test. A follow-on version of HARM will be a software/hardware change called Block IV. Block IV will be competed with a second source Low Cost Seeker (LCS) version of HARM.

OT&E ISSUES

Critical operational issues include detection range, accuracy (lethal range), reprogrammability, survivability of shooter, the launch aircraft; susceptibility to countermeasures, reliability, maintainability, availability, and training.

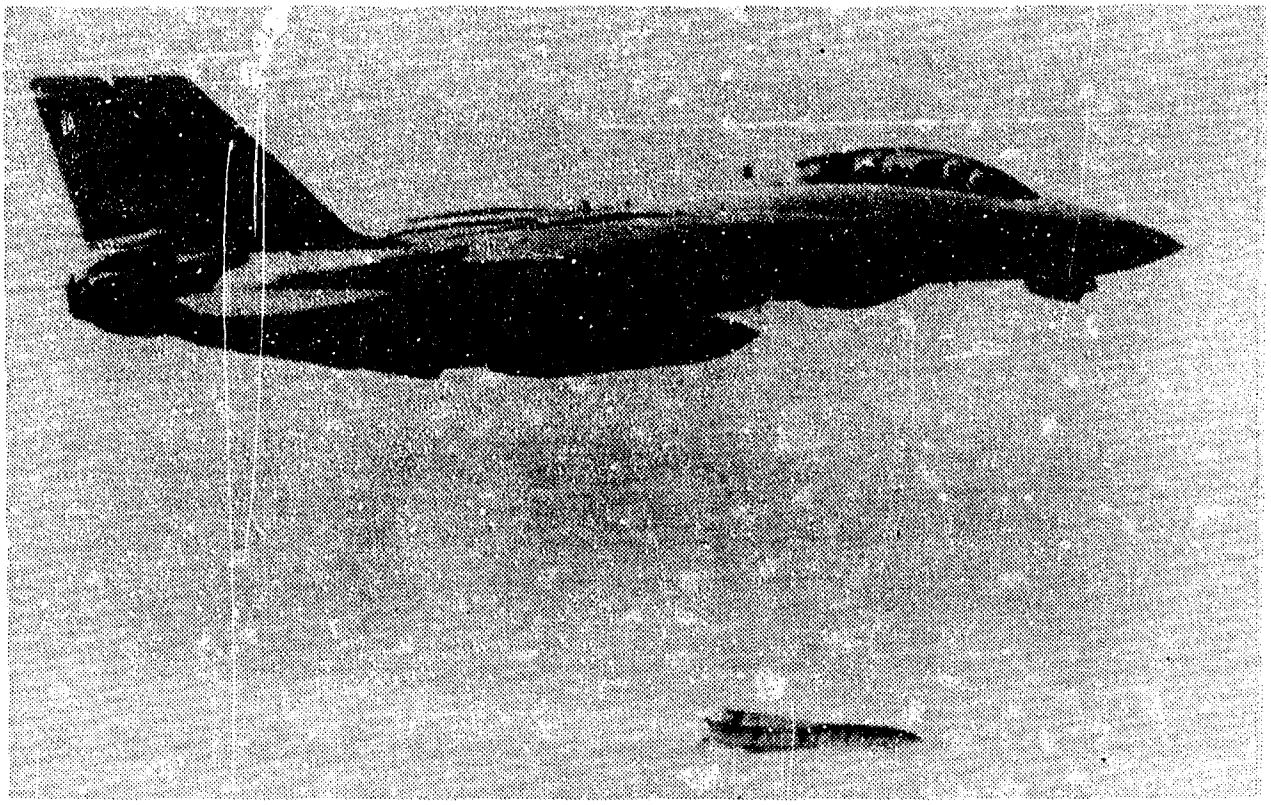
OT&E ACTIVITY

The Navy conducted operational testing on the Block II version during FY87 and FY88. The final results, available in mid-FY88, supported continuing fleet deployment and demonstrated the missile to be operationally effective and suitable. Deficiencies noted were combined with the Air Force's OT&E results and resulted in the Block III software upgrade. OT&E activity on Block III will begin in early FY89. OT&E on the Block IV and LCS versions is projected for FY90. DOT&E reviewed and approved the Block III Test and Evaluation Master Plan (TEMP) and the OT&E test plan in November 1988.

SUMMARY

Joint operational testing has been under way since 1979. Although each service has slightly different requirements, the critical review and recommended changes by the two separate tests and the resultant system changes are strengthening the system overall. Changes to the system in Blocks III and IV and the LCS should provide the capabilities necessary for today and for the future. Well-planned tests are scheduled for each of the new versions.

AIM-54 PHOENIX



SYSTEM DESCRIPTION

The AIM-54 Phoenix is an all-weather, long-range, conventional-warhead air-to-air missile which uses semiactive mid-course guidance and active terminal guidance. Six Phoenix missiles can be carried aboard the F-14A/A+/D, which can perform nearly simultaneous missile launches against six targets in both clear and jamming environments. The AIM-54C incorporates upgrades of selected components of the AIM-54A. It is designed to improve missile lethality, stream-raid discrimination, ECCM performance, high- and low-altitude performance, reliability, maintainability and availability. Additional changes have been made to the AIM-54C through an engineering change proposal (ECP-82) to further improve its ECCM capabilities and permit employment on the F-14D in a sealed/dry (liquid coolant no longer required) configuration. It can still be carried on the F-14A in the "wet" configuration (i.e., the aircraft supplies coolant for heating or cooling the missile). The AIM-54C with ECP-82 is sometimes referred to as the AIM-54C+.

BACKGROUND

The AIM-54C entered development in 1976 in response to an increasingly sophisticated and capable threat. (AIM-54A production ceased in 1979.) The AIM-54C completed operational evaluation (OPEVAL) in August 1984 and initial operational capability (IOC) was declared in

December 1986. The first phase of follow-on operational test and evaluation (FOT&E), OT-IIIA, was completed in FY86 and was described in our FY86 Annual Report. OT-IIIB was divided into two phases. OT-IIIB1 tested the AIM-54C (ECP-82) with 2.1 firmware. OT-IIIB2 tested the AIM-54C (ECP-82) with 3.0 firmware.

The AIM-54 was built under a sole-source contract with Hughes Aircraft Company until 1986, when Raytheon became a second source. A three-phase qualification test and evaluation (QT&E) for the Raytheon missiles is planned utilizing FY86 (Phase I) "learn" missiles, FY87 (Phase II) "validation" missiles, and FY88 (Phase III) "directed-buy" missiles. Raytheon will bid on the FY89 production missiles. The only missile which has undergone OT&E to date is the Hughes missile.

OT&E ISSUES

The purpose of OT-IIIB1 and OT-IIIB2 was to determine the operational effectiveness and operational suitability of the AIM-54C with ECP-82. Additional items to be addressed included correction of the design and production deficiencies associated with the FSU-10/A safety and arming device, target detecting device (TDD) performance, and missile modifications not tested in OT-IIIA. The critical operational issues were (1) operational capabilities, (2) operating environment effects, (3) vulnerability, (4) programmability, (5) ECCM/sealed missile, (6) F-14/AWG-9 support, (7) reliability, (8) maintainability, (9) logistic supportability, (10) compatibility, (11) interoperability, (12) training, (13) documentation, (14) human factors, and (15) safety.

The TEMP and OT-IIIB1/2 test plan are very detailed and extensive. In particular, the scope and intensity of planned ECM testing during OT-IIIB is impressive. Areas of DOT&E interest identified in the TEMP approval letter are OT&E of second-source missiles and OT&E in the presence of electromagnetic interference (EMI).

OT&E ACTIVITY

OT-IIIB2 began in May 1988 and was completed in December 1988. The DOT&E assessment of OT-IIIB2 will be included in our next Annual Report. A member of the DOT&E staff has been closely involved in the operational testing of the AIM-54C during OT-IIIB1 and B2, observing the missile-launch profiles and reviewing the test data.

OT&E ASSESSMENT

OT-IIIB1 of production AIM-54Cs with ECP-82 began in April 1987 and was completed in July 1988. Testing was conducted in California at the Pacific Missile Test Center, Point Mugu, and Naval Weapons Center, China Lake, test ranges.

The live-fire missions and captive-data flights in OT-IIIB1 exercised the AIM-54C and F-14A weapon system.

The major results of the critical operational issues are discussed below. Due to the small number of missiles launched during OT-IIIB1, the live-fire test results obtained during OT-IIIA are referenced here. The AIM-54C missiles tested during OT-IIIB1 and OT-IIIA contained the same 2.1 firmware logic and blast fragmentation warhead. However, the OT-IIIA AIM-54C did not include ECP-82, and the target detecting device (TDD) was revised from 7.0 firmware in OT-IIIA to 7.3 firmware in OT-IIIB1.

Operating Environment Effects. The missile was tested in OT-IIIB1 and OT-IIIA in a variety of environments with no discrepancies noted.

F-14/AWG-9 Support. The F-14/AWG-9 generally provided adequate support of the AIM-54C.

Maintainability. The AIM-54C demonstrated direct maintenance man-hours per flight hour (DMMH/FH) was 0.4 hours (no criterion).

Logistic Supportability. The AIM- 54C logistic support was adequate.

Interoperability. The AIM-54 C with ECP-82 was interoperable with its operating environment.

Training. The aircrew mission trainers (simulators) and maintenance personnel training were adequate.

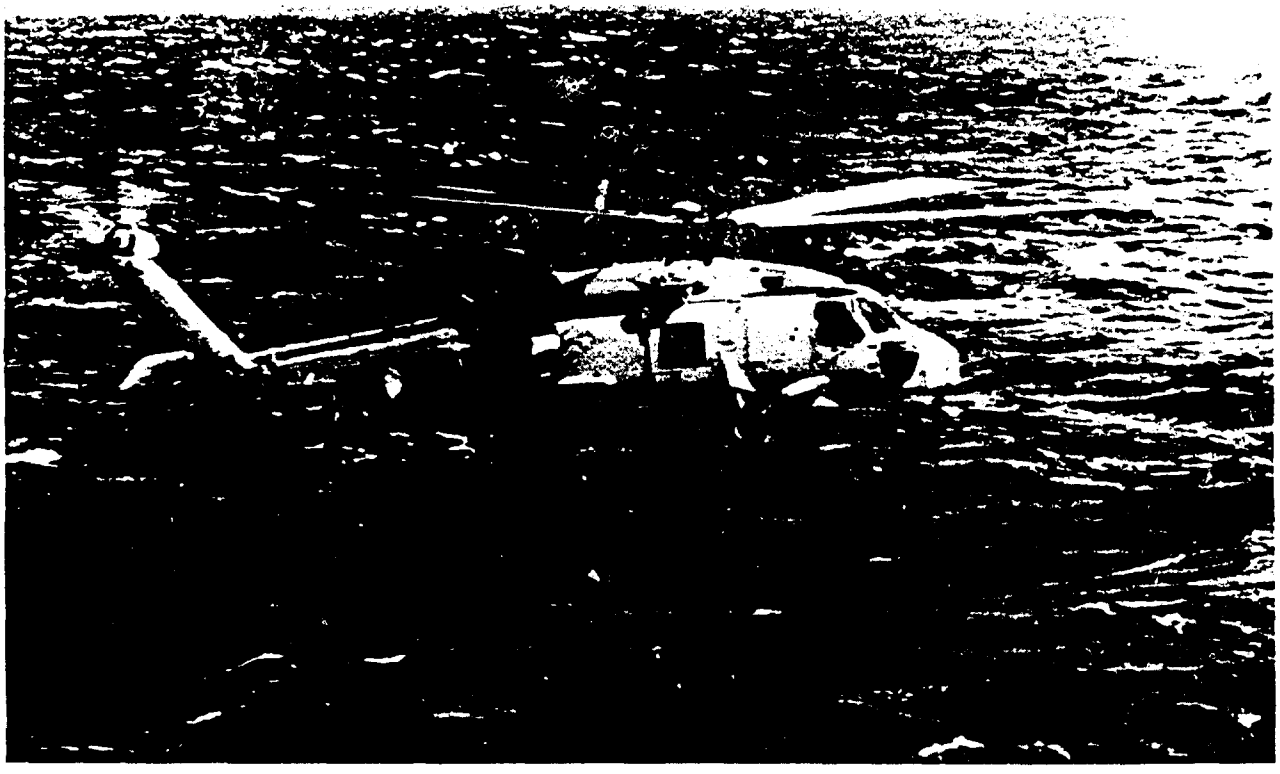
Documentation. The AIM-54C documentation was unsatisfactory due to deficiencies in the Conventional Weapons Checklist for the AIM-54 and F-14. In addition, the aircrew could not identify missile firmware and hardware during preflight inspections without the use of missile log cards. This is important because the firmware and hardware modifications affect tactical employment.

Human Factors and Safety. No deficiencies were noted.

SUMMARY

We will continue our close observation of Phoenix operational testing.

AIRCRAFT CARRIER INNER-ZONE ASW HELICOPTER (SH-60F)



SYSTEM DESCRIPTION

The SH-60F provides a carrier battle group with quick reaction inner-zone anti-submarine warfare (ASW) protection (up to 50 nautical miles) and secondary missions of search and rescue, logistics support, medical evaluation, and chaff launching. It replaces the SH-3 helicopter. The SH-60F is a derivative of the SH-60B (LAMPS Mk III) helicopter. It uses the SH-60B airframe and drive train and replaces mission avionics designed for outer-zone ASW with those designed for inner-zone ASW. This includes the addition of the AQS-13F active dipping sonar, which operates deeper, has a greater source level, a higher figure of merit (FOM), and a faster reeling machine than its predecessor. The combination of greater depth and higher FOM increases the average area searched per dip. A new avionics architecture, based on the existing ASN-123 mission computer and a data bus, has been developed for the SH-60F. Automatic Flight Control System (AFCS) modifications have been incorporated to tailor the automatic approach, departure and hover capabilities to inner-zone mission requirements. An internal auxiliary fuel system has given the SH-60F additional endurance, and a third weapons station has been added on a port side stub

wing so that two Mk 50 torpedoes can be carried along with an external fuel tank.

BACKGROUND

The SH-60F was approved as a new start in FY82 and entered full-scale engineering development (FSED) in February 1985. The AQS-13F sonar initially underwent separate development as an improvement to the existing AQS-13E sonar and has been converted to SH-60F equipment furnished by the contractor for completion of development. Initial operational test and evaluation (IOT&E) was conducted in 1986 on a YSH-60B (prototype for the SH-60F). The system was found to be potentially operationally effective and suitable.

OT&E ISSUES

Operational issues addressed furing FY88 operational testing included determination of SH-60F capability to detect, classify, localize, and attack threat-representative submarines; determination of the SH-60F capability to perform other missions; assessment of sonobuoy employment capability; and assessment of mission endurance. Operational suitability issues included determination of reliability, maintainability, and availability and assessment of logistic supportability, compatibility, interoperability, training, human factors, safety, and technical documentation.

OT&E ACTIVITY

Operational testing was conducted from November 1987 through January 1988. This included combined developmental/operational testing at the Atlantic Undersea Test and Evaluation Center (AUTEC), Andros Island, Bahamas underwater range. Subsequent testing included an operational evaluation (OPEVAL), with operations conducted aboard two aircraft carriers and ashore at the Naval Air Station, Patuxent River, Maryland. A DOT&E staff member observed the operational testing at AUTEC.

OT&E ASSESSMENT

Operational scenarios were conducted against simulated threat submarines attempting to attack either a simulated or an actual carrier battle group. Target submarines were allowed to use full attack and evasion tactics. Achievement of attack criteria by the SH-60F on the submarine was verified by reconstruction. In addition, exercise Mk 46 torpedoes were launched during testing at the AUTEC range.

The SH-60F demonstrated capability to conduct ASW operations during day, night, and instrument meteorological conditions employing the AQS-13F active dipping sonar. The AQS-13F dipping sonar demonstrated active and passive detection ranges in excess of the current fleet equipment capability. Mission endurance requirements were satisfactorily demonstrated, as were some of the secondary missions (plane guard, medical evacuation, and limited logistics support).

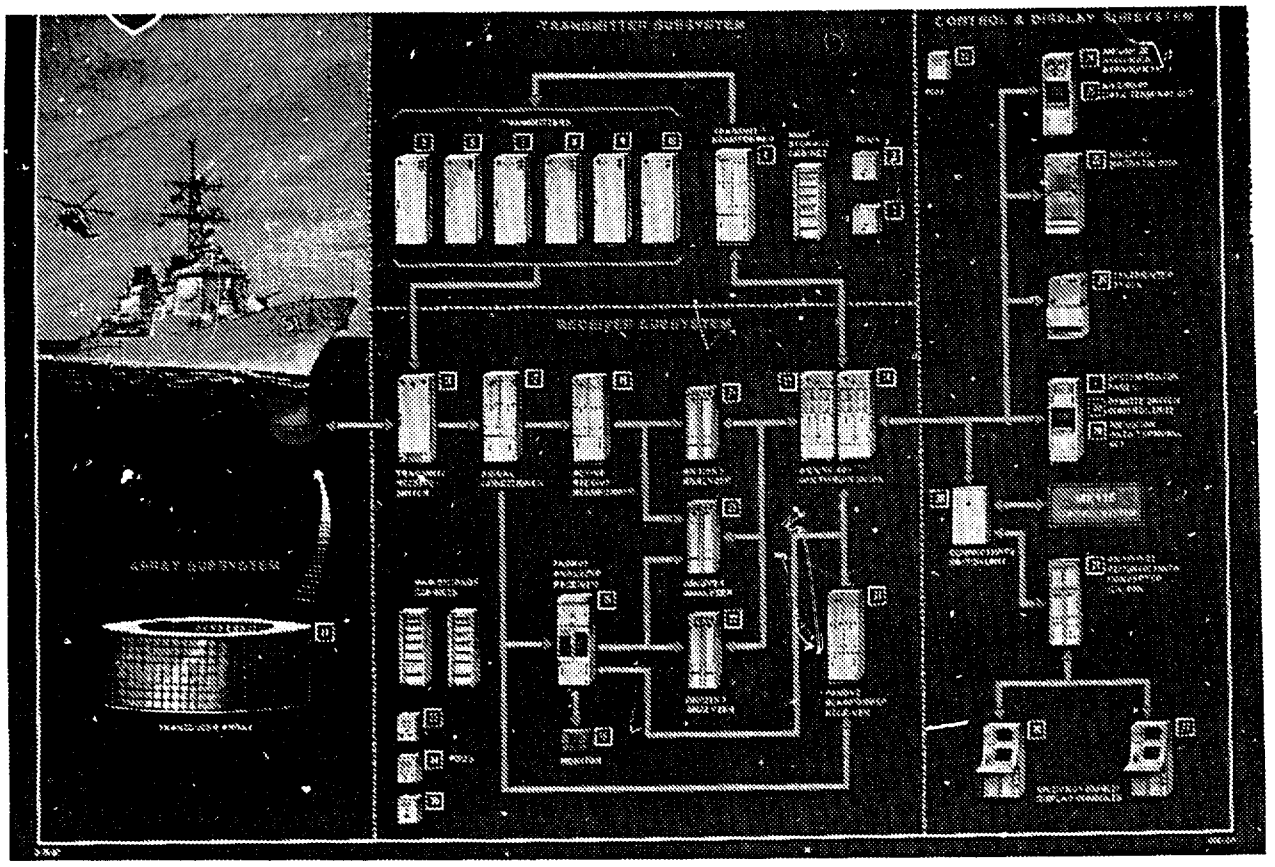
With regard to operational suitability, the SH-60F met one of its four reliability criteria. Three of five maintainability criteria were met. Compatibility deficiencies identified included unreliable automatic fuel management, limitations on required inspections, and slow and unreliable automatic main rotor blade folding and system resets caused by electrical system operation. Interoperability deficiencies were identified in the areas of communications, acoustic control and display and automatic preset of torpedoes. The most significant of the human factors deficiencies noted was cumbersome operation of the centralized management system control display unit. Deficiencies were noted in the logistics documentation as well as in the documentation used during test operations.

The training syllabus for fleet training had not been implemented.

SUMMARY

Results of the FY88 testing presented here were reported to the Secretary of Defense and Congress in the DOT&E's April 1, 1988, "Report on the Operational Test and Evaluation of the CV Inner-Zone ASW Helicopter SH-60F" which is required before the decision to proceed beyond low-rate initial production (LRIP). In that report we concluded that operational testing of the SH-60F was conducted in an operationally realistic manner, that it addressed most of the critical operational issues, and that it was considered adequate to support a beyond-LRIP decision. We also concluded that operational testing results indicated that the SH-60F had demonstrated operational effectiveness in its primary mission of ASW. Secondary missions, with the exception of antiair warfare and command control and communications were also satisfactorily demon- strated. Although operational suitability was deficient in the areas of reliability, compatibility, interoperability and human factors, the nature of these deficiencies indicated that they can be corrected in the production aircraft. Finally, we concluded that the decision to proceed beyond LRIP of the SH-60F was low risk. Follow-on OT&E of the SH-60F is scheduled for FY89 to verify that the deficiencies noted during OPEVAL have been corrected.

AN/SQS 53C SONAR



SYSTEM DESCRIPTION

The AN/SQS 53C is a long-range, multi-mode search sonar designed to detect, classify, localize and track submarines actively and passively. The sonar is designed to provide performance and operability improvements over the AN/SQS 53A/B sonars, as well as to provide a major reduction in electronic space and weight. The AN/SQS 53C was developed to equip the DDG-51 class and upgrade the AN/SQS 53A/B sonars installed in DD-963, DD-993 and CG-47 class ships.

The AN/SQS 53C sonar consists of a cylindrical array formed from 576 broadband transducer elements. The sonar's transmitter consists of a power supply, a programmable time delay beamformer and 576 transmit modules. The active receiver contains the active signal conditioning, beamforming and processing functions for variable depression (VD), surface duct (SD), and track modes of operation. The passive receiver contains the signal conditioning, beamforming and signal processing for passive broadband (PBB), passive narrowband (PNB), and demodulated noise (DEMON) operation.

BACKGROUND

The AN/SQS 53C is the latest result of an evolutionary process in sonar development. The AN/SQS 26 sonar was the Navy's first production high-power, low-frequency, bow-mounted sonar designed to exploit the convergence zone and bottom

bounce sound paths. One of several modifications of this sonar is installed on many of the older Navy surface combatants. The Surface Ship Sonar Modernization Program was initiated in FY 74. In 1978, the program was restructured as a multi-phase program. The initial phase consisted of improvements to the AN/SQS 26C sonar in both its passive and active capability. The AN/SQS 53A sonar is similar to the AN/SQS 53A sonar is similar to the AN/SQS 26CX, except that it contains a digital interface with its anti-submarine warfare (ASW) fire control system. The next phase resulted in the AN/SQS 53B, which replaced the analog controls and displays of the AN/SQS 53A with digital Navy standard building block components. The AN/SQS 53C builds on the AN/SQS 53B conversion to digital by replacing the remaining 1960s technology with modern digital components, including the AN/UYK 44 Computer. Both the AN/SQS 53B and 53C systems were designed to interface with the AN/SQR 19 Towed Array, the AN/SQQ 28 LAMPS Mk III shipboard processor and the Mk 116 ASW Fire Control System, as a component of the AN/SQQ 89 ASW Combat System.

Initial Operational Test and Evaluation (IOT&E) of the AN/SQS 53C sonar was conducted in two phases using an engineering development model installed in USS *Stump* (DD-978). The IOT&E of the AN/SQS 53C was done with the sonar in a stand alone configuration. Follow-on operational test and evaluation will be conducted with the AN/SQS 53C as an integrated component of an AN/SQQ 89 system.

OT&E ISSUES

The primary operational effectiveness issues addressed in the IOT&E on the AN/SQS 53C include: the capability of the sonar to detect, localize and track threat targets; the capability of the ASW fire control system to support contact management using the sonar input; and the ability of the sonar to operate in shallow water. The testing will also address the full range of operational suitability issues including: reliability, maintainability, availability, interoperability, logistics supportability and documentation.

ASSESSMENT

In October 1987, the first phase (OT-IIA) of IOT&E was conducted in the Western Atlantic Fleet operating area in accordance with a test plan approved by the DOT&E. The test consisted of four days of operations against USS *Narwhal* (SSN-671) in which a total of 13 screening, datum search and pouncer scenarios were conducted. The testing was limited by the fact that the test area was representative of only one of the intended operational environments. Testing was also limited because the software configuration in the USS *Stump* was not fully representative of that planned for production units and the capability of the sonar to support placement of own-ship weapons could not be assessed due to the inaccuracy of scenario reconstruction. The testing was not conducted on an instrumented range.

The Navy's independent operational test agent, Commander, Operational Test and Evaluation Force (COMOPTEVFOR) concluded that the AN/SQS 53C was potentially operationally effective and potentially operationally suitable. This testing supported a recommendation for limited production after correction of software reliability problems and provisions were established for an adequate tactical employment doctrine.

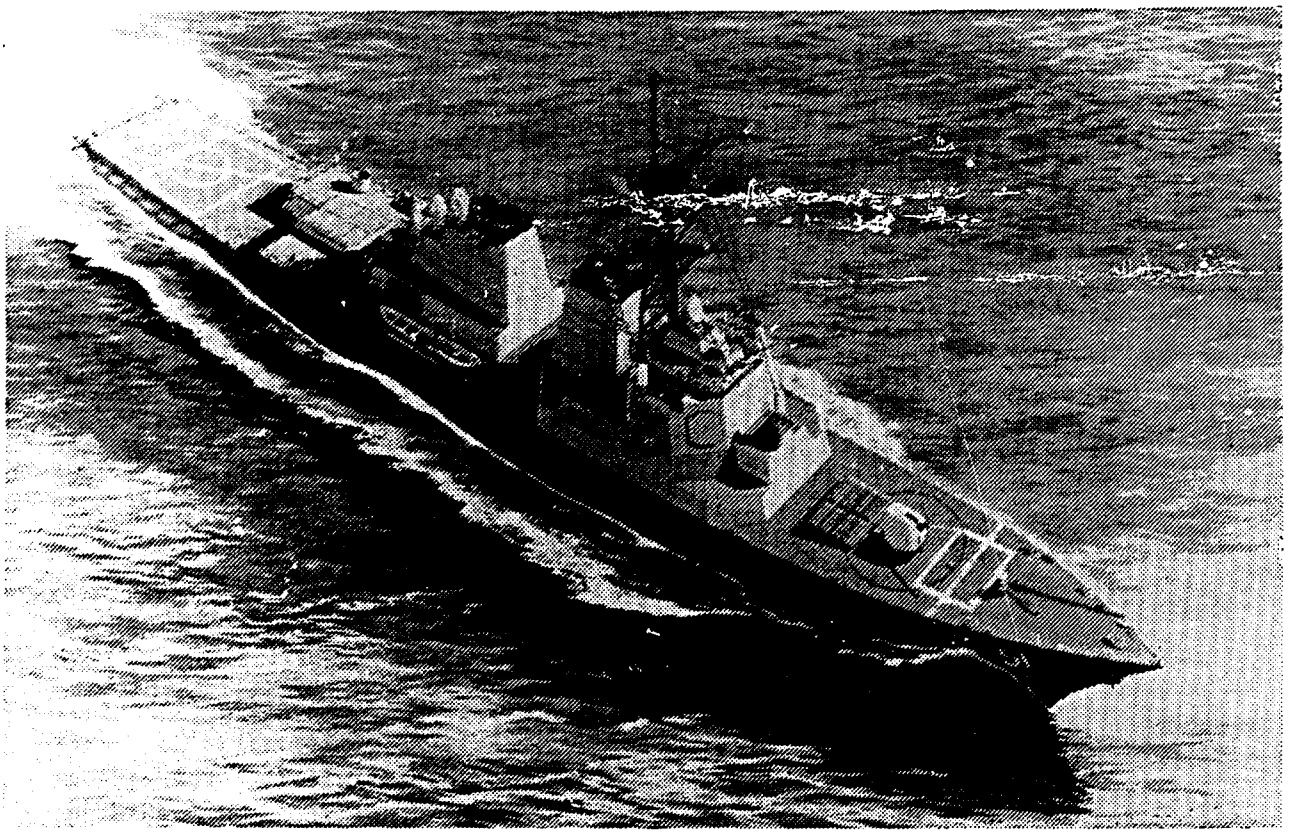
The second phase of IOT&E (OT-IIB, OPEVAL) was conducted from January through August 1988 in accordance with a test plan approved by the DOT&E. The results of this testing are still being ana-

lyzed and will be reported in the FY89 DOT&E Annual Report.

SUMMARY

In our view, the first phase of IOT&E demonstrated that the AN/SQS 53C sonar has the potential to be operationally effective and operationally suitable.

ARLEIGH BURKE (DDG-51) GUIDED MISSILE DESTROYER



SYSTEM DESCRIPTION

The *Arleigh Burke* class multi-mission guided missile destroyer, DDG- 51, is planned to replace existing guided missile destroyers in the early 1990s. It is designed to carry out offensive and defensive operations as a unit in carrier battle groups and surface action groups, or as the lead combatant in support of replenishment and amphibious groups. With two Mk-41 vertical launch systems, DDG-51 will be armed with a mix of 90 missiles which can be varied to support any of its specific missions.

The DDG-51 area defense antiair warfare (AAW) capability is provided by the AEGIS Weapon System (AWS), which includes the AN/SPY-1D radar and the vertically launched SM-2 surface-to-air missile. For antisubmarine warfare (ASW) DDG-51 will use the SQQ-89 surface ASW Combat System employing hull and towed array sonars, the LAMPS Mk III ASW helicopter, a vertically launched ASW standoff weapon and over-the-side torpedoes. DDG-51 will also employ TOMAHAWK and HARPOON missiles, and the 5 inch/54 gun for antisurface and strike warfare missions. The DDG-51 AEGIS Combat System is the integration of the AWS, the SQQ-89 ASW Combat System, and the ship's antisurface and strike warfare systems. The DDG-51 will use a CG-47 type propulsion system to

provide a maximum speed of at least 30 knots.

The AN/SPY-1D is the multifunction, phased-array, three-dimensional (range, altitude and bearing) radar system which supports the Mk-7 Mod 6 AWS in DDG-51 class ships. Radar beams radiate from the four arrays of its antenna system to support the radar functions of search, track, and missile midcourse guidance. The AN/SPY-1D is a variant of the AN/SPY-1A and AN/SPY-1B radars systems on *TICONDEROGA* (CG-47) class cruisers, tailored for employment on a destroyer-sized ship. The system initiates automatic detection and tracking of air and surface targets.

BACKGROUND

The DDG-51 class ship completed contract design in FY84, and the shipbuilding contract for the first ship of the class was awarded in FY85. The Navy's decision to procure additional ships of the DDG-51 class was based on several considerations. These considerations included the in-service experience and operational test results of those systems planned for DDG-51 which were already in service or had previously undergone operational testing on other platforms, and the operational test results of the DDG-51 unique AEGIS Weapon System and Combat System conducted during FY86. In accordance with 10 U.S.C. 138, the decision to proceed beyond low-rate initial production (LRIP) was preceded by a DOT&E report to the Secretary of Defense and Congress. In September 1988, OT&E was conducted on the DDG- 51 AEGIS Combat System at the Combat System Engineering Development Site (CSEDS) at Moorestown, New Jersey.

The AN/SPY-1D (for DDG-51 class ships) and the AN/SPY-1B (in later CG-47 class ships) are the results of major improvements to the AN/SPY-1A (in early CG-47 class ships). The upgrades in the antenna group, transmitter and signal processor are common to both the AN/SPY-1B and-1D radar systems. To date all testing of the AN/SPY-1B and -1D systems has been conducted at CSEDS. The AN/SPY-1A has undergone extensive OT&E at sea.

The CSEDS includes a mockup of the DDG-51 Combat Information Center (CIC) using standard Navy display and weapon system consoles. A combination of actual equipment (including an AN/SPY-1D radar) and simulators provide a fully operational prototype of CIC. For safety reasons, no actual firing is permitted at CSEDS. The vertical launching system and 5 inch/54 gun mount are replicated by simulators. The major differences between the AN/SPY-1D radar system configuration at CSEDS and that for the DDG-51 are: (1) only one antenna array is installed; (2) the array power supplies are commercial units; (3) the signal processor's full Moving Target Indicator (MTI) capabilities are not installed; and (4) the transmitter has two rather than three radio frequency amplifiers.

In October 1985 the final phase of the Initial Operational Test and Evaluation (IOT&E) of the AN/SPY-1B was completed at CSEDS. The Navy's independent operational test agent, Commander, Operational Test and Evaluation Force (COMOPTEVFOR), recommended full fleet introduction of the AN/SPY-1B and the Navy subsequently authorized full production. The AN/SPY-1D radar system was approved for limited production. The first phase of IOT&E (OT-IIC) on the AN/SPY-1D radar was conducted as a combined developmental and operational test (DT/OT) in June 1986. COMOPTEVFOR concluded that the AN/SPY-1D was potentially operationally effective and potentially operationally suitable, and recom-

mended continued limited fleet introduction.

The second phase of IOT&E (OT-IID1) was conducted at CSEDS as combined DT/OT in November 1987. The third phase of IOT&E (OT-IID2) on the AN/SPY-1D was a strictly operational test conducted at CSEDS in conjunction with the September 1988 DDG-51 AEGIS Combat System OT&E. Both of these tests were conducted in accordance with a test plan approved by the DOT&E. Between these two phases of testing, an updated Test and Evaluation Master Plan was submitted which addressed the testing of the DDG-51 Gun Weapon System (GWS) as requested by this office.

OT&E ISSUES

The primary OT&E issue examined during FY88 operational testing of the DDG-51 AEGIS Combat System was its ability to detect, track, and initiate engagement of threat representative targets in a multi-warfare environment. Other issues included the interoperability of the various DDG-51 combat system elements and the AEGIS Combat System reliability, maintainability, and availability.

Two phases of IOT&E on the AN/SPY-1D radar system were conducted in FY88. The primary OT&E issues examined during OT-IID1 were the radar's search, detection, track and missile engagement support capabilities in a clear and electronic countermeasure (ECM) environment against AAW targets. Suitability issues assessed included reliability, maintainability, availability, interoperability, and human factors. The objectives of OT-IID2 included those of OT-IID1 as well as the ability of the radar system to support GWS engagements against air, surface and shore targets.

OT&E ASSESSMENT

The results of the OT&E on the DDG-51 AEGIS Combat System are still being analyzed and will be reported in the FY 89 DOT&E Annual Report.

During OT-IID1, fifteen raids of multiple aircraft were conducted using F-14, A-6, and Lear Jet aircraft, with an NKC-135 and an ECM configured Lear Jet providing active ECM. Two raids were presented without ECM, seven raids presented a single ECM platform, and six raids used both ECM aircraft. Manned aircraft profiles were designed to test the system's capability to track and successfully support engagement of targets in a variety of threat representative tracking environments. Computer simulated targets were introduced into the radar system to replicate Antiship Missile (ASM) profiles including high speed, high and low altitude, and small radar cross section targets. There were several major test limitations including: chaff could not be deployed due to adverse environmental conditions; only non-firing engagements were conducted; electromagnetic radiation restrictions at CSEDS limit the radar power from zero to two degrees in elevation; the system configuration and maturity of the computer programs did not allow a full assessment of reliability and availability; and some of the radar interfaces with other systems were not installed. COMOPTEVFOR concluded that the AN/SPY-1D radar system was potentially operationally effective and potentially operationally suitable. He recommended continued limited fleet introduction after corrections are made in two areas of system performance.

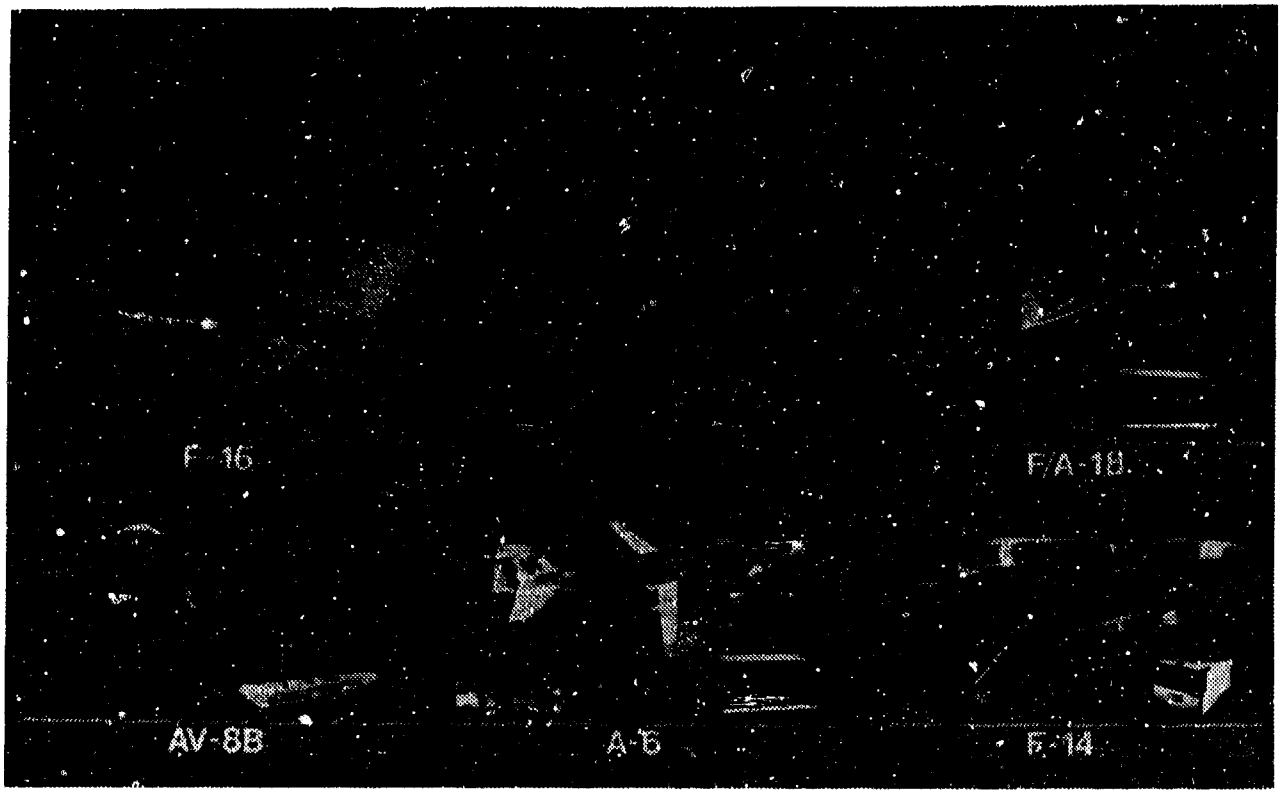
In OT-IID2, 41 manned aircraft raids were conducted using F/A-18, A-6, and Lear Jet aircraft, with an NKC-135, EA-6B, and an ECM configured Lear Jet

providing ECM. Ten raids were presented in a clear environment. Eighteen raids included active ECM. Chaff corridors were laid during four raids, and nine presentations included a combination of ECM and chaff. The major test limitations included those discussed above for OT-IID1, except that, although they were not fully threat representative because of FAA restrictions, chaff corridors were used in OT-IID2. The objectives of OT- IID2 included the assessment of the AN/SPY-1D in support of the GWS. Significant test limitations associated with the GWS testing included: the AN/SPY-1D to GWS interface was not fully developed, precluding a full assessment; and restrictions imposed by the land-based test site limited surface engagements to simulated targets and precluded a full assessment of the radar's support of Naval Gun Fire Support (NGFS). COMOPTEVFOR concluded that the AN/SPY-1D radar system was potentially operationally effective and potentially operationally suitable, and recommended continued limited introduction in DDG-51 class ships scheduled for commissioning prior to the completion of at-sea IOT&E.

SUMMARY

The FY88 OT&E of the AN/SPY-1D radar indicates it is potentially operationally effective and potentially operationally suitable, and supports its continued procurement for DDG-51 ship construction until OT&E can be conducted on the first DDG-51 class ship. The results of the FY88 OT&E on the DDG-51 AEGIS Combat System is still being analyzed and will be reported in the FY89 DOT&E Annual Report.

ASPJ (ALQ-165)



SYSTEM DESCRIPTION

The AN/ALQ-165 Electronic Countermeasures (ECM) Pod is a modular reprogrammable self-protection jamming system designed to protect Navy and Air Force tactical aircraft against a variety of radar threats. A pod version is available for the AV-8B. The system is supported by the Navy developed Advanced Electronic Warfare Test Set (AEWTS), but neither the Navy nor Air Force is expected to field the system with this support. Fielded support systems will be integrated with the basic aircraft support systems.

BACKGROUND

The AN/ALQ-165 joint Air Force and Navy program engineering development program began in 1981. Twelve engineering development models (EDM) were delivered by 1985. The Secretary of the Navy capped the program to limit government liability in 1984. An award for six production verification units was made in 1987. Effectiveness assessment tests completed early in 1988 supported execution of an option for 14 additional production verification units in August 1988. The system completed development tests in May 1988 and operational tests began in June 1988. Operational tests are scheduled in four phases but a fifth may be added. The OSD-approved phases are: (1) OT-IIA quicklook aircraft effectiveness tests to determine if additional production verification units are warranted; (2) OT-IIB simulation tests at the Air

Force Electronic Warfare Evaluation Simulator (AFEWES) (additional OT-IIB tests will be conducted after OT-IIC); (3) OT-IIC comprehensive system effectiveness and system suitability (successful accomplishment of this phase will be considered by the DAB in approving low rate initial production (LRIP)); (4) OT-IID comprehensive system effectiveness and suitability testing on F-18C and F-16C Block 40 aircraft (these aircraft are designated as the first aircraft to deploy with the AN/ALQ-165); and (5) OT-IIE comprehensive tests of the production verification models, which may be necessary before proceeding to full-rate production (the necessity of this phase is expected to be determined by the DAB in 1989).

OT&E ISSUES

The major objectives are: (1) evaluate the capability to provide tactical aircraft self-protection, (2) assess reliability, (3) assess maintainability, (4) assess the built-in-test (BIT), (5) evaluate the reprogrammability of the pod, and (6) assess the suitability of the AN/ALQ-165 for operation in its intended environment.

OT&E ACTIVITY

The ALQ-165 OT-IIA was started in June 1988 with F-16A flight tests at Eglin AFB, Florida, and F-18A flight tests at the Naval Weapons Center, China Lake, California. The OT-IIA flight tests were completed in July 1988. The Air Force began simulation tests (OT-IIB) at AFEWES in August 1988 and the Navy began OT-IIC flight tests in July 1988.

OT&E ASSESSMENTS

OSD delegated the additional production verification procurement to the services. The Air Force and Navy operational test activities (OTA) recommended the production verification units be procured based on the satisfactory completion of OT-IIA. The Air Force OTA referred to the AN/ALQ-165 as "the best ECM system seen tested." The OT-IIA indicates the AN/ALQ-165 has the potential to be operationally effective. Insufficient data was obtained to determine the potential for operational suitability.

AV-8B HARRIER



SYSTEM DESCRIPTION

The AV-8B Harrier II is a second-generation, single-seat, transonic, vertical/short takeoff and landing (V/STOL), light attack aircraft. It is powered by a single, vectored thrust F402-RR-406 engine. The AV-8B is capable of operating from short fields, forward sites, roads, and surface ships. It includes such improvements over the AV-8A as a larger supercritical wing, positive circulation flaps, lift improvement devices, enlarged intakes, and advanced composite materials applications in major structural elements of the wing, forward fuselage, and empennage. It also incorporates an updated weapons system to improve weapons delivery effectiveness and tactical flexibility. The mission computer and its associated Omnibus software manage most communication, navigation, and weapon systems functions. The AV-8B is capable of carrying a wide variety of conventional air-to-ground weaponry, the GAU-12 25mm gun, and Sidewinder air-to-air missiles.

A night-attack system has been incorporated as an engineering change proposal (ECP) to the AV-8B. It expands the daylight visual meteorological conditions (VMC) mission capabilities of the aircraft to include night VMC through the use of various complementary subsystems. These include a forward-looking infrared (FLIR) navigation system, an expanded head-up display (HUD), a night vision goggles system (NVGS), NVG compatible cockpit lighting, and a color moving map/

display. In addition, target acquisition capabilities are expected to be expanded during day and night operations.

The TAV-8B is a two-place trainer, derived from the AV-8B, which retains maximum commonality in handling qualities, inflight performance and logistics support. The AV-8B cockpit is moved forward, and a second cockpit with its associated equipment is placed above and behind. The TAV-8B is slightly heavier than the AV-8B, and certain systems such as the angle rate bombing system (ARBS) and the electronic warfare (EW) suite have been deleted.

BACKGROUND

The AV-8B was designed to replace the A-4M and AV-8A to meet the Marine Corps' iight attack requirements through the year 2000. It first flew in November 1981. It completed OPEVAL in March 1985 and IOC was declared in August 1985. FOT&E of various subsystems, ordnance, and updates of the Omnibus mission computer software continues.

The AV-8B night-attack system is intended to increase the time available for the AV-8B to accomplish its primary mission by over 40 percent. The system is expected to provide a night tactical navigation capability to levels approaching or equaling day VMC, to improve its day and night operational capabilities, and to increase night flight safety.

The TAV-8B was developed to satisfy the Marine Corps' requirement for a V/STOL training aircraft for the AV-8B. Its primary function will be to train V/STOL attack pilots for the fleet. It will be employed as a transition trainer to familiarize Marine Corps pilots with the flight controls, flight characteristics, weapons, and basic tactical use of the AV-8B. The TAV-8B completed OT-IIIA in August 1987. The test results were reported in the FY87 DOT&E Annual Report.

OT&E ISSUES

AV-8B Omnibus 5 software issues focused on improvements to and deficiency corrections of the previous mission computer software and expansion of the air-to-ground weapons clearances. Issues associated with the electronic warfare (EW) suite, the ALQ-164 and ALR-67, focused primarily on the effectiveness and suitability of the suite once it is installed in the AV-8B. Its effect on aircraft survivability is of particular interest. The AV-8B night-attack system test objectives were to (1) determine the capability of the AV-8B to conduct single and two-plane night close air support (CAS); (2) determine its capability to conduct night vertical short takeoff and landing (V/STOL) operations; (3) determine if the night attack system will be reliable, maintainable, and available in austere employment environments; and (4) assess supportability, compatibility, interoperability, training, human factors, safety, and technical documentation.

OT&E ACTIVITY

Operational testing of the ALQ-164 and ALR-67 EW suite began in July 1987 and was completed in November 1987. The COMOPTEVFOR test report is expected to be released in January 1989. Our assessment will be included in our next Annual Report.

OT&E ASSESSMENT

Operational testing of the Omnibus 5 mission computer software, the follow-on to the Omnibus 4 software, was conducted at NWC China Lake, California, MCAS Cherry Point, North Carolina, and Eglin AFB, Florida ranges from July 8 to September 16, 1988. A total of 39 sorties and 42.6 flight hours were flown. All quantitative effectiveness criteria for Omnibus 5 were achieved with no deficiencies noted

in aircraft performance. Minor software-related deficiencies were identified during the test. Deficiencies noted in Omnibus 5 testing were designated for correction in Omnibus 7 or follow-on software. Omnibus 5 was assessed to be operationally effective and operationally suitable.

Operational testing (OT-IIIA) of the AV-8B night-attack system commenced in October 1987 and was finished in June 1988. Concurrent contractor, DT, and OT operations were conducted because only one fully equipped night-attack test aircraft was available. Testing was conducted at China Lake, California; CFB Cold Lake, Canada; MCAGCC; 29 Palms, California; and WSMR, New Mexico, in a variety of terrain and meteorological conditions. There were 145 operational test sorties and 183.7 flight hours, with 68 support sorties and 77.5 flight hours flown in the AV-8B and TAV-8B. Limitations to the test included: (1) no operations were conducted from aircraft-capable ships; (2) vulnerability testing was not conducted; (3) contractor maintenance and logistic support were provided due to lack of system maturity; (4) only one fully equipped night-attack AV-8B was available (this resulted in limited spare weapon replaceable assemblies and limited the ability to assess two-plane tactics); (5) the available targets were not always threat representative; and (6) the system may not have been tested against all countermeasures.

The AV-8B night-attack system demonstrated the capability to employ typical daylight tactics during the hours of darkness, with at least minimum ambient light levels. Improved navigation, target acquisition, and target attack capability at night, and the ability to operate in low-visibility conditions during daylight, as compared to the current AV-8B system were demonstrated. It is important to note that, although the night-attack system provided a significant increase over unaided vision at night and in low-visibility conditions, it did not "turn night into day." Because of the reliance on artificial cues for low-altitude terrain avoidance, navigation, and target detection, the operating altitudes varied from 100 to 200 feet above that which could be achieved during daylight hours over the same terrain. The weapons delivery system performance was equal to daytime delivery. The AV-8B night-attack system was assessed for both aircraft and night-attack sensor susceptibility. The ability to maneuver dynamically at night was slightly reduced when compared to daylight, due to the lack of visual cues. When compared to the current night capability, there was a quantum improvement. This, combined with the night-attack system's ability to use darkness to effectively negate optically guided weapons systems and visual detection by enemy ground forces decreased its overall susceptibility. More than 25 night test passes were run against various electro-optical countermeasures (EOCM). The Electro-optical Counter Countermeasures Test and Evaluation Directorate is still reducing and analyzing the data collected. The results will be reported in our next Annual Report.

Night V/STOL launch and recoveries, in conditions ranging from starlight through full-moon conditions, were safely and effectively accomplished. This included operations from roads and confined areas. In all cases, the use of IR beacon(s) or lamp(s) made the takeoff and landing evolution easier because of lineup cues and improved ambient light conditions.

The limited flight time prevented a complete evaluation of system reliability, although it was assessed as unsatisfactory. The lack of system maturity precluded the ability to document meaningful maintainability, availability, logistic supportability, and training results (see test limitations above). Compatibility was determined to be unsatisfactory because of major deficiencies. There were minor inter-

operability problems associated with multi-aircraft operations and landing area lighting requirements. Human factors, safety, and documentation were all assessed as adequate, with minor deficiencies.

SUMMARY

Within the constraints imposed by the test limitations, the AV-8B is assessed to be operationally effective and potentially operationally suitable.

FOT&E of the Omnibus software to correct deficiencies and improve system capabilities will continue on an annual basis. Further testing of other system upgrades, such as the upgraded 408 engine, are planned in 1989.

BLU-80B CHEMICAL WEAPON SYSTEM (BIGEYE)



SYSTEM DESCRIPTION

The Bigeye is a 500 pound class freefall canister binary chemical weapon designed for single or multiple carriage on tactical fighter aircraft. Designed to be capable of supersonic carriage and high subsonic release airspeeds, Bigeye is intended to be compatible with level, loft, and dive deliveries. It produces a persistent nerve agent from two nontoxic chemicals which are physically separated within the Bigeye airframe until the weapon has been released from the aircraft. The basic components of the Bigeye weapon include the FMU-140/B dispenser proximity fuze, reactor assembly (including liquid reactant (QL), ballonet assembly (including sulfur reactant), and tail-fin assembly.

BACKGROUND

Inherent problems with the storage, transportation, and employment of toxic chemical weapons led the DoD to seek a safer, more reliable method to achieve chemical warfare deterrence. A binary concept, two nontoxic chemicals physically separated until used, evolved as the most plausible solution. In 1976 the Navy was designated the executive agent for development of the Bigeye, with the Air Force as the participating Service and the Army as the supporting Service responsible for chemical development and evaluation. Funding

shortfalls in FY80 resulted in a restructuring of the program and a decision to place it in a hold status at the end of that year. Renewed interest in the program during FY81 resulted in a decision to complete development as quickly as possible. The design of the system was changed in FY82 to allow the chemical reactant to mix after the weapon was released from the aircraft ("off-station mixing"). Operational testing of this design began in FY85.

OT&E ISSUES

The operational effectiveness issues being examined during operational testing include delivery accuracy of the system, capability of providing desired deposition densities when delivered with operationally realistic maneuvers, successful employment under all conditions encountered during mission operations and whether the required delivery maneuvers will result in an unacceptable increase in delivery aircraft vulnerability. Suitability issues include reliability, availability, maintainability (RAM); logistic supportability; environmental compatibility; interoperability; training; and safety during transportation, handling, loading, delivery, and jettison from the aircraft.

OT&E ACTIVITY

To date, the Navy and Air Force have conducted two phases of joint operational testing. The Navy completed Phase I testing (OT-IIA) on September 5, 1985. Twenty-two weapons were dropped at Naval Weapons Center, China Lake, California, and Dugway Proving Ground, Utah. The Commander, Operational Test and Evaluation Force (COMOPTEVFOR) concluded that the BLU- 80/B was potentially operationally effective and potentially operationally suitable and recommended only limited fleet introduction until compliance with several recommendations.

Phase I of the Air Force IOT&E was conducted at Nellis AFB, Nevada, from April 1985 to February 1986. Twenty BLU-80B weapons were dropped from F-4 and F-16 aircraft at China Lake and Dugway. The Commander, Air Force Operational Test and Evaluation Center (AFOTEC) concluded that BLU-80B operational effectiveness was satisfactory and operational suitability was unsatisfactory, and recommended proceeding to low-rate initial production (LRIP).

Joint USAF IOT&E (Phase II) and Navy OT-IIB (OPEVAL) testing of Bigeye commenced January 1987. After 10 weapons were test dropped, the weapon was decertified in March 1987 by the Commander, Naval Air Systems Command (COMNAVAIRSYSCOM) due to excessive failures. During this pause in testing, the Navy conducted a failure-mode analysis and modified the tail-fin actuator assembly and the FZU-37 air turbine generator fuze. Recertification was approved in August 1987, and testing recommenced on 24 August. A member of the DOT&E staff witnessed portions of the testing, both on the ground at Dugway and in the air from an Air Force F-16 chase plane. Operational testing (OT-IIB) of a combined Navy and Air Force total of 58 weapons was completed in December 1987. COMOPTEVFOR issued a final joint Navy/Air Force report in June 1988 that supported continued limited production for operational testing. Limited fleet introduction was not recommended. Prior to approving the Bigeye Test and Evaluation Master Plan (TEMP) and the operational test plan, this office persuaded COMOPTEVFOR to include in his final OT-IIB report an Army appendix that contains the results of the Army's effectiveness modeling based on chemical simulant data collected during OT-IIB.

In January 1988, on the recommendation of the Secretary of Defense and in accordance with Section 152 of the National Defense Authorization Act for FY87 (Public Law 99-661), the President certified

that (1) production of the Bigeye binary chemical bomb is in the national security interest of the United States, and (2) the design, planning, and environmental requirements for production facilities have been satisfied. On the recommendation of this office, production will be held to a minimum, no Bigeye bombs will be deployed, and production will not continue beyond the first lot unless the next phase of operational testing is fully successful.

While the provisions of 10 U.S.C. 138 do not require the DOT&E to submit a report on operational test adequacy and system operational effectiveness and suitability until a decision is to be made to proceed beyond LRIP, an interim report was submitted to Congress in August 1988. The results of operational testing conducted as of that time were not sufficient to provide a basis for an assessment of operational effectiveness and suitability.

OT&E INTERIM ASSESSMENT

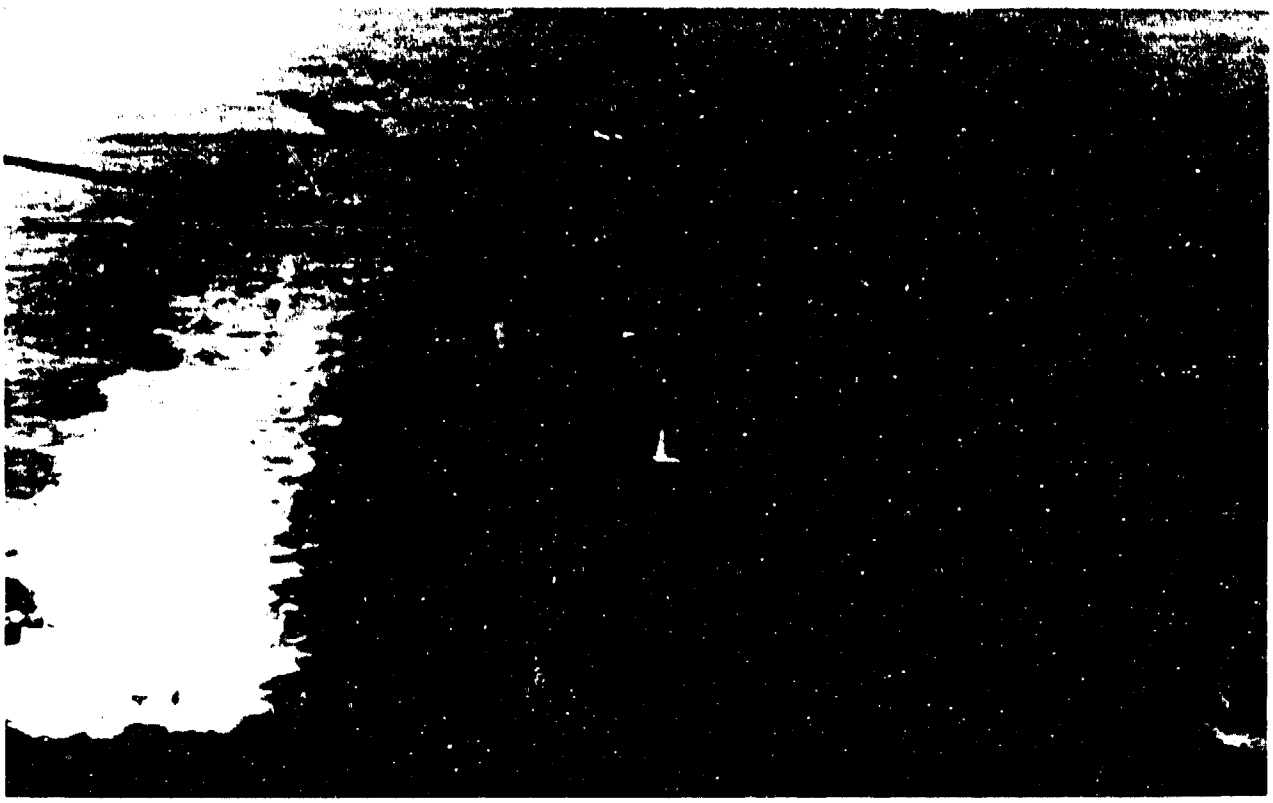
The OT-IIB operational testing was designed to resolve operational effectiveness issues of delivery accuracy, deposition density, and operational suitability issues, including hardware reliability. Results from this phase of testing, if positive, were to have supported a full-rate production decision. While the TEMP and test plan criteria for agent deposition density were met, the delivery accuracy and reliability criteria were not. Other questions remain unanswered and will require further testing: the Bigeye bombs tested were pre-production prototype models, not fully representative of the factory-built production-representative weapon configuration; certain employment maneuvers and tactics used when delivering the Bigeye may result in an unacceptable increase in aircraft vulnerability; and a measurable criterion for mission success (end-to-end) will be needed in order to establish the likelihood of completing a mission successfully and effectively.

Although the data analysis and evaluation of OT-IIB test results did not provide a conclusive basis for an assessment of operational effectiveness and suitability, the results indicate that Bigeye has the potential to be operationally effective and operationally suitable. Because reliability was below threshold, this office requested that two independent producibility studies be done, one by OSD and one by the Navy. Based on the results of these studies, the DOT&E test observations, and the OT-IIB report, this office recommended that production be held to a low rate and further operational testing be conducted using production-representative weapons.

SUMMARY

Within the constraints imposed by the limitations to the scope of testing to date, the Bigeye chemical bomb has demonstrated the potential to be operationally effective and suitable. These findings do not support a recommendation for full-rate production. These findings do support continued full-scale engineering development to correct deficiencies. Low-rate initial production to create articles for testing should be conducted, and further operational testing should be conducted (and is planned by FY90) on production-representative Bigeye weapons to determine, prior to a full-rate production decision, whether or not the system's deficiencies and limitations to the scope of testing has been satisfactorily resolved. The DOT&E's final report will be submitted at the conclusion of the next phase of operational testing, prior to the full-rate production decision.

C/MH-53



SYSTEM DESCRIPTION

The CH-53E is an improved/growth version of the Navy/Marine Corps H-53A/D transport helicopter. It features a third engine, a larger diameter rotor, seven (versus six) main rotor blades, an uprated main transmission, and a greater maximum gross weight and payload capability. Maximum payload is 16 tons for the CH-53E vice 8 tons for the earlier H-53A/D aircraft. The CH-53E is currently in full production and is employed by both Marine Corps and Navy fleet units. The MH-53E is a variant of the H-53E and was recently approved for full production for use in the airborne mine-countermeasures (AMCM) mission. There is 80 percent commonality between the MH and CH aircraft, with the main rotor, engines, transmissions, and basic airframe being essentially the same.

BACKGROUND

The MH-53E was developed as an engineering change proposal modification to the CH-53E aircraft, intended to replace the RH-53D as the Navy's airborne AMCM platform. The MH-53E is designed to increase time on station and improve mission reliability, as well as to provide the increased tow capability required by new AMCM devices. Initial operational testing (OT-IIA) was conducted in 1984. Based on OT-IIA and development test results, a limited production decision was made in March 1985. Operational evaluation (OT-IIB) of the MH-53E was

conducted in FY86 and reported upon in our FY86 Annual Report. OT-IIB test objectives included a determination of the MH-53's capability to stream, tow and recover AMCM towed bodies, and navigate with the accuracy required to conduct AMCM operations. Major deficiencies identified in OT-IIB included recoverability with single-engine failure during tow operations, full-throw authority of the cyclic during emergencies, readability of the tension skew indicator, durability of the main and tail rotor bearings and rotor brake slippage. Based on FY86 test results, continued low production of the MH-53E was recommended. No operational testing occurred in FY87.

OT&E ISSUES

In FY88, the Navy conducted follow-on operational test and evaluation (OT-IIIA) of the MH-53E. The objectives of OT-IIIA were to assess production fixes to OT-IIB deficiencies, assess interim fixes for those OT-IIB deficiencies with long-term solutions, and determine the readiness of the MH-53E for full production. OT-IIIA testing determined that the MH-53E was marginally operationally effective and not operationally suitable. Although the MH-53E demonstrated an adequate airborne mine countermeasures (AMCM) tow capability, once the mine countermeasures gear was streamed, the integrated system was not considered operationally effective for the conduct of the primary AMCM mission. The Precise Navigation System (PNS) needed improvement, and the major suitability issues of reliability, maintainability, compatibility, interoperability, safety and human factors required resolution. Major deficiencies were identified in OT-IIIA for correction and testing in an additional phase of operational test and evaluation. These deficiencies were: (1) unresolved OT-IIB deficiencies; (2) unsafe conditions created by certain AMCM configurations (safety); (3) design of AMCM equipment interoperability; (4) lack of a reliable, precise navigation system (reliability); (5) hazards during emergency egress (safety); (6) excessive noise levels which can injure hearing and cause communication difficulties; (7) lack of ventilation and heating during warm and cold climates (safety); (8) design of fuel sponsons and hardware (safety); (9) readability of cockpit indicators and status lights (human factors); (10) stowage provisions to eliminate hazards to aircrew movement (human factors); (11) need for better human performance engineering for completion of aircrew and maintenance tasks (human factors); (12) need for better aircraft and AMCM equipment logistic support; (13) training deficiencies; and (14) documentation deficiencies. Limited production of eight MH-53E aircraft was granted in April 1988. The DOT&E considered the Navy to have proceeded beyond low-rate initial production with this decision and submitted to the Congress a B-LRIP report in May 1988. The B-LRIP report contains the details of OT-IIIA testing.

OT-IIIB was conducted in December 1987. Its objective was to demonstrate the transportability of the MH-53E aircraft in a C-5 aircraft. The test was considered successful and the Air Force approved MH-53E transportability.

OT&E ACTIVITY

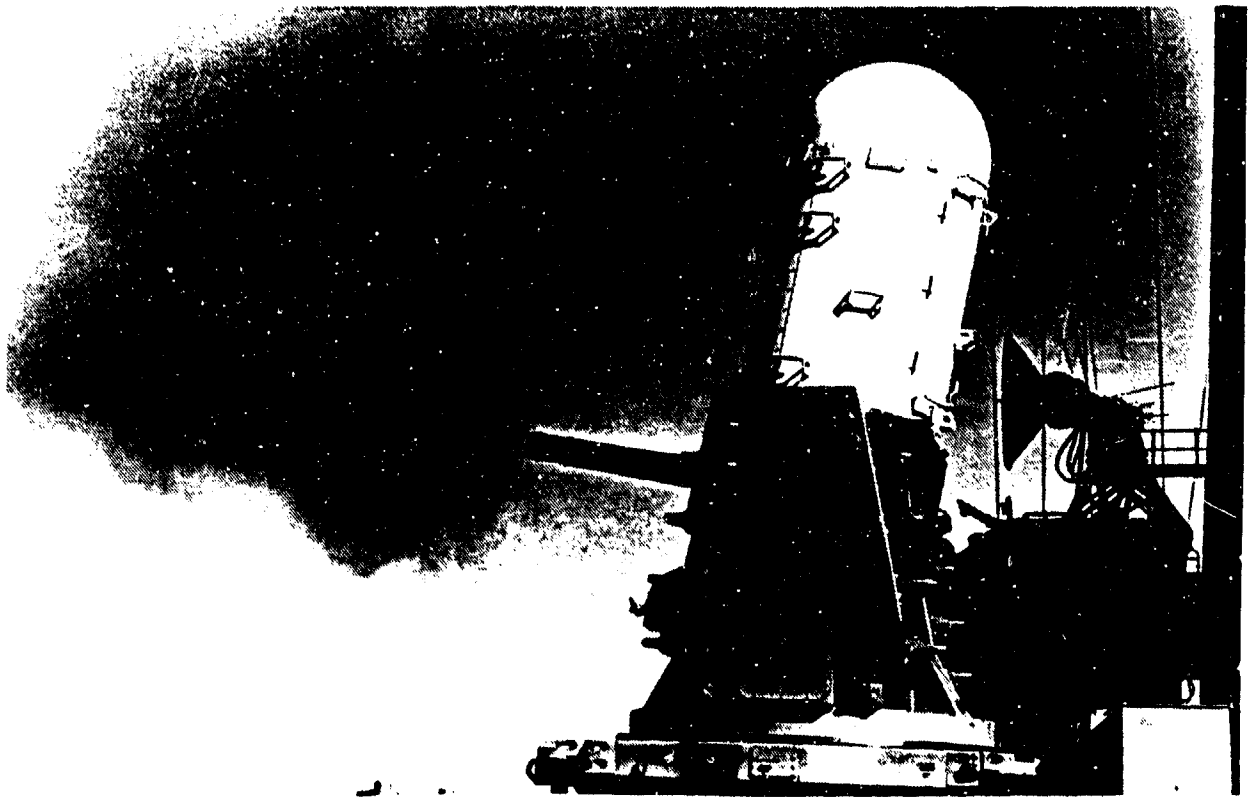
Additional follow-on testing after OT-IIIA was directed and conducted as OT-IIIA Phase II from July to September 1988 for verification of corrections to deficiencies found in OT-IIIA. Testing was conducted by Helicopter Mine Squadron 15 based at Alameda Naval Air Station, California. The test involved 265.5 flight hours using a variety of mine countermeasures equipment, not including the ALQ-141, which could not be tested. Evaluation determined that the PNS needed further improvement. Suitability issues of Mk-103 compatibility and AMCM mission safety were not resolved satisfactorily. Reliability

in the AMCM mission remained unsatisfactory. Maintainability was unsatisfactory and higher than criterion. Problems with stream and recovery operations, high acoustic noise levels, and cockpit PNS instrumentation caused safety issues to remain unsatisfactory. Because of inadequate PNS publications, training was considered unsatisfactory.

SUMMARY

It is our judgment that the MH-53 is still only marginally operationally effective in the AMCM mission, primarily due to PNS deficiencies, and is not yet operationally suitable. Navy efforts to improve and correct the integrated weapon system deficiencies in the AMCM mission are underway.

CLOSE-IN WEAPON SYSTEM Block 1



SYSTEM DESCRIPTION

The Close-In Weapon System (CIWS) Block 1 is a rapid-fire 20 mm gun designed for close range defense of surface ships against antiship missiles. The system uses a search radar and tracking radar with the antennas enclosed in a radome on top of the gun assembly. After the search radar detects an incoming target, the track radar locks on and tracks the target. When the target moves within a predetermined range, the gun fires projectiles made of depleted uranium or tungsten to provide high kinetic energy and hardness to penetrate antiship missiles. The tracking radar then detects the outgoing stream of projectiles as it tracks the incoming target and moves the gun barrel to minimize the angular difference between projectiles and target, thereby bringing the projectile stream onto the target. This process is called electronic closed-loop spotting. The major differences between the Block 1 version of CIWS tested and the earlier Block 0 version include an ability to search for threat targets higher in elevation, an increased magazine capacity, ability to accommodate higher speed targets, and a higher firing rate. CIWS provides a new capability and does not replace any existing system.

BACKGROUND

The CIWS Block 0 reached initial operational capability (IOC) in 1979. The Block 0 system was designed to counter the low-altitude threats of the late 1960s.

Accordingly, it was designed with a low search elevation coverage. To provide capability against current threats (diving on ships along higher approach angles), the Naval Sea Systems Command awarded a contract to General Dynamics, Pomona, in 1978 to develop the Block 1.

Operational Testing of the Block 1 was conducted in three phases. The third phase (OT-IIC) occurred in FY88. OT-IIA took place at the Naval Weapons Center, China Lake, California (June 1981 to May 1982). The Navy's operational test agency did not make an operational assessment because of significant differences between test and operational conditions and numerous hardware and software configuration changes. The second phase, OT-IIB, was conducted with three different platforms: two FFG-7 *Oliver Hazard Perry* class frigates and a remotely controlled terminal-defense test ship (a decommissioned destroyer) during the period from February to September 1985. The testing with the frigates included tracking of manned aircraft and firings against towed targets. Testing with the terminal defense test platform included live firings of the CIWS Block 1 against a missile diving toward the platform from a high elevation angle, a low-altitude drone, and towed targets. Based on the results of OT-IIB, production was shifted from Block 0 to Block 1.

OT&E ISSUES

Operational effectiveness issues addressed during FY88 IOT&E included determining the Block 1 capability to detect air threats throughout its expanded search volume; determining capability to bring effective fire to bear on supersonic and subsonic air threats, determining capability to provide accurate kill assessment and timely kill declaration; determining capability to shift to the next engageable air threat in a timely manner; assessing vulnerability; determining Block 1 capability to enhance survivability of the defended ship relative to Block 0; and determining capability of Block 1 to detect and destroy more types of threats and complete more engagements than Block 0 prior to reloading the magazine.

Operational suitability issues included the determination of Block 1 reliability, maintainability, availability, logistic supportability, compatibility with the operating environment, interoperability, training adequacy, manning adequacy, safety, documentation adequacy, adequacy of the Integrated Logistic Support Plan and the time to reload from Conditions I and III.

OT&E ACTIVITY

Operational testing was conducted in two phases. The first phase used a Block 1 CIWS on the remotely controlled test ship. The second phase used the USS *Josephus Daniels*, a cruiser of the *Belknap* class, as the test ship. The first phase was dedicated to determining operational effectiveness issues in as realistic an environment as possible. The second phase, conducted with an operational ship, was dedicated to determination of operational suitability issues.

During the first phase, which was conducted at the Pacific Missile Test Center off the coast of Southern California, the test ship towed a decoy barge astern, and the targets guided toward the barge which was located in the defended zone of the CIWS. Testing was conducted against both subsonic and supersonic targets.

The second phase of testing with *Josephus Daniels* was conducted during fleet exercises with a battle group in the Caribbean operating area and operating areas off the Virginia and Florida Coasts. Testing included aircraft tracking, and in some instances, with *Josephus Daniels* simulating utilization of her own passive defense systems to decoy the simulated targets "attacking" her. These latter tests were intended to investigate inter-

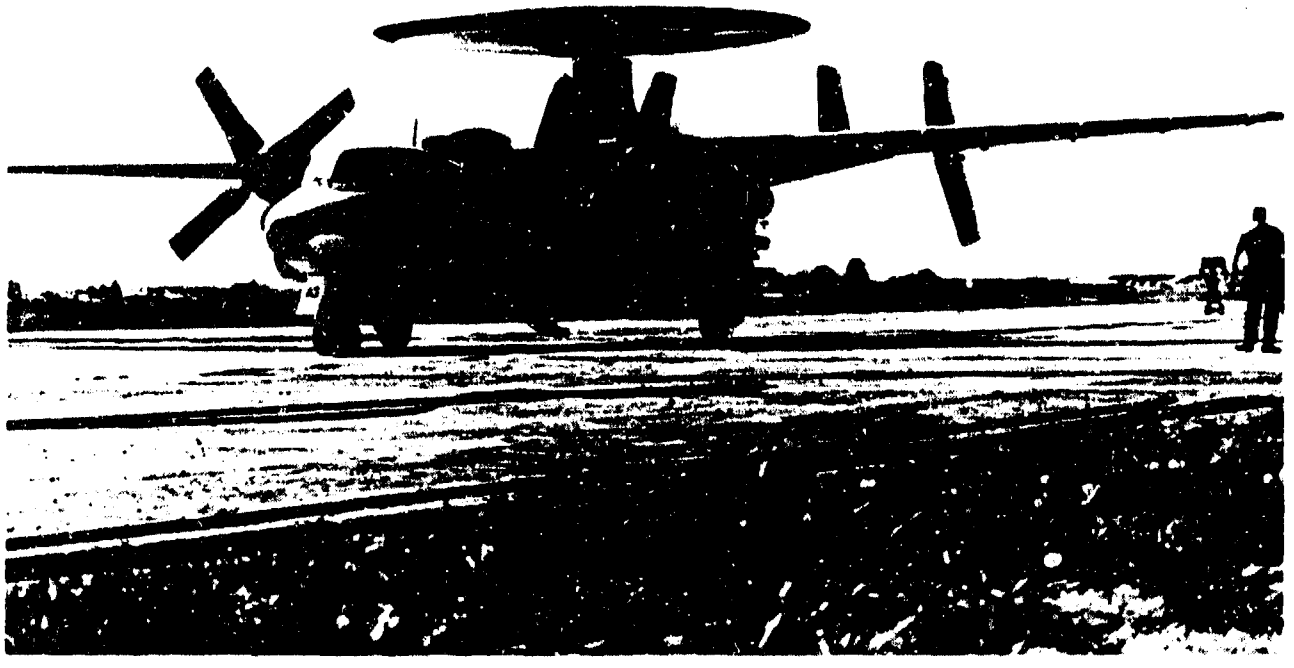
operability issues of CIWS with other onboard systems. Testing also included live firing against tow targets.

OT&E ASSESSMENT

Limitations during the FY88 operational testing included those associated with targets and weather conditions. The available targets did not fully represent the threats in some operational characteristics. Weather conditions were those encountered during the testing period.

It is our view that the FY88 operational testing of Block 1 CIWS demonstrated that the system does provide more capability than Block 0. Results of FY88 operational testing of Block 1 CIWS demonstrated that it is operationally suitable. Based on the results, it is our view that continued low-rate production is justified, but capability in certain areas should be pursued.

E-2C



SYSTEM DESCRIPTION

The E-2C is the third variant of a carrier-based airborne early warning (AEW)/command and control system developed and produced since 1956. It is equipped with an airborne tactical data system which includes both active and passive sensors. The five-man crew interfaces with the data processing and sensor inputs to provide real-time threat warning and tactical analysis to the battle group commander.

The Update Development Program is composed of Group I and Group II improvements. Group I consists of high-speed processor and radar improvements. Group II provides the radar with extended range, environmental processing, and an improved Identification Friend or Foe (IFF) system. The T-56-A-427 engine upgrade is being developed in parallel and will be tested with Group I and Group II in the final operational evaluation.

BACKGROUND

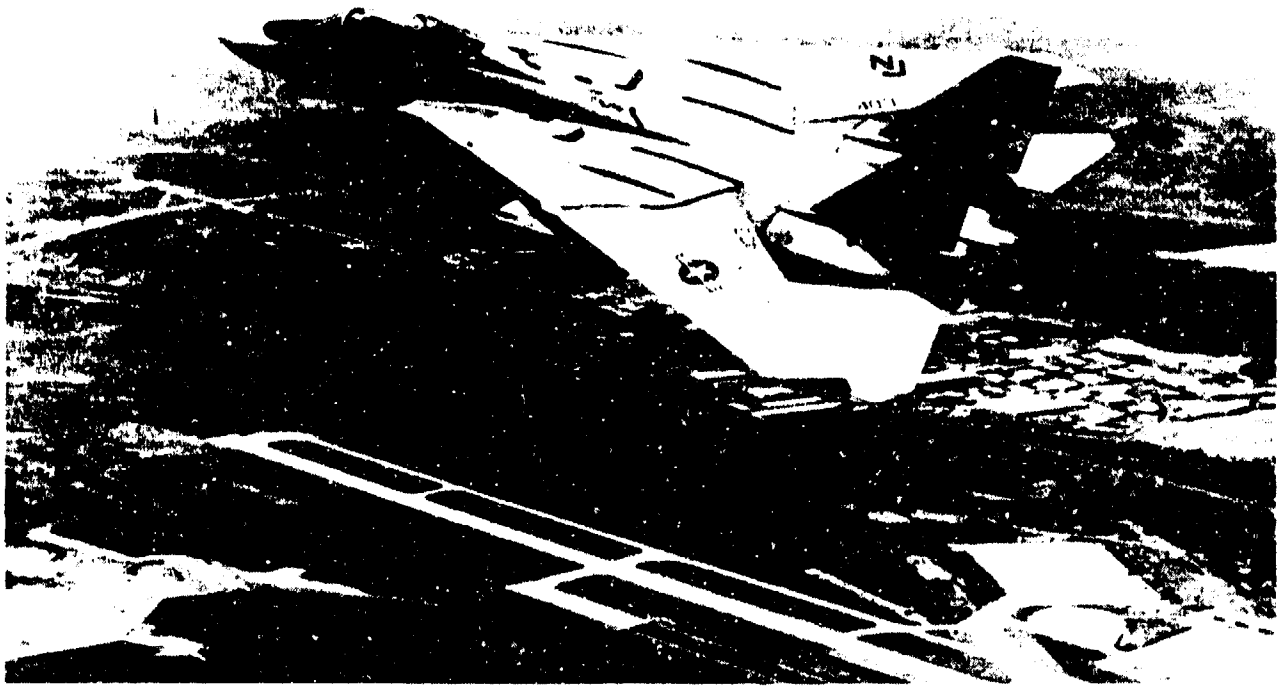
The E-2C has been in production since 1973. A previous radar upgrade was completed in 1977. Developmental tests of Group I and the engine were completed in Sept 1988. The operational evaluation of these tests is scheduled for 1989. The op-

erational evaluation of the Group I and engine upgrade is scheduled for 1992.

OT&E ASSESSMENT

No dedicated operational tests have been conducted, but OTA monitoring and reviews of developmental tests indicate the Group I and the engine upgrade are potentially operationally effective and potentially operationally suitable. COMOPTEVFOR recommended limited production.

F-14 TOMCAT



SYSTEM DESCRIPTION

The F-14A Tomcat is a carrier-based, two-seat, twin-engine, auto or manual variable-sweep-wing aircraft. It is an all-weather, supersonic, air-superiority fighter capable of carrying the Phoenix, Sparrow, and Sidewinder missiles together with an internal M-61 (20 millimeter) gun for fleet air defense or fighter roles. An air-to-ground capability is secondary and has never been fully developed. Its major subsystems are the AWG-9 weapons control system (WCS) and two TF30-P-414A engines. The AWG-9 is a software programmable WCS designed to detect and track multiple airborne targets at extended ranges and to prepare and fire the air-to-air missiles and M-61 cannon. The AWG-9/Phoenix missile combination gives the F-14 the ability to attack up to six targets nearly simultaneously at long ranges.

The F-14A Plus (A+) involves an engineering change proposal (ECP) to replace the current TF-30 engine with the F110-GE-400, a derivative of an Air Force engine. Associated engine accessories, structure, hydraulic, fuel system and ECS modifications will be incorporated, as well as provisions for the ALR-67 radar homing and warning (RHAW) system. The F-14D incorporates the same engine and associated modifications as the A+, but also includes major upgrades through new digitized avionics and a new digital radar (APG-71). The avionics will utilize a modern digital multiplex bus architec-

ture and incorporate state-of-the-art avionics equipment such as JTIDS, ASPJ, and IRSTS. The APG-71 will retain the high-peak-power output of the AWG-9 radar and provide for signficiant improvements in ECCM capability, reliability, and maintainability. The F-14D's weapons capability will increase to include AMRAAM, HARM, and Harpoon.

BACKGROUND

The F-14A first flew in December 1970 and became fleet operational in December 1973. In July 1983, a memorandum from the Secretary of the Navy delineated the required capabilities for an upgraded F-14A, the F-14D. The need for an early, limited upgrade, the F-14A+, was determined to be necessary due to safety and operability problems associated with the TF-30 engine. In September 1986, the Secretary of the Navy directed that the procurement of new production F-14Ds would be supplemented by remanufacturing F-14A/A+s into F-14Ds. Significant OT&E of the F-14A is completed. Current activity consists of OT&E of the operational flight program (OFP). The OFP is the software for the AWG-9 weapons control system (WCS). The F-14A+ is currently in operational test. The F-14D (avionics/radar) first flight took place on November 23, 1987. Testing to date has centered on radar developmental testing using an APG-71 radar installed in a Pacific Missile Test Center (PMTC) A-3 test aircraft, and avionics development and radar integration using full-scale development F-14D aircraft. The F-14D completed its first phase of OT in September 1988.

OT&E ISSUES

The combined F-14A and F-14A+OT issues were the operational effectiveness and suitability of OFP 114C/P14C. The major OFP changes concerned the fatigue engine monitoring system (FEMS) associated with the F110-GE-400 engine, the ALR-67 interface, the ALQ-126B (defensive electronic countermeasures system) interface, and the AWG-15F (integrated armament control system) interface.

The F-14A+ test issues were to assess the operational effectiveness of the F-14A+ in the maritime air superiority (MAS), strike escort, and tactical air reconnaissance pod system (TARPS) missions while operating in the carrier or land base environments. The suitability test issues were reliability, maintainability, availability, logistic supportability, compatibility, interoperability, training, documentation, human factors, and safety.

The F-14D OT-IIA critical operational issues (COIs) were intended for partial resolution due to the early stage of test. These COIs were weapon system performance, reaction time, standoff detection, identification and engagement capabilities, command and control, weapons management, compatibility, interoperablity, human factors, safety, and built-in test (BIT).

OT&E ASSESSMENT

OFP 114C/P14C. Concurrent DT/OT was conducted from November 2 to December 28, 1987. Dedicated OT occurred from December 29, 1987 to April 1, 1988. A total of 180 sorties and 293.4 flight hours were flown in the F-14A and F-14A+ during the two test phases. Sorties were flown in the maritime air superiority (MAS), power projection, carrier operations, and reconnaissance mission areas. OFP 114C/P14C was assessed as operationally effective and suitable and released to the fleet in May 1988. A DOT&E staff member has flown the F-14A with OFP 114C/P14C.

F-14A+. OT-IV of the F-14A+ commenced in July 1988 and is still under way. The delays have been caused by deficiencies in the engine clearance and the

engine/gear box turnbuckle mounting link. A DOT&E staff member flew the F-14A+ simulator and flew a performance comparison against the F-14A+ in the F-14A. The performance comparison consisted of a side-by-side acceleration and a simulated air-to-air engagement.

F-14D. OT-IIA began on August 22, 1988, and was completed on September 1, 1988. OT-IIA was an early look at potential operational effectiveness and suitability utilizing full-scale developmental (FSD) models of the F-14D. The radar and avionics software maturity was approximately 15 percent complete. Radar-mode selection was limited and no defensive electronic countermeasures (DECM) equipment was installed. Test limitations included: a limited number of radar intercepts precluding a determination of 90 percent probability of detection range; airspace restrictions; low altitude safety of flight restrictions for the target aircraft; F-14D FSD aircraft not cleared for night or instrument meteorological conditions (IMC) flight; and system contractor maintenance and logistics support.

Twenty-six sorties were flown in OT-IIA. All critical operational issues were partially resolved. The F-14D was assessed to be potentially operationally effective and potentially suitable. Some areas identified for correction (normal for an early phase of test) prior to the next phase of OT are: (1) safety issues associated with the head-up display (HUD) and vertical display indicator (VDI); (2) performance issues associated with the range while search (RWS) and pulse doppler search (PDS) radar modes; (3) human factors issues regarding display readability, lighting, and mode selection capability; and (4) excessive BIT false alarm rate of the onboard checkout (OBC) continuous monitor.

SUMMARY

The F-14A is a mature weapons system which is undergoing minor modifications and updates during FOT&E. Major changes and improvements to the F-14 (F-14A+ and F-14D) began in FY88. The F-14A+ is still in test, pending resolution of the carrier suitability issue. The F-14D completed its first phase of OT, an early operational test, and is assessed to be potentially operationally effective and potentially operationally suitable.

F/A-18 HORNET



SYSTEM DESCRIPTION

The F/A-18A Hornet is a single-seat, twin-engine, carrier-based strike fighter. It was designed to replace the F-4 and A-7, and is being employed in the Navy strike fighter squadrons and Marine fighter attack squadrons. It has an internally moutned M-61 (20 millimeter) gun, carries the Sparrow and Sidewinder missiles in the air-to-air role, and various nuclear and non-nuclear air-to-ground weapons in the strike role. It is also capable of dropping most air-deliverable mines. The aircraft incorporates a digital control-by-wire flight control system, multiplexed digital avionics and weapons control system and the APG-65 radar. It is powered by two F404-GE-400 engines.

The F/A-18C involves major upgrades to the F/A-18A. These changes, grouped under engineering change proposal (ECP) 178, include provisions for new hardware systems with the associated software for ASPJ, AMRAM, IIR Maverick, and the flight incident recorder and aircraft monitor system (FIRAMS). Other changes incorporated are a left/right fuel system (ECP-162) and an improved environmental control system (ECP-35), which is not unique to the F/A-18C. Night attack, tactical reconnaissance and tactical air controller (airborne)/forward air controller (airborne) TAC(A)/FAC(A)) capabilities will be added in future F/A-18D's. The F/A-18B and F/A-18D respectively, are the two-seat variants of the F/A-18A and

F/A-18C. These versions are currently being used for training only.

BACKGROUND

The F/A-18 first flew in November 1978 and completed OPEVAL in October 1982. IOC was declared in March 1983. Follow-on operational test and evaluation (FOT&E) of discrepancies discovered during OPEVAL and of the electronic warfare (EW) suite/HARM missile (not available for OPEVAL) was completed by August 1985. A program management proposal (PMP), which was approved by the Secretray of the Navy in January 1985, combines several new subsystems and improvements into a single block upgrade as part of an overall preplanned product improvement (P3I) program. Due to the significant changes in system capabilities resulting from this P3I, the model designation was changed from F/A-18A to F/A-18C/D, beginning with Lot X aircraft. However, because the Lot X aircraft retain the XN-5 mission computer of the Lot IX and previous aircraft, they are not currently compatible with ASPJ, AMRAAM, and IIR Maverick. The F/A-18 with the 87X operational flight program (OFP) completed OT&E in June 1988. The OFP associated with the aircraft's mission computers, inertial navigation system (INS), and stores management set (SMS) receives periodic updates which undergo developmental and operational testing. OFP 87X is the follow-on software to the 85A+ OFP.

OT&E ISSUES

Operational testing of the 87X operational filght program (OFP) addressed the operational effectiveness and suitability of 87X, including correction of previously identified deficiencies, in the F/A-18A and F/A-18C. Included in this operational test was an assessment of the operational effectiveness and suitability of Lot X F/A-18C aircraft. Critical operational issues included the total system performance in the mission areas of maritime air superiority (MAS), war at sea (WAS), power projection, air combat maneuvering (ACM), defense suppression, close air support (CAS), and deep air support. Included in these issues were individual assessments of sensor performance (e.g., radar and noncooperative target recognition (NCTR)), XN-5 mission computer performance, air-to-air missile capability, air-to-ground weapon accuracy, and survivability. The suitability issues were reliablity, availability, maintainability (RAM); logistic supportability; compatibility; interoperablity; training; safety; documentation; and human factors.

OT&E ASSESSMENT

Operational testing of the 87X OFP and Lot X F/A-18C aircraft was conducted at NWC China Lake, California; PMTC, Point Mugu, California; Edwards AFB, California; NAS Miramar, California; Nellis AFB, Nevada; NAS Fallon, Nevada; Luke AFB, Arizona; MCAS Yuma, Arizona; Eglin AFB, Florida; and NWEF Kirtland AFB, New Mexico. Carrier-base operations were accomplished on board USS *Carl Vinson* (CVN-70). Testing consisted of 402 sorties and 559.6 flight hours.

Limitations to scope of testing included: (1) the Mk-50 and Mk-60 series mines, the GBU-78/B Gator, and the BLU-88 Bigeye were not tested for air-to-ground weapon accuracy; and (2) the FLIR pod, laser tracker designator/ranging (LTD/R) pod, and F/A-18D aircraft were not available for testing.

The F/A-18A with the 87X OFP exhibited no degradation of operational effectiveness or operational suitability as compared to an F/A-18A with the 85A+ OFP.

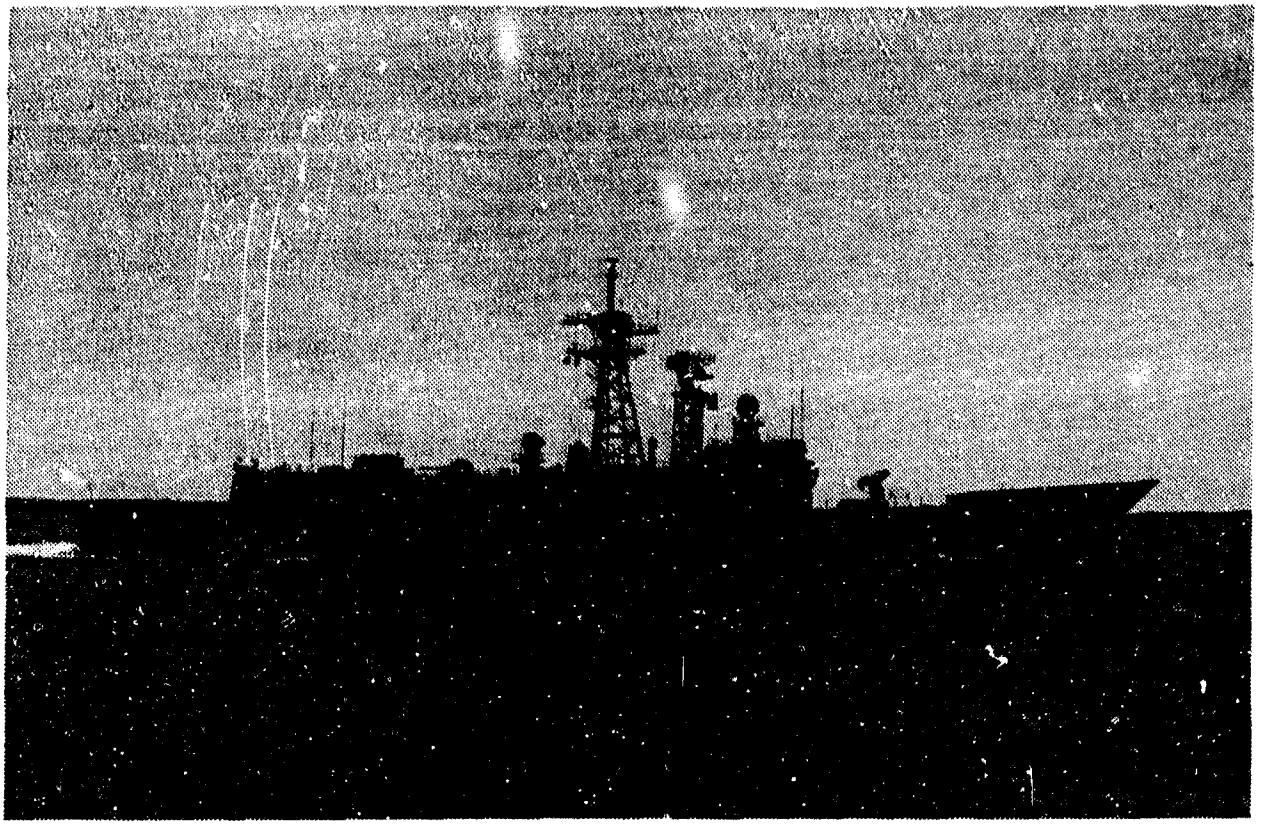
The test found the 87X OFP operationally effective and operationally suitable.

The F/A-18C with the 87X OFP exhibited no degradation of operatonal effectiveness as compared to an F/A-18A. However, the F/A-18C did not meet the unrefueled on-station loiter time for the MAS mission or the unrefueled range for the power projection and deep air support missions. The F/A-18A and F/A-18C rate of fuel consumption and ranges for these mission scenarios were essentially identical. This matches the results of the F/A-18A OPEVAL in May to October 1982 (and F/A-18A FOT&E), which resulted in a recommendation either to increase the F/A-18 fuel capacity or increase embarked air wing tanking assets. Significant deficiencies in the operational suitability of the F/A-18C were noted in documentation and human factors. Maintenance publications were inadequate, particularly for the fuel system, electrical system, and environmental control system. This inadequacy resulted in extended maintenance times. The integrated fuel and engine indicator (IFEI) was difficult to read. It did not permit the monitoring of all fuel settings simultaneously, and it was difficult to use. Therefore, the F/A-18C with the 87X OFP is assessed to be operationally effective and potentially operationally suitable.

SUMMARY

Continued updates of the OFP are planned. They will correct deficiencies and accommodate improved capabilities and upgrades to the F/A-18. OT&E of the F/A-18 weapons system integration (e.g., ASPJ and AMRAAM) is scheduled for March 1989 in conjunction with 89X OFP testing.

FFG-7 GUIDED MISSILE FRIGATE



SYSTEM DESCRIPTION

The mission of the FFG-7 class guided missile frigate is to provide self-defense and supplement planned and existing escorts effectively in the protection of underway replenishment groups, amphibious forces, and military shipping against subsurface, air and surface threats. The original (FY75) combat system suite on this class is being upgraded on FY79 and later year ships to include the Light Airborne Multi-Purpose System (LAMPS) Mk III, a tactical towed array sonar (TACTAS) AN/SQR-19, Naval Tactical Data System (NTDS Link 11), and the integrated electronics warfare support measures (ESM) AN/SLQ-32(V)2. The FY75 combat system provides only short range antisubmarine warfare (ASW) capability and lacks full NTDS. The FY79 combat system provides both long-and short-range ASW sensor and weapon systems capability as well as full NTDS capability. The FY84 combat system improvement will provide enhanced anti-air warfare (AAW) capability.

BACKGROUND

The guided missile frigate (FFG) program entered the conceptual phase in January 1971. The ship system design was completed in April 1973. Contracts for detail design and construction of the lead ship were awarded to Bath Iron Works in 1973 and the lead ship of the class, USS *Oliver Hazard Perry* (FFG-7), was delivered to

the Navy in November 1977. The fifty-first and final ship was delivered to the Navy in November 1988. The final ship of this class, USS *Ingraham* (FFG-61), will be equipped with the FY84 combat system which will undergo FOT&E during FY91. (Four ships of the class with the FY75 combat system have been built for Australia.)

Operational Evaluation (OPEVAL) of the FFG-7 baseline combat system was conducted at the combat system test center (CSTC) Ronkonkoma, New York, in 1975. Follow-on operational test and evaluation (FOT&E) was conducted in 1977 at the CSTC and in 1980 on board USS *Oliver Hazard Perry*.

Additional operational testing of the FFG-7 combat system was not conducted until July 1987 when the first ship with the FY79 combat system, USS *Elrod* (FFG-55), became the test ship for FOT&E. Test results were not completely analyzed in time to be included in our FY87 Annual Report and are reported here.

OT&E ISSUES

The principal issues addressed in the FOT&E of the FY79 combat system were: (1) the capability of the system to provide self-protection and protection of underway replenishment groups, amphibious forces, and military shipping against submarine, air, and surface threats in single and multi-threat environments; (2) the capability of the system's command, control, and communications subsystems to fully sustain the assigned mission areas in independent and coordinated operations; and (3) the capability of the system's electronic warfare subsystem to support the ship's ability to carry out its mission.

OT&E ACTIVITY

As reported in the FY87 annual report, FOT&E of the FFG-7 FY79 combat system was conducted onboard USS *Elrod* (FFG-55) during July-August 1987 (analysis of results was not complete when our FY87 Annual Report was published). Testing was conducted in the Atlantic Fleet Weapons Training Facility (Puerto Rico) area, in the Jacksonville, Florida, operating area and in the Western Atlantic operating area during July. This was supplemented by observations by the COMOPTEVFOR operational test director during *Elrod's* participation in a fleet exercise in August (Phase 3). A DOT&E staff member observed the entire phase of testing conducted in the Puerto Rico operating area. This was the only phase during which live ordnance was fired; simulated attacks were also conducted by manned aircraft.

The Phase 1 period tested the combat system in the AAW, ASUW, and ASW warfare areas. During this phase, *Elrod* simulated firing ordnance at the targets. AAW testing included simulated attacks on *Elrod* by manned aircraft, during which *Elrod* attempted to detect, establish fire control radar tracking with the Mk 92 fire control system, and simulate missile or gun system firing against the aircraft. Phase 1 ASW and ASUW testing utilized a fleet submarine as the "target," with ASW surveillance assistance provided by a P-3C aircraft deploying and monitoring sonobuoys.

Phase 2 testing was conducted in the Puerto Rican operating area and included operational testing in the areas of AAW, ASW, and ASUW. Target drones were presented to be engaged by Standard mis-

siles during AAW testing, and manned aircraft conducted simulated attacks against *Elrod* in some cases. In these latter instances, *Elrod* was to detect, track,, establish fire control solutions and simulate missile launch. In some cases, the testing included multiple warfare areas: simultaneous AAW and ASW. Mk 46 exercise torpedoes were launched at ASW targets.

Limitations to testing included the differences between available targets and actual threats, with the former presenting considerably less stringent environments than expected with the latter. The SQS-56 sonar was operated in degraded mode. Actual simultaneous engagements in all three warfare areas (AAW/ASUW/ASW) were not achieved. All surface-to-surface missile engagements were simulated.

OT&E ASSESSMENT

As a result of the FY87 operational testing the FFG-7 FY79 Combat System is considered marginally operationally effective in ASW and marginally operationally effective in command, control, and communications capability in single-mission warfare areas. The FFG-7 FY79 Combat System is considered potentially operationally suitable.

FIXED DISTRIBUTED SYSTEM (FDS)



SYSTEM DESCRIPTION

The Fixed Distributed System (FDS) will be an Anti-Submarine Warfare (ASW) surveillance system using clusters of hydrophones distributed on the ocean floor to gather acoustic data.

BACKGROUND

A FDS test bed which uses current surveillance hardware was installed in an ocean area to validate the FDS concept. The program has been in the demonstration and validation phase and is approaching a Milestone II decision (approval for full-scale development, including authorization to acquire an engineering development model) in 1989. This very early operational test and evaluation was conducted to test the FDS concept and provide the Defense Acquisition Board (DAB) more information for its deliberations at that decision point.

OT&E ISSUES

The major OT&E issue addressed during the FY88 testing was assessment of the capability of the FDS concept utilizing demonstration/validation phase test bed hardware and software.

OT&E ACTIVITY

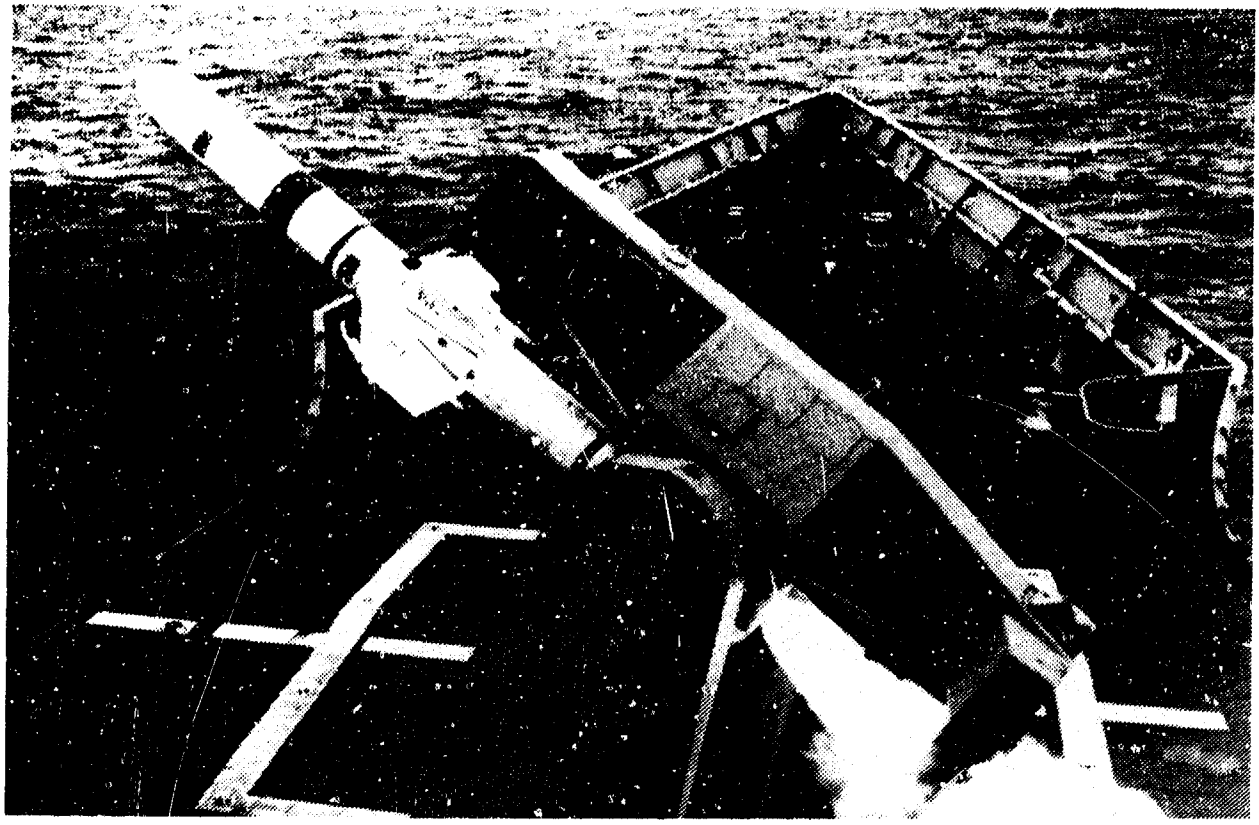
Commander, Operational Test and Evaluation Force (COMOPTEVFOR) conducted initial operational test and evaluation (IOT&E) during mid-September 1988, using the FDS test bed to assess the operational issue as described above. Because

this program is at such an early point in the acquisition cycle, there are no schools in place to train operators in the use of its unique equipment. Consequently, contractor representatives who are still modifying the software instructed operators during the testing. A DOT&E staff member observed the testing from the shore-based test bed facility.

SUMMARY

Test limitations resulted primarily from the immaturity of the FDS test bed. Although these limitations will have some impact on resolution of critical operational issues, this was an opportunity to operationally test the FDS concept. Results of this testing are being analyzed and will be reported in the DOT&E FY89 Annual Report.

HARPOON WEAPON SYSTEM



SYSTEM DESCRIPTION

The Harpoon weapon system is an antiship weapon system designed for employment from air, surface, and submarine launch platforms. The surface-and submarine-launched missiles utilize a booster to attain flight speed. All missiles use a turbojet sustainer engine to maintain speed and cruise altitude to maximum range. An active radar seeker provides target acquisition and terminal homing. The Block 1C variant of Harpoon has increased tactical flexibility.

Each launch plattorm has a unique combat system, which provides engagement planning, missile initialization, and launch control of Harpoon. These platforms also have unique launchers for Harpoon.

BACKGROUND

The Harpoon initial operational evaluations were conducted from 1975 to 1977 on an FF-1052 class ship, P-3 aircraft, and an SSN-594 class submarine. Harpoon was evaluated as operationally effective but not operationally suitable due to failure to meet reliability thresholds. After production process improvements and follow-on OT&E, Harpoon was approved for full production in 1981. Additional FOT&E was conducted between 1977 and 1981 to evaluate the canister launcher, Harpoon Block 1 missile seeker improvements, a sea-skim trajectory improvement

developed by the United Kingdom and the Harpoon weapon system installed on A-6E aircraft.

In 1983 the Harpoon Block 1C missile was operationally tested on various launch platforms. Tests determined that the missile was potentially operationally effective and suitable. In 1985 the Block 1C missile and AN/SWG-1A(V) Harpoon Ship Command and Launch Control Set (HSCLCS) were operationally tested from a destroyer and determined to be potentially operationally effective and suitable. As we reported last year, 1987 operational testing included an evaluation of the Tartar/ASROC variant Harpoon Block 1C missile and the AN/SWG-1A(V) HSCLCS. Both the Block 1C missile and the AN/SWG-1A(V) HSCLCS were determined to be potentially operationally effective and suitable. The Block 1C missile seeker was also operationally tested during 1987. It was determined to be potentially operationally effective and suitable.

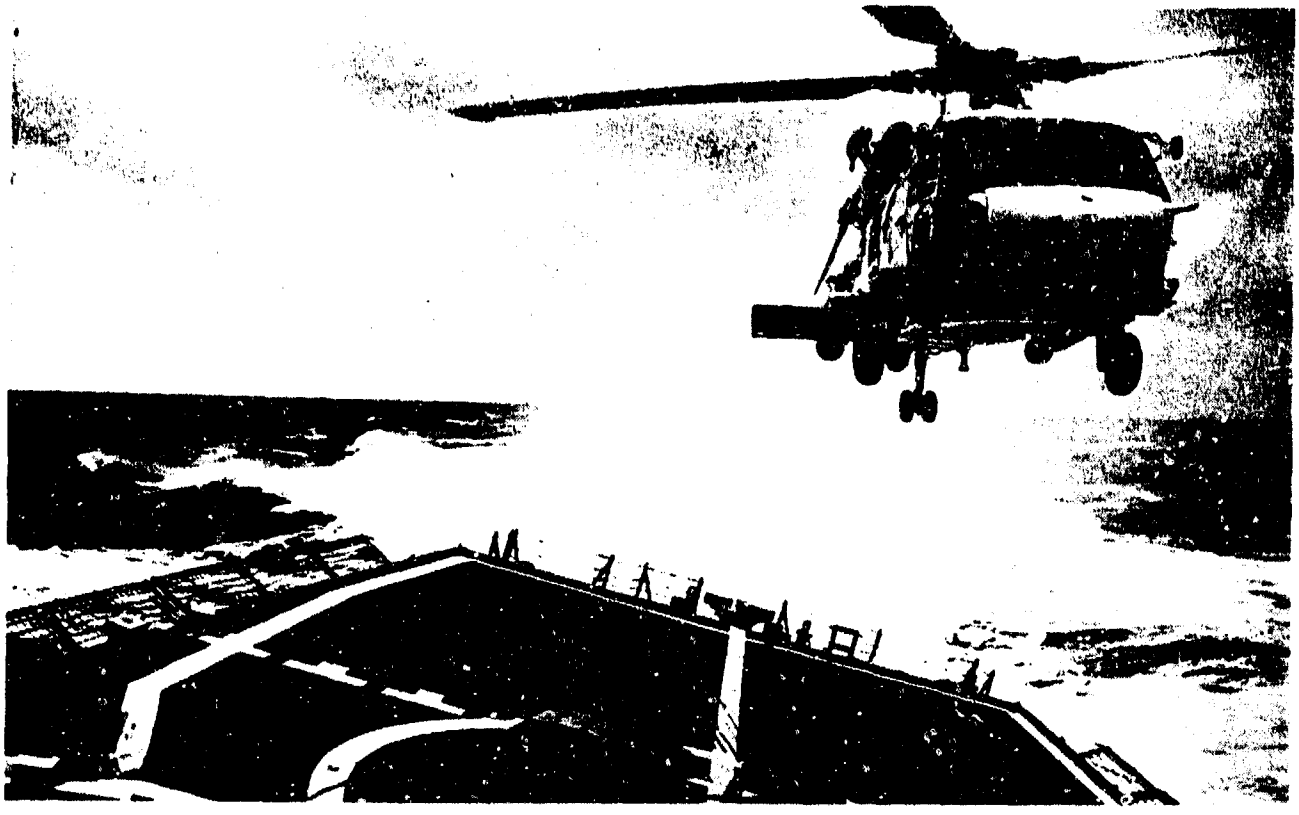
OT&E ISSUES

OT&E issues investigated during FY88 operational testing included operational testing included operational effectiveness and suitability of the AN/SWG-1A(V) HSCLCS canister variant with the graphic display processor and data processing computer software. Specifically, the FY88 testing focused on the capability of the HSCLCS and operator to prepare missiles for flight. Suitability issues included logistic supportability, interoperability, human factors, safety, and both availability and adequacy of tactics for HSCLCS employment.

OT&E ACTIVITY

FY88 operational testing was conducted January–August 1988 with two different DDG-993 class destroyers, USS *Callaghan* and USS *Chandler*, in the southern California operating area. Testing consisted of simulated firings of Harpoon missiles. Results of this testing are being analyzed and will be reported in the FY89 DOT&E Annual Report.

LIGHT AIRBORNE MULTI-PURPOSE SYSTEM (LAMPS) MK III



SYSTEM DESCRIPTION

The Light Airborne Multi-Purpose System (LAMPS) Mk III is a computer integrated ship/helicopter system designed to increase the effectiveness of surface combatants. It uses the SH-60B SEAHAWK helicopter which carries sonobuoys, torpedoes, acoustic processors, and Magnetic Anomaly Detection (MAD) equipment for its antisubmarine warfare (ASW) mission. Its radar and electronic support measures (ECM) equipment are used in its other primary mission, antiship surveillance and targeting (ASST). The various classes of ships which employ LAMPS Mk III (DD-963, DDG-993, FFG-7, CG-47) provide additional sensor processing, command and control, landing and traversing systems, and maintenance and support facilities, as well as integrate LAMPS information with other sensor data. LAMPS Mk III secondary missions include search and rescue, medical evacuation, vertical replenishment, communications relay, logistics support, and naval gunfire support.

BACKGROUND

The LAMPS Program was initiated in 1969 based on a CNO requirement for a manned helicopter to operate from destroyer-class ships to enhance their ASW and ASST capabilities. The LAMPS Mk I was the initial result of this requirement,

with the LAMPS Mk III being the follow-on version.

The LAMPS Mk III validation phase was completed in December 1976 and the first flight of the SH-60B was conducted in December 1979. A full-scale development model was used for OT&E (OPEVAL) in the stand-alone mode aboard USS *McInerney* (FFG-8) from May 1981 through February 1982. The LAMPS Mk III was determined to be potentially operationally effective and potentially operationally suitable. Provisional approval for service use was granted in September 1981, and the first production aircraft was delivered in September 1983. Follow-on operational test and evaluation (FOT&E) (OT- IIIA/B) resulted in the Navy's independent operational test agent, Commander, Operational Test and Evaluation Force (COMOPTEVFOR) concluding that the LAMPS Mk III was potentially operationally effective and operationally suitable, and recommending limited fleet introduction. Open-ocean ASW effectiveness could not be determined due to cancellation of this phase of testing.

In July and August 1987, FOT&E (OT-IIIC) was conducted to evaluate open-ocean ASW effectiveness and other outstanding OT&E issues as well as verify correction of deficiencies noted in earlier operational tests. The testing was conducted onboard USS *Elrod* (FFG-55) at instrumented ASW and electronic warfare (EW) ranges, as well as during a fleet exercise. COMOPTEVFOR concluded that the LAMPS Mk III weapon system was operationally effective and operationally suitable, and recommended full fleet introduction upon correction of automatic bladefold system deficiencies.

FOT&E (OT-IIID) on a production LAMPS Mk III using Fleet Issue (FI) software 1.18.1 was conducted from shore based facilities and USS *Halyburton* (FFG-40) in FY 88. FI 1.18.1 is an interim software release designed to fulfill the need for ESM helicopter threat warning (HTW). HTW incorporates new automatic airborne ESM threat processing and an enhanced display of identified threat emitters.

Operational effectiveness issues examined in OT-IIID included: ASW redetection, classification, localization and attack capability; ASST capability; and survivability. The operational suitability issues addressed included: reliability, maintainability, availability, logistics supportability, human factors, and interoperability.

OT&E ASSESSMENT

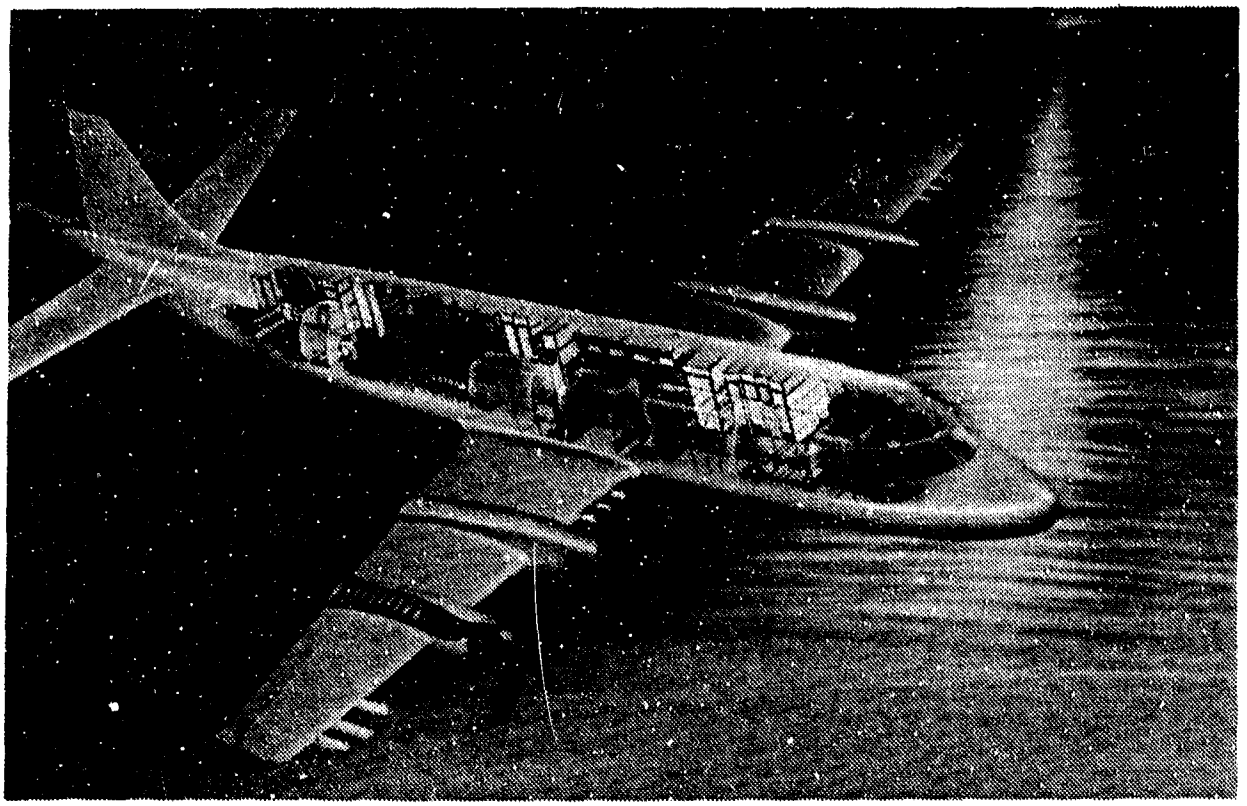
OT-IIID was conducted in two phases. The first phase was conducted in December 1987 from *Haylburton* during a fleet exercise to assess the ASW effectiveness and suitability issues. The second phase of testing was conducted from January to February 1988, using the Chesapeake Test Range (CTR) to assess ASST effectiveness. The testing was limited in that the equipment on USS *Haylburton* (FFG-7 class) is not the same as that on the other ship classes, and therefore, an assessment of the FI 1.18.1 capabilities when integrated with CG-47, DD-963, and DD-993 class ships could not be made. FI 1.18.1 performance appeared to be directly related to the type and number of computer functions selected simultaneously. Processing degradation was most apparent in the multi-mission scenario. System faults and software system slowdowns affected the relevance of tactical data available to the operator, impacting mission success. The Navy's independent operational test agent, Commander, Operational Test and Evaluation Force (COMOPTEVFOR), concluded that the LAMPS Mk III weapon system using FI 1.18.1 was potentially operationally effective and potentially operationally suitable. COMOPTEVFOR recommended that fleet use of 1.18.1 software be withheld until the computer

faults, software system slowdowns, and display degradation problems are corrected.

SUMMARY

The interim FI 1.18.1 software release for the LAMPS Mk III is potentially operationally effective and potentially operational suitable. A non-interim software release, FI 1.19.1, is in development and will be evaluated in future FOT&E.

LONG-RANGE AIR ASW CAPABILITY AIRCRAFT (LRAACA)



SYSTEM DESCRIPTION

The LRAACA represents the new aircraft with the capability to meet the ASW threat of the 1990s and beyond. Its exterior appearance resembles the P-3 maritime patrol aircraft, but the airframe will use new alloys and composites to provide corrosion resistance. More fuel-efficient turboprop engines will be used. It will utilize fly-by-wire control and engine control-by-wire and it will have higher capacity environmental control and electrical power capability. In terms of payload, the LRAACA will have the capability to carry more torpedoes, more air-to-surface missiles, and more sonobuoys. The combat radius will be increased while maintaining on-station capability. The avionics suite for processing acoustic, radar, and ESM sensor data will be the Update IV, which is already in full-scale development (FSD) for the P-3C aircraft.

BACKGROUND

A draft request for proposal (RFP) was released in early 1987 for a follow-on to the P-3C. This aircraft was designated the P-3G. It was determined that there was insufficient interest within industry for competitive procurement of a P-3 derivative. In May 1987, the Navy conducted a LRAACA mission requirements determination study. A draft RFP was released and industry comments were solicited on the operational potential of a commercial derivative aircraft to perform the LRAACA mission. Industry proposals

were received in early 1988 and source selection was completed in October 1988 when the P-3C contractor was announced as winner of the LRAACA competition. This competition was for the airframe. The intended avionics suite is in FSD with a different contractor who will receive the LRAACA airframes as government furnished equipment (GFE) and will have installation and system integration responsibility.

OT&E ISSUES

One of our initiatives has been to conduct operational assessments earlier in the acquisition cycle, while there is still sufficient program flexibility to correct projected deficiencies identified in the assessment. COMOPTEVFOR, the Navy's operational test agency, conducted an Early Operational Assessment (EOA) for this program. EOA objectives were to assess the operational concept of LRAACA and to project both the potential operational effectiveness and potential operational suitability.

OT&E ACTIVITY

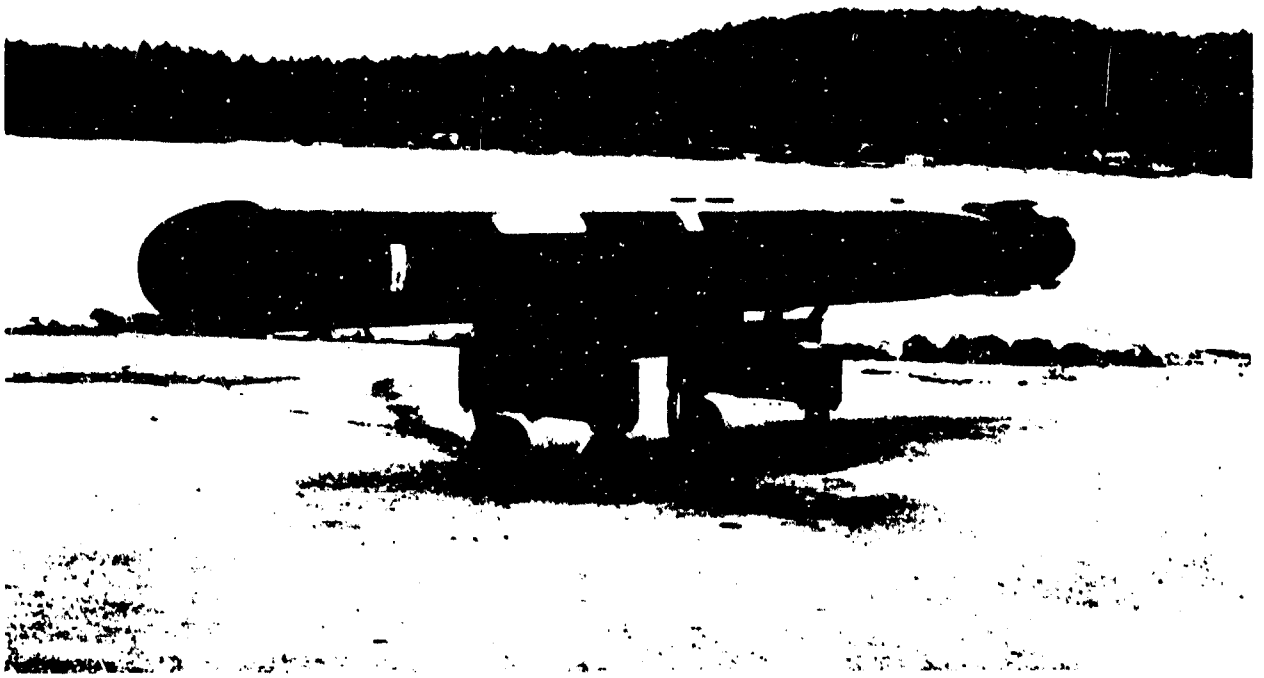
A team of Navy personnel with P-3C operational experience conducted the EOA through FY88. Since there were no test results to examine, the team used LRAACA program documentation such as the RFP, the Operational Requirement, the Decision Coordinating Paper, and the Update IV avionics specifications. Because this was an examination of program documentation by a group of experts in the area of maritime patrol aircraft operations and requirements, the EOA projections are qualitative in nature and represent expert opinion instead of hard facts.

OT&E ASSESSMENT

With regard to assessment of the operational concept and projection of potential operational effectiveness, the EOA considered the areas of mission profiles; ASW detection, classification, localization, tracking, attack; surface threat targeting and attack; combined arms; mining capability; search and rescue; communications; and deployed operations. With the qualification that these are expert opinions, potential operational effectiveness in each of these areas was projected as satisfactory. Areas considered in projection of potential operational suitability included reliability; maintainability; availability; logistic supportability; compatibility; interoperability; training; human factors; safety; documentation; reaction time; and growth potential. Compatibility, interoperability, human factors, reaction time, and growth potential were projected as potentially satisfactory. The other areas were unresolved due to limitations of scope stemming from the degree of program maturity and unavailability of documentation at this early stage.

DOT&E considers this EOA to have been highly beneficial to the LRAACA program and an excellent example for future programs. The LRAACA EOA identified areas requiring attention before the program entered FSD. Other benefits of this EOA were identification of documentation shortfalls and early identification of the need for more realistic T&E resources.

MK 48 ADVANCED CAPABILITY (ADCAP) TORPEDO



SYSTEM DESCRIPTION

The Mk 48 advanced capability (ADCAP) torpedo is a submarine-launched antisubmarine warfare (ASW) and antisurface warfare (ASUW) wire-guided and acoustic (both active and passive) homing torpedo. It is an upgrade to the existing Mk 48 heavyweight torpedo. It replaces the guidance and control system with an all-digital, computer-based system; upgrades propulsion for increased speed and depth; and improves the warhead sensor for ASUW. The Mk 48 ADCAP should provide significantly improved tactical flexibility through greater endurance; shorter preset, warm-up and reactivation times; improved salvo operation; and shorter minimum effective launch ranges than the Mk 48 torpedo it will replace.

BACKGROUND

The Mk 48 was developed to maintain weapon effectiveness against surface ships and counter advances in threat submarine capabilities. The program entered the demonstration and validation phase in FY79 and full-scale development in FY82. In FY84, early operational test and evaluation (OT-I) was conducted concurrently with development testing on an advanced development model torpedo. The OT&E supported initial procurement of long-lead materials, tooling, and test equipment. Results of an operational assessment in FY85 supported funding for fabrication of the initial pilot production torpedoes.

Both the FY84 and FY85 operational test/assessment reports made recommendations to enhance weapon performance. In January 1985, the DOT&E designated the Mk-48 ADCAP as a DOT&E oversight program.

In FY87 a second phase of operational test and evaluation (OT-IIA) was conducted to support a decision to commence low-rate initial production (LRIP). The final phase of initial operational test and evaluation (OT-IIB) was conducted from December 1987 through May 1988. Both the OT-IIA and OT-IIB test plans were approved by DOT&E. A surface target sinking exercise (SINKEX) was also conducted off the Virginia Capes in July 1988

OT&E ISSUES

Operational testing during FY88 examined the operational effectiveness and suitability of the Mk 48 ADCAP in attacking submarines and surface ships. The principal OT&E issues addressed were the ability of the torpedo to attack maneuvering and non-maneuvering targets and a full range of operational suitability issues. These issues are detailed in the DOT&E approved Test and Evaluation Master Plan (TEMP).

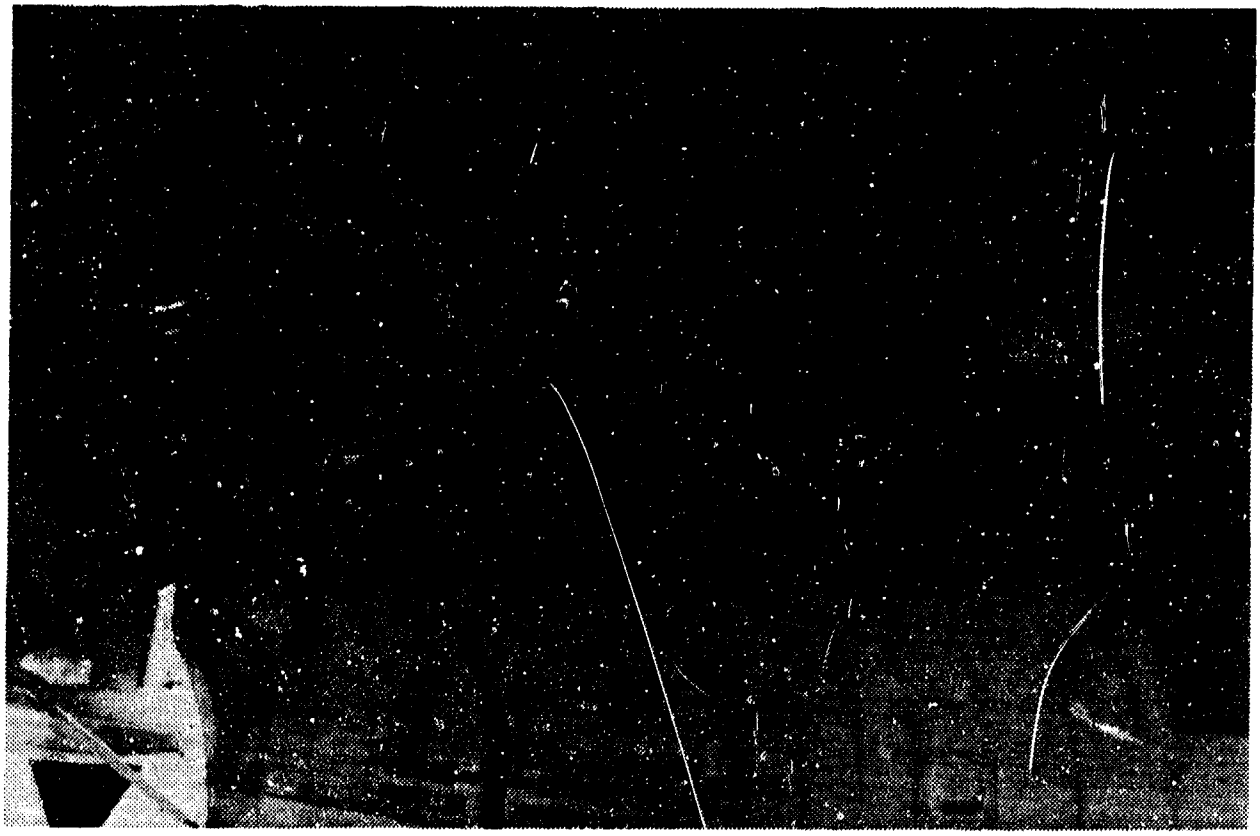
OT&E ASSESSMENT

The details of the OT&E assessment are classified and are provided in the DOT&E Beyond-LRIP Report to Congress and the Secretary of Defense dated December 8, 1988.

OT&E SUMMARY

It is our view that the Mk 48 ADCAP has demonstrated a significant improvement in operational effectiveness over the in-service Mk 48. The classified details of its operational effectiveness are contained in the DOT&E Beyond-LRIP Report to Congress and the Secretary of Defense (December 8, 1988). The Mk 48 ADCAP weapon system is potentially operationally suitable with improvements required in two areas.

MK 50 TORPEDO



SYSTEM DESCRIPTION

The Mk 50 Torpedo is being developed as the next generation lightweight antisubmarine warfare (ASW) torpedo to counter the projected submarine threats of the late 1980s to the year 2000. It will replace the Mk 46 Mod 5 as the U.S. Navy's primary conventional ASW weapon for aircraft and surface ships. An exercise version is being developed in which the warhead is replaced with a data recorder and buoyant recovery system to provide for exercise in-water runs. The Mk 50 system includes the torpedo, ancillary support equipment, workshop test and handling equipment, and logistics support facilities.

The Mk 50 Torpedo warshot and exercise versions shall be capable of being deployed from land-based patrol (VP) aircraft (P-3), ASW carrier-based (VS) aircraft (S-3), ASW helicopters (SH-2, SH-3, SH-60), ASW surface vessel torpedo tubes (SVTT), and the new ASW Standoff Weapon (SEA LANCE).

BACKGROUND

The Mk 50 Program started with a technical assessment phase in 1975, which re-

viewed various designs from industry of the next generation lightweight torpedo.

Advanced Development commenced in July 1979, with two competitive designs. Honeywell and McDonnell Douglas were awarded contracts to develop and test prototype models. In January 1981, the competition was terminated due to cost growth and excessive technical risk in the McDonnell Douglas design. The program was restructured to form a Navy-industry team composed of Honeywell, Garrett (propulsion subcontractor), the Naval Ocean Systems Center, and the Applied Research Laboratory, Pennsylvania State University. The Demonstration and Validation phase was successfully completed in July 1983.

In January 1984, the program began the Full Scale Development (FSD) phase. Early FSD testing included laboratory and field testing of various components, warhead lethality tests, and the fabrication of the first fleet prototype. Reductions in the FY86 budget necessitated a replanning of the Mk 50 Engineering Qualification Trials (EQT) to reflect a reduction in RDT&E expenditures.

The first phase (OT-IIA) of Initial Operational Test and Evaluation (IOT&E) commenced in September 1986, but was terminated by the program office due to restructuring of the FSD program. The previous decision to reduce RDT&E torpedo quantities was reversed, and the FSD was extended with adequate numbers of torpedoes programmed to support a viable development plan.

OT&E ISSUES

The primary operational effectiveness issues addressed during the FY88 OT&E included: the ability of the torpedo to attack maneuvering and non-maneuvering submarines; the ability of the torpedo to operate in shallow water; and the ability of the torpedo to operate in a countermeasure environment. The suitability issues to be addressed included: reliability, compatibility, safety and logistic supportability. Another issue was the suitability of mobile artificial targets for use in future OT&E. This office has been working with the Navy to clearly define and improve the test resources (targets and countermeasures) that will be used in the final phase of IOT&E (OPEVAL).

OT&E ASSESSMENT

OT-IIA restarted on August 26, 1988, and was completed on November 26, 1988. The test plan for OT-IIA was approved by DOT&E. To date, the data from 18 of the 20 torpedo launches has been analyzed. Testing was conducted at the Nanoose Underwater Tracking Range near Nanaimo, British Columbia, Canada; the Quinault Underwater Tracking Range, off the coast of Washington; and the Barking Sands Tactical Underwater Range, Kauai, Hawaii. The torpedoes were launched from P-3, S-3, SH-2, and SH-3 aircraft. The surface platforms used to launch the torpedoes were FF 1052 and FFG 7 class ships as well as a range craft. The targets consisted of Mk 30 and Mk 40 mobile artificial targets and SSN 688 class submarines.

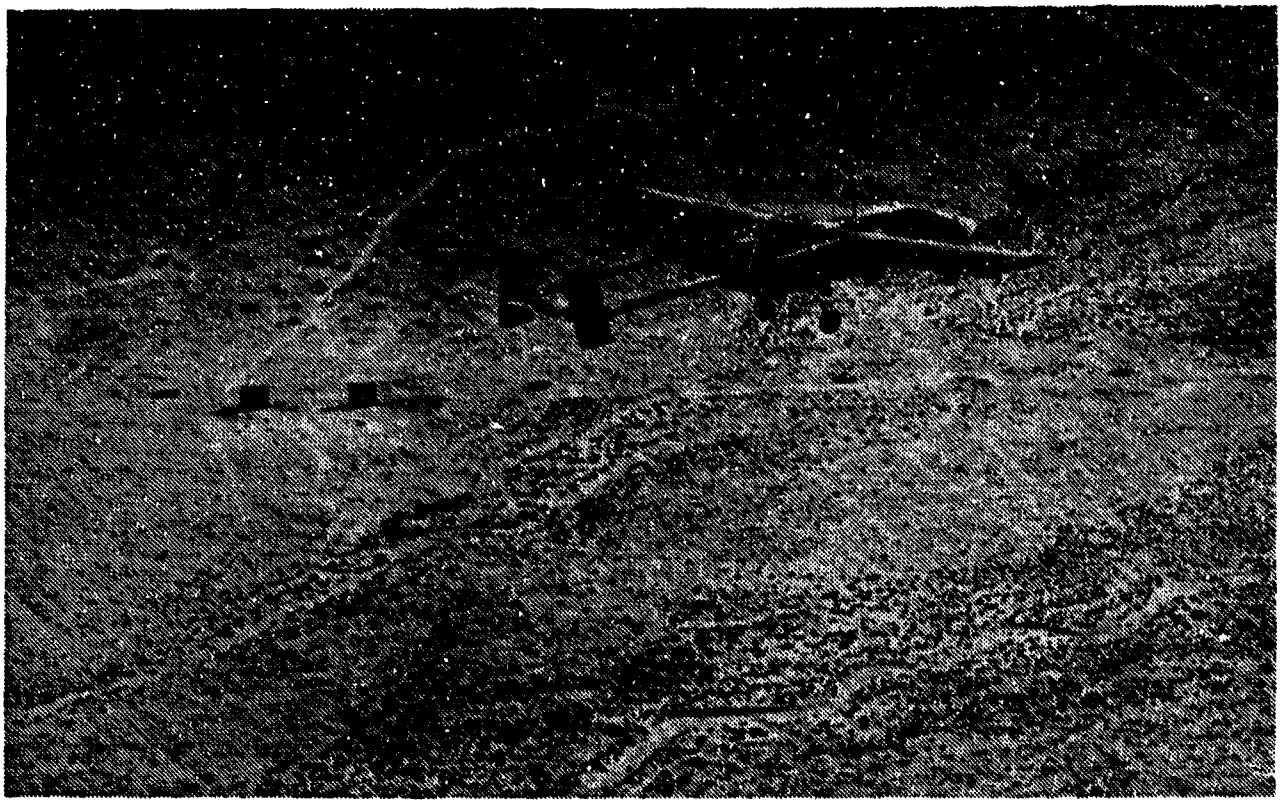
Although the analysis of the final two launches is not complete, it is evident that they will not affect the overall conclusions of this OT&E. The Navy's independent operational test agent, Commander, Operational Test and Evaluation Force (COMOPTEVFOR), concluded that the Mk 50 torpedo has the potential to be operationally effective and the potential to be operationally suitable, and indicated that the testing supported a recommendation for limited production. COMOPTEVFOR recommended the correction of several

deficiencies before OPEVAL, scheduled for FY90.

SUMMARY

Within the constraints of the test limitations, the FY88 OT&E of the Mk 50 torpedo indicates that it is potentially operationally effective and potentially operationally suitable.

PIONEER REMOTELY PILOTED VEHICLE (RPV)



SYSTEM DESCRIPTION

The Pioneer short-range remotely piloted vehicle (SR-RPV) is a cued surveillance system. Its mission is to provide day or night real-time reconnaissance, battlefield surveillance, target acquisition, artillery/gun support, and battle damage assessment (BDA). The Pioneer system was originally designed to operate from a fixed base using a runway or pneumatic launcher for takeoff and a runway for landing. An added capability to operate from selected ships was developed.

The Pioneer system consists of five to eight air vehicles (AVs), one ground control station (GCS), one remote tracking control unit (TCU), one portable control station (PCS), two remote receiving stations (RRS), launch and recovery equipment, and ancillary transport and maintenance equipment. The shipboard-peculiar items are the rocket assisted take-off (RATO) launch system and a net recovery system. The unmanned AV carries a mission payload and is operated by direct control or through a preprogrammed mission mode. Direct control of the mission payload/AV is by an operator in the GCS or via the PCS through a combination of UHF radio and C-Band data link transmissions. The mission payloads which the AV can carry are the MKD-200 daylight electro-optic (EO) low-light-level TV camera or the MKD-400 infrared (IR) night capable camera. A VHF/FM radio

relay mission payload is under development.

BACKGROUND

In a July 8, 1985, decision memo, the Secretary of the Navy directed the procurement of unmanned aerial vehicle (UAV) systems as soon as possible, using proven RPV systems in order to provide a minimum essential operational capability. This procurement was intended to correct shortfalls in reconnaissance capabilities experienced during the Granada, Lebanon, and Libyan operations. In April 1986, the Secretary of the Navy initiated the RPV "Quick Go" program. Its purpose was to accelerate the use of RPV systems aboard amphibious and surface combatants other than aircraft carriers. The overall plan for "Quick Go" involved Navy and Marine Corps units. The Pioneer system was first installed aboard USS *Iowa* (BB-61) in August 1986. Initial Pioneer operations from the *Iowa* were successfully accomplished in December 1986. During a proof of concept mini-cruise aboard *Iowa* in January-February 1987, problems were experienced. The lessons learned were incorporated into an integrated action plan to correct these and previously identified deficiencies. Operational assessment and tactical employment of the Pioneer with Navy and Marine Corps units continues.

OT&E ISSUES

The critical operational issues that have been identified in draft documents are mission performance, targeting, naval gun fire spotting (NGFS), Marine Corps artillery adjustment, survivability, reliability, maintainability, availability, logistic supportability, compatibility, training, safety, human factors, and documentation. The Pioneer SR-RPV does not have an OSD-approved Test and Evaluation Master Plan (TEMP).

OT&E ACTIVITY

To date, dedicated operational testing of the Pioneer has not been conducted. However, the Navy and Marine Corps have deployed the Pioneer operationally. In FY88, both Services conducted separate operational assessments of the Pioneer.

The Navy operational assessment was conducted on the shipboard version of the Pioneer system onboard the *Iowa* from September 29 to October 6, 1987, in the Mediterranean during the NATO exercise Display Determination. Participation of the Pioneer was very limited. Four day and/or night operational flights were flown employing either the TV or IR cameras in the reconnaissance, surface, and subsurface control (SSC), NGFS, and BDA mission areas. Because of the limited nature of this evaluation, only observations and recommendations were made by the Navy's operational test agency, OPTEVFOR.

The Marine Corps operational assessment was conducted at Marine Corps Base, Camp Lejeune, North Carolina, from September 28 to October 9, 1987, during the Second Marine Division's command post exercise Excellent Sword and an artillery firing exercise. Surveillance and reconnaissance missions were flown using either the TV camera or IR camera payloads. Assessments were made of the capability of the Pioneer system to perform the reconnaissance, battlefield surveillance/target acquisition, gunfire spotting/adjusting, and BDA missions. Operations involved 14 flights, five of which were launched at night. All flights were recovered during daylight due to poor AV external lighting. A member of the DOT&E staff observed the operational employment of the Pioneer system by the 2nd RPV Company during this exercise

and flew the AV and controlled the payload during part of one mission.

The following assessments were made by the Marine Corps Operational Test and Evaluation Activity (MCOTEA):

o The Pioneer system can locate and identify a target when cued to the general target location if the target is not heavily camouflaged or obscured.

o The Pioneer system did not demonstrate the ability to spot and adjust gunfire. The system was marginally effective in providing BDA.

o The AV can be detected visually and aurally when flown at its normal operating altitudes.

o The technical maintenance publications are not comprehensive and were difficult to understand. The Pioneer system integrated logistics support plan is not fully mature.

o The Pioneer system training package is insufficient.

o The Pioneer system demonstrated mobility/transportability but with some deficiencies.

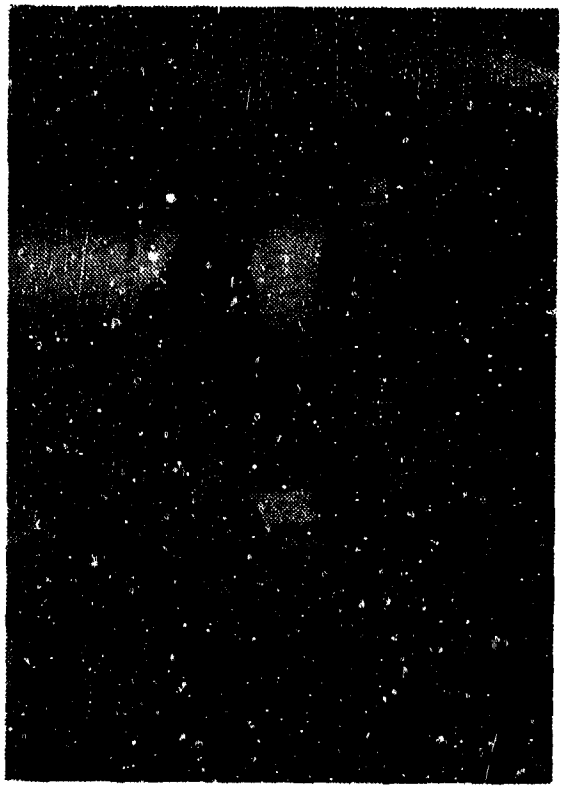
o There were various human factors design weaknesses found. The most significant was the fact that the S-250 shelter is not large enough to house the GCS components and crew adequately.

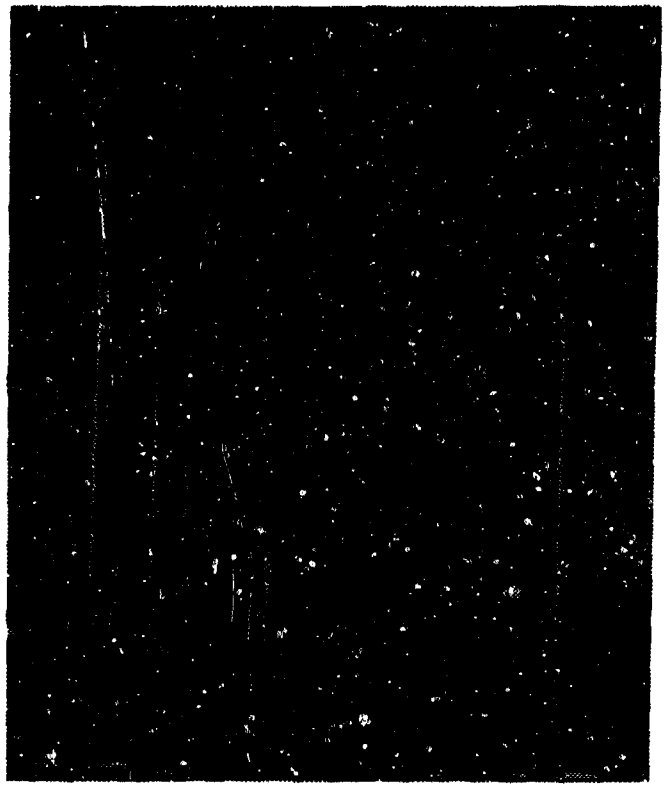
o There are several serious safety related conditions associated with the Pioneer system.

Recommendations were made by MCOTEA to modify the Pioneer system significantly to reduce or eliminate safety hazards, improve mission payload preflight checks, eliminate the AV aural signature, allow for night recovery operations, improve the GCS, and permit AV flight in certain rain conditions.

Operational testing of the Pioneer by both the Navy and Marine Corps is currently planned to begin in April 1989. This schedule is in part dependent upon receipt and approval of a TEMP and an Operational Test Plan by DOT&E.

RELOCATABLE OVER-THE-HORIZON RADAR (ROTH-R)





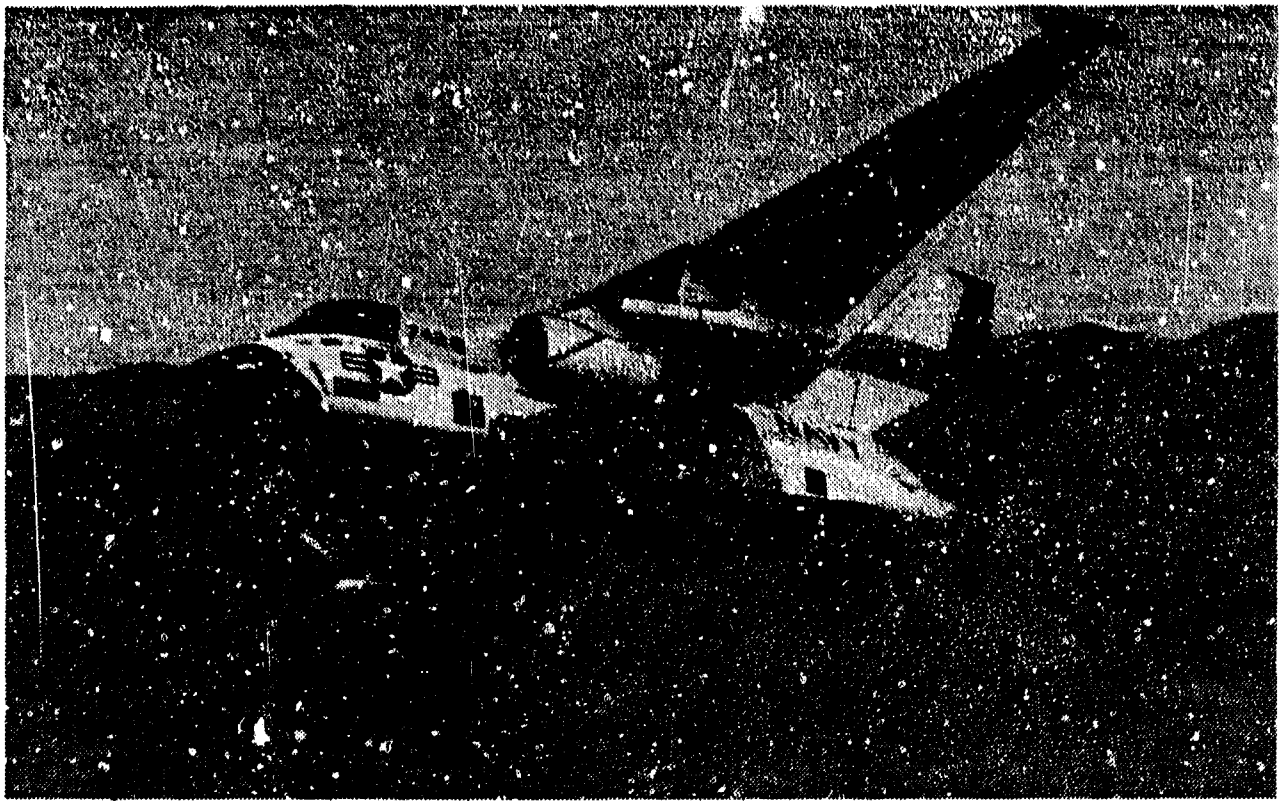
SYSTEM DESCRIPTION

The relocatable over-the-horizon radar (ROTH-R) provides long-range detection, tracking, and correlation of airborne targets. The system consists of separate transmit and receive antennas and a control system. The control system is relocatable, but the antennas require a surveyed location and are not considered relocatable.

OT&E ASSESSMENT

Operational tests are scheduled for 1989. No operational assessment has been made but developmental tests indicate potential effectiveness.

S-3 WEAPON SYSTEM IMPROVEMENT PROGRAM (WSIP)



SYSTEM DESCRIPTION

The S-3A WSIP is designed to upgrade the carrier-based S-3 weapon system to better perform the sea control mission against more capable threats. The new system, designated S-3B, includes a new acoustic processor, a 99-channel sonobouy receiver, and a new acoustic tape recorder for improved anti-submarine warfare (ASW) capability in the outer ASW zone. The radar system was redesigned to provide an inverse synthetic aperature radar (ISAR) capability which allows the classification of surface ships. The electronic support measures (ESM) system was modified to increase its ability to detect and classify threat emitters. These improvements provide a more capable surface, subsurface, and surveillance coordination (SSSC) capability which, when combined with the HARPOON missile added as part of the WSIP, provides the S-3B with stand-off surface attack capability. The S-3B was also provided with a defensive capability through the addition of electronic countermeasures (ECM) dispensers for chaff, flares, and jammers. The future command and control capability of the S-3B will be further enhanced through the WSIP space and weight reservation for the global positioning system (GPS) and joint tactical information distribution system (JTIDS).

BACKGROUND

Initial operational test and evaluation (IOT&E) of the S-3B was conducted in

two phases. During FY85, the S-3B underwent its first phase of operational testing (OT-IIA) to assess potential operational effectiveness and suitability. The Navy's independent operational test agent, Commander, Operational Test and Evaluation (COMOPTEVFOR), determined that this testing demonstrated that the S-3B had the potential to be operationally effective. With the exception of software, the S-3B was also determined to have the potential to be operationally suitable. COMOPTEVFOR'S findings supported a recommendation for limited production.

In FY86, the second phase of IOT&E (OT-IIB - OPEVAL) commenced using two full-scale engineering development (FSED) aircraft. The OPEVAL test plan was approved by DOT&E. The performance of several subsystems (radar, ECM, and HARPOON) was excellent. However, deficiencies in the system software and the maintainability of the aircraft rendered the S-3B system not sufficiently operationally suitable to support OPEVAL, and COMOPTEVFOR placed the S-3B in deficiency status in September 1986. As a result of the delay in OPEVAL and discussions with DOT&E, the Navy decided to restructure its procurement plan for the S-3B. It remained in low-rate initial production (LRIP) pending satisfactory completion of OPEVAL. Initially the Navy had intended to commence full production in FY87. Following extensive modifications to the system software and maintainability improvements, the OPEVAL was restarted in December 1987 and subsequently completed in March 1988.

OT&E ISSUES

Principal operational effectiveness issues addressed during the OPEVAL included: submarine detection, classification, localization and attack; HARPOON targeting and attack; and electronic support measures (ESM) capabilities The operational suitability issues addressed included: reliability, maintainability, interoperability, training, documentation and human factors.

OT&E ASSESSMENT

The details of our OT&E assessment are classified and were provided in the DOT&E Beyond-LRIP Report to Congress and the Secretary of Defense (June 13, 1988).

SUMMARY

The summary of the OT&E assessment is classified and was provided to Congress and the Secretary of Defense in the DOT&E Beyond-LRIP Report dated June 13, 1988. A continuing program of follow-on operational testing is required to verify correction of various deficiencies in effectiveness and suitability, and to resolve limitations to the scope of testing to date. However, the decision to proceed beyond low-rate initial production of the S-3B is considered low risk.

STANDARD MISSILE-2 BLOCK II (SM-2)



SYSTEM DESCRIPTION

The SM-2 Block II is a solid-propellant-fueled, tail-controlled, surface-to-air and surface-to-surface missile. It was designed to counter high-speed, high-altitude antiship missiles in an advanced electronic countermeasures (ECM) environment. There are four versions of this missile: three medium-range (MR) rounds (for the Aegis Mk 26 rail-launch system, the Aegis vertical launching system, and the Tartar rail-launch system) and one extended-range (ER) round (for the Terrier rail-launch system). SM-2 has the capability to engage targets through utilization of mid-course guidance with illumination of the target by the ship for missile homing during the terminal phase, or home-all-the-way guidance wherein the target is illuminated throughout the period of missile flight and the missile guides toward intercept, utilizing the reflected radar signal from the target (SM-1 guides only in home-all-the-way mode). Block II improvements include a new signal processor to provide less vulnerability to ECM, an improved fuze and focused-blast fragment warhead to provide better kill probability against smaller, harder targets, and new propulsion for higher velocities and maneuverability. Component commonality is maximized among the various SM-2 Block II versions.

BACKGROUND

The SM-2 Block II began development in 1976 and began production in 1982 (ER)

and 1983 (MR). Follow-on OT&E (FOT&E) was successfully conducted on the SM-2 Block II (ER) in FY85 and was followed by submission of the DOT&E's Beyond Low-Rate Initial Production Report to the Secretary of Defense and Congress. FOT&E of the MR version was conducted in FY86 with an Aegis cruiser, USS *Vincennes*, equipped with the Mk 26 rail launcher. These firings provided the basis for the FY87 procurement. The overall results of this FOT&E supported a recommendation by the Navy's Operational Test Agency to continue limited fleet introduction of the weapon. Full production approval for SM-2 Block II was granted in December 1986.

OT&E ISSUES

The major OT&E issues addressed during the FY88 testing included determination of missile effectiveness against various air targets. Other issues included determination of missile effectiveness when supported by the particular weapon/combat system involved (Terrier New Threat Upgrade (NTU) and Baseline 2 Aegis Weapon System), as well as assessment of missile survivability in an operational environment.

OT&E ACTIVITY

FY88 FOT&E consisted of testing both the ER version from a Terrier NTU ship and the MR Aegis version from an Aegis ship with vertical launch capability. A DOT&E staff member observed testing from the missile firing ship during the ER testing and during the MR testing. ER testing was conducted with USS *Biddle* with a production NTU Combat System, which is designed to counter the Soviet AS-4 and AS-6 antiship cruise missiles in an ECM environment. Eight SM-2 Block II ER missiles were fired in the Atlantic Fleet Weapons Training Facility Puerto Rican operating area during April and May 1988. MR testing was conducted with USS *Antietam* during April 1988. Twelve SM-2 Block II MR missiles were fired at the Pacific Missile Test Center range off the coast of southern California.

OT&E ASSESSMENT

SM-2 ER. Testing of the SM-2 Block II ER missile with the Terrier NTU system in the Puerto Rican operating area resulted in the presentation of 15 targets. Although security and safety considerations resulted in the briefing of the ship's commanding officer on threat sectors, target presentation times, and target geometries, he did not share that information with his crew.

SM-2 MR. Testing of the SM-2 Block II MR missile with the vertical launch-capable Aegis cruiser in the southern California operating area resulted in presentation of 12 targets. As in the case of the ER testing, the commanding officer was briefed on the intended scenarios, but did not share this information with his crew except for an instance where a target cruise missile was engaged. That scenario placed *Antietam* at a position offset about five miles from the target missile flight path. Since there was a potential that the missile could lock onto *Antietam* instead of its intended target boat, the commanding officer requested and was granted permission to share the scenario information with selected officers in his crew. In the judgment of DOT&E, this selected sharing of information which could affect ship/crew safety did not compromise the integrity of the operational testing nor did it bias results.

In conjunction with testing from *Antietam*, the throughput at the supporting Naval Weapons Station was examined in order to evaluate the success rate for missile tests conducted during missile assembly.

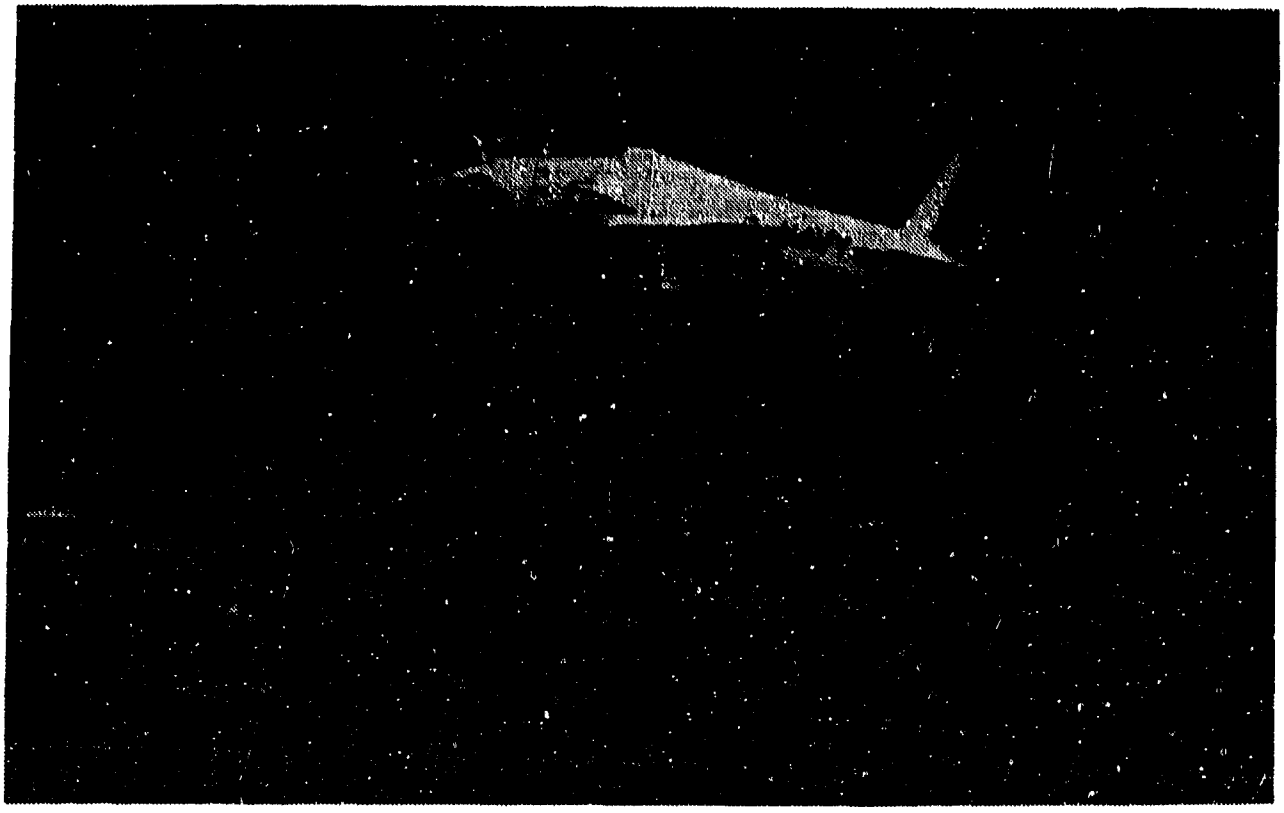
Both phases of testing (ER in the Puerto Rican operating area and MR in the southern California operating area) shared

similar limitations to testing. These included the use of various targets which approximate air threat characteristics to different degrees. Areas in which there are disparities between the actual threat and the targets include the approach speeds and altitudes, physical dimensions, and radar reflective characteristics. Other limitations to testing included those associated with safety and conduct of testing on instrumented test ranges. For example, as noted under preceding discussions, the commanding officers of both ships were briefed on the intended scenarios prior to the tests, but they did not share the information with their crews (except for the case of the target missile fired on by *Antietam*). Any other alertment of crew members, such as preparation of missiles, would have been no different than that experienced in a combat situation. The physical size of the test ranges generally results in the presentation of air targets in such a manner that missiles fired at them are toward the open ocean, thereby providing general knowledge to a ship's crew of the direction from which the simulated threats will approach. Moving the ships farther from land renders useless much of the instrumentation required for reconstruction of the operational testing, introduces more problems of communication, and reduces the available flight time of many of the air targets. Moreover, during the period preceding actual combat, crews usually know the general axis direction along which enemy air targets will approach.

SUMMARY

Based on results achieved, SM-2 Block II is considered operationally effective against most targets, taking into consideration the constraints imposed by test limitations. The SM-2 Block II (Aegis) missile, supported by the Baseline 2 Aegis weapon system, is considered potentially operationally suitable.

T-45 TRAINING SYSTEM



SYSTEM DESCRIPTION

The T-45 training system (T-45TS) is an integrated training system composed of five main subsystems: the aircraft, simulators, an academics package, the training integration system (TIS), and contractor logistics support. The T-45TS is intended to provide the Navy with modernized fixed wing intermediate and advanced undergraduate jet flight training, replacing the T-2B/C and TA-4J and their associated training systems.

The T-45A Goshawk is a tandem-seat, light-weight, carrier-capable, high-performance aircraft, powered by a single Rolls Royce F405-RR-400 turbofan engine. It incorporates an on-board oxygen generating system, a head up display (HUD), and a weapons delivery capability for training. The T-45A is a derivative of the existing British Aerospace (BAe) Hawk.

The simulator subsystem includes the 2F137 instrument flight trainer (IFT) and 2F138 operational flight trainer (OFT). The IFT is essentially an OFT without the visual cueing system. The OFT is a ground-based flight simulator equipped with a wide-angle visual system, a buffet-vibration motion cueing system, a dynamic G-seat, an active anti-G suit, lap belt, and restraining harness. The simulators utilize

existing technology developed for the F/A-18 simulator.

The academics subsystem is intended to provide a totally integrated multi-media based system capable of providing a balance of classroom and other instruction for both students and instructors under training (IUT). It includes a combination of classroom lectures, textbooks, workbooks, 4E10 computer assisted instruction (CAI) training devices and other media, which will be closely integrated with the simulator and flight training phases.

The TIS consists of computer hardware (4E9), software, communications and peripheral equipment. The purpose is to facilitate efficient scheduling and use of all training resources, (including instructors and students), maintenance of student and instructor records, and management of the curriculum and student flow.

Contractor logistics support will be provided for all levels of maintenance and logistics for the T-45TS subsystems. The contractor will determine the integrated logistic support (ILS). The Navy will fund them and turn them over to the contractor for ILS management.

BACKGROUND

The T-45TS was authorized for full-scale development in October 1984. Based on reviews of the T-45TS program by the OSD staff, the September 1987 Milestone IIIA review was changed to September 1988. In the interim, the Navy was authorized to release the FY88 funding for the procurement of 12 pilot production lot aircraft, 1 OFT, 1 IFT, 1 TIS, 1 academic suite, and FY 88 long-lead funding for procurement of the first limited production lot of 24 aircraft. The T-45A first flew in April 1988. During developmental flight testing, a longitudinal control system anomaly was encountered. The cause has been identified, a solution has been proposed, and flight testing is continuing. Also, a clean wing powered approach "roll-off" problem was experienced. This roll-off has been reduced by adding wing dressing elements. Wing configuration development is progressing toward identifying a configuration with satisfactory stall characteristics. These development problems delayed the start of T-45A and OFT initial operational testing. The Milestone IIIA decision is now scheduled for early 1989.

OT&E ISSUES

The purpose of OT-IIA was to assess the potential operational effectiveness and suitability of the T-45A aircraft. The critical operational issues for partial resolution were to assess (1) the potential effectiveness of the T-45A as an undergraduate jet trainer (flight training), (2) cockpit design for safety and instructor control, (3) reliability, (4) availability, (5) logistic supportability, (6) training, (7) documentation, (8) human factors, and (9) ground and airborne safety.

OT&E ACTIVITY

In order to determine the T-45A's potential training effectiveness and suitability, IOT&E of the 2F138 flight simulator (OFT) was conducted in December 1988. A member of the DOT&E staff observed the operational test and "flew" the OFT. Three members of the DOT&E staff previously flew the developmental version of the OFT. These simulator flights included exposure to all six mission elements for which the OFT will be used. Our assessment of the OFT will be included in our next Annual Report.

DOT&E has been closely involved in the designation of the Navy independent test agency, COMOPTEVFOR, as the responsible agency for the T-45TS OPEVAL. We have also emphasized the issues of (1) ensuring that adequate T-45TS operational test information is

available for the Milestone IIIA decision, and (2) the hybrid digital cockpit.

OT&E ASSESSMENT

The T-45A underwent early IOT&E, OT-IIA, from November 17 to November 21, 1988. This was the first phase of IOT&E for the aircraft. OT-IIA consisted of 10 flights and 13.3 flight hours. The limitations to test included (1) a limited aircraft flight envelope; (2) prohibition of flight into visible moisture or precipitation; (3) the NACES seat, standard attitude heading reference system, head up display, and production lighting were not installed; (4) the aircraft was 427 pounds heavier than the production model due to instrumentation; (5) the wing dressing, longitudinal control system, yaw damper and arresting hook were not in their final configurations; and (6) maximum rate of descent for landing was restricted to 15 feet per second.

Findings on the critical operational issues were as follows: *Flight training*: Excessive pitch problems were encountered with speedbrake extension and retraction. Speedbrake extension/retraction caused a pitch-up/pitch-down requiring approximately 10 pounds of stick pressure and large stick movement to counter. Load factor changes of 0.5-0.6G were observed. Waveoff performance during field carrier landing practice (FCLP) was unsatisfactory when attempted from power settings below that for a nominal approach. Altitude loss was excessive when correcting from higher than optimal sink rates or decelerating approaches. Bolter ground roll distances of more than 800 feet occurred with less than optimal power settings at touchdown. Stall cues were inadequate for a student naval aviator to recognize, roll-off was rapid, large and unpredictable, and stall recovery angle of attack (AOA) was difficult to establish. Acceleration and deceleration performance was poor in side-by-side comparisons with the current advanced jet trainer aircraft, the TA-4J. The T-45A demonstrated excellent turn performance and aerobatic potential. *Cockpit design:* The forward field of view from both cockpits was excellent. There were some deficiencies noted regarding control of the aircraft from the rear cockpit in case of an emergency. *Reliability:* There were no cancellations or major failures during the test. *Availability:* The demonstrated availability was 1.0. *Logistic supportability:* No logistic support deficiencies were noted. *Training:* No deficiencies were noted. *Documentation:* No deficiencies were noted. *Human factors:* There were various deficiencies noted in handle/switch activation and instrument readability. *Ground and airborne safety:* There were some significant safety concerns and issues including poor wave-off and bolter performance, inadequate stall warning, excessive roll-off after stall, and pitch changes after speedbrake extension or retraction.

Based on these test results and within the test limitations, COMOPTEVFOR and DOT&E assess the T-45A to be (1) potentially operationally effective as a flight trainer in the non-aircraft carrier environment, (2) not operationally effective in the carrier environment in its current configuration, and (3) not operationally suitable in its current configuration due to safety deficiencies.

In December 1988, the Director received a briefing from the T-45TS program manager concerning corrections to the deficiencies identified in this early operational test. Fixes to the most significant deficiencies are expected to undergo operational testing in January/February 1989, and the results will be available before making the Milestone IIIA production decision.

MARINE CORPS
TACTICAL AIR OPERATIONS CENTER/ MODULAR CONTROL EQUIPMENT (TAOC/MCE)



SYSTEM DESCRIPTION

The tactical air operations center/modular control equipment (TAOC/MCE) program is not a major defense acquisition program, but was designated for DOT&E oversight in accordance with 10 USC 138. The program is in the second year of low-rate initial production (LRIP). Tactical air operations modules (TAOMs) and operations modules (OMs), nomenclatured AN/TYQ-23(V), are the primary equipment developed in this program. These modules are used as automated air command and control system building blocks in varying combinations to replace the currently deployed Marine Corps tactical air operations central (TAOC) and tactical data communications central (TDCC), collectively known as the Marine Tactical Data System (MTDS), and the Air Force control and reporting center (CRC)/control and reporting post (CRP) and forward air control post (FACP) systems known as 407L and 485L. TAOC/MCE systems are packaged in 8x8x20 foot transportable military shelters (TAOMs or OMs) to provide ground-based automated air surveillance and command and control capability. Tailoring of the system capacity is achieved by the use of one or more of the modules. Up to five modules are to be interconnected with fiber optic cables at lengths to allow dispersion for tactical or other considerations.

All mission essential equipments are internal to the module except the separate radars, identification friend or foe (IFF) equipment, and prime power sources. Shelter design is to allow the transport of a module by fixed or rotary wing aircraft, ship, rail, mobilizer, or truck. On-an-off loading is to be accomplished by crane, container transporter, or fork lift.

BACKGROUND

TAOC/MCE is a multi-Service program. Acquisition is being conducted by the Marine Corps under a Navy contract. The Navy initiated development in 1978, and the Air Force entered the program in 1982. A full-scale development system was tested from June 1986 to January 1987. Four modules were tested by Marine Air Control Squadron One (MACS-1) at Camp Pendleton, California, and one module was tested at Hurlburt Field, Eglin Air Force Base, Florida. A single module was transported by C-141 from Camp Pendleton to Hurlburt Field for interoperability testing. Results of initial operational test and evaluation (IOT&E) provided information for separate Service LRIP decisions and award of the contract in May 1987. The Services plan various future improvements to the system to add separately developed system enhancements and such other mission essential preplanned product improvements (P3I) as jam resistant communications.

OT&E ISSUES

Different issues have been applied by the Marine Corps and the Air Force. Marine Corps issues included the capability to increase system mobility and modular capability; reduce mission reaction time and increase system capacity; improve commonality among modules; enhance "graceful degradation;" and possess the ability to exploit the capabilities of new sensors, communications systems, and weapons fully during the system's lifetime. Air Force issues included the capability to function as elements of the ground tactical air control system (TACS), sustain operations in TACS despite reconfiguration or losses due to hostile action, be deployed and redeployed in the tactical environment, interoperate with other command and control facilities and systems, support mission essential P3I, and support sustained operations within the maintenance concept. Limited assets did not allow full-configuration testing by the Air Force during the FY86-87 IOT&E consequently, the Air Force observed and used Marine Corps IOT&E results wherever practical.

Follow-on operational test and evaluation (FOT&E) is required to demonstrate corrections to problems noted during IOT&E, provide information for the full-rate production decision, and ensure integrated capability of the fully P3I-configured system. These issues have yet to be coordinated into a Test and Evaluation Master Plan (TEMP) and an operational test (OT) plan for approval by OSD. Efforts by OSD to obtain a Service-approved TEMP have been unsuccessful to date.

OT&E ACTIVITY

There has been no OSD-approved OT&E of TAOC/MCE in FY88. Activities have focused on the Service approval of a TEMP to resolve IOT&E deficiencies.

IOT&E of TAOC/MCE began in June 1986 and continued through January 1987. Marine Corps testing was conducted in three phases. Phase 1 including setup/packup of OMs, training of MCAS-1 augmentee personnel, and system checkout. Phase 2 consisting of eight weeks of operational scenarios, including data link with F-4 and F-18 aircraft, embarking and operation aboard ship, landing across the beach, and interface/interoperability with existing Navy and Marine Corps command and operations centers, including participation in Exercise Kernel Blitz 86-2. Phase 3 entailed dual TAOM opera-

tion establishing a two-site capability with data link and remote radar operations. TAOMs have been used in various exercises since IOT&E.

Air Force testing was conducted in four phases. Phase 1 consisted of observing activities at MACS-1. Phase 2 involved single OM testing at Hurlburt Field to evaluate the concept of modular replacement of the existing FACP and CRC/CRPs with automated systems. Phase 3 was testing of interoperability between a single Air Force OM and a Marine Corps TAOM which was transported from Camp Pendleton to Hurlburt Field after completion of testing by MACS-1. Phase 4 included conversion of the Marine Corps TAOM to an Air Force OM configuration followed by two-OM testing.

The Marine Corps Operational Test and Evaluation Activity (MCOTEA) participated in testing of the TAOM and issued an independent evaluation report (IER) in December 1986. The Air Force Operational Test and Evaluation Center (AFOTEC) conducted testing of the MCE and issued two reports, a preliminary report November 1986 and a final report in April 1987. IOT&E was observed by DOT&E representatives.

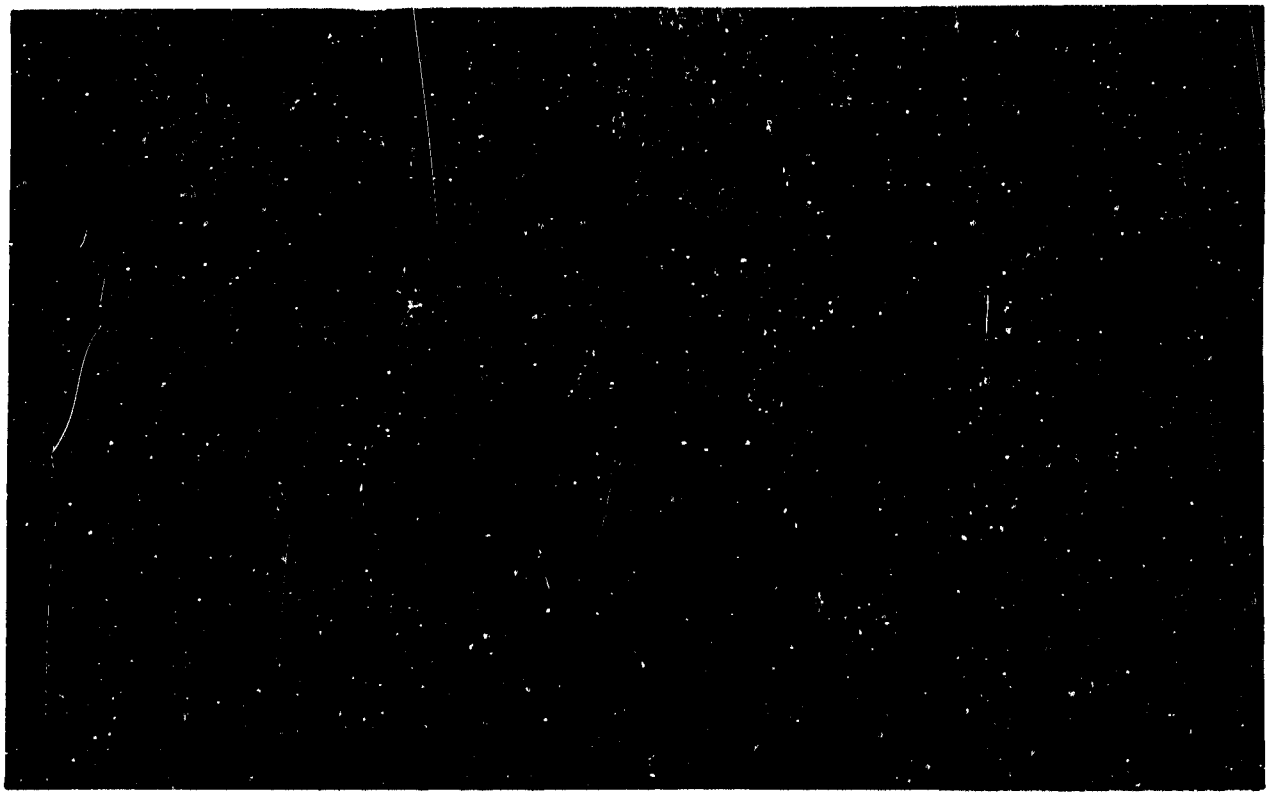
OT&E ASSESSMENT

TAOM/MCE is assessed by DOT&E as operationally effective and capable of carrying out its mission. It is estimated that fielding of the system can be expected to increase operational effectiveness over the systems being replaced. A limited operational capability can be established with only one module. Setup and initialization times are approximately eight times faster than those of current systems. Air surveillance, weapon control, and air traffic control functions along with the operator console capability are improvements over current systems. Primary constraints that periodically limit operational effectiveness are limitations in the TAOM automatic handling of high density radar target inputs that occurs when the interconnected radars are operating in an automatic acquisition mode, periodic critical loss of communications capability due to failures of the communications interface unit (CIU) or the fiber optic interface panel, delays in keying for voice communications, soft vare maturity, and durability of cables and connectors.

The system's operational suitability is marginal. Improvements are required in reliability, technical manuals and documentation, and supportability of software and firmware. Transportability was not rated by the Air Force due to the lack of a production-representative mobilizer and the approved tractor-trailer combination.

A thorough FOT&E is required to demonstrate the correction of operational effectiveness problems noted during IOT&E, confirm operational suitability, provide information for execution of individual Service option-year awards and an appropriate full-rate production decision, and ensure integrated capability of the fully P3I-configured systems. Service approval of a TEMP and OT Plan for submission to OSD is seriously delinquent.

TOMAHAWK



SYSTEM DESCRIPTION

The TOMAHAWK System is a long-range cruise missile system designed to be launched from submarines and surface ships against land targets and ships. There are four missile variants, anti-ship (TASM), nuclear land attack (TLAM-N), conventional land attack (TLAM-C), and conventional land attack submunition (TLAM-D). Each variant is contained within a pressurized canister to form an all-up-round. The submarine all-up-round is launched from torpedo tubes or vertical tubes located in the nonpressure hull area. The surface ship all-up-round is launched from an armored box launcher or the vertical launching system (VLS) Mk-41. Both submarines and surface ships have combat/weapons control systems to perform engagement planning, missile initialization and launch control functions. Targeting for TOMAHAWK is supported by the Theater Mission Planning System, which provides the land targets and overland missile navigation update. Targeting is also support by the Over-the-Horizon Detection, Classification and Targeting (OTH/DC&T) System, which provides ship targets and contact avoidance information.

BACKGROUND

Development of the sea launched cruise missile began in 1972 with full-scale engineering development (FSED) starting in

1977. Initial operational test and evaluation (IOT&E) began in 1981.

OT&E of each TOMAHAWK missile variant and the various associated weapons systems has been preceded by a combined development and operational test to minimize the expenditure of test resources while achieving both technical and operational test objectives.

The final phases of IOT&E of the TASM and TLAM-N missile variants from both submarines and surface ships were completed in 1984. In November of that year, the DOT&E submitted his report to Congress and the Secretary of Defense. As required by 10 U.S.C. 138, this report was submitted prior to the decision to increase the production rates of the TASM and TLAM-N beyond the low-rate initial production (LRIP) level. The DOT&E submitted a similar report for TLAM-C in December 1985.

OT&E ISSUES

Six phases of testing on the various components of the TOMAHAWK weapon system were completed during FY88. All OT&E was conducted in accordance with a DOT&E approved test plan. These tests and their major OT&E issues are as follows:

o The final phase of initial operational test and evaluation of the TLAM-D (OT-IID, OPEVAL) was conducted to evaluate the operational effectiveness and suitability of this variant of the TOMAHAWK missile. Specific operational effectiveness and operational suitability issues addressed included: missile launch performance, cruise flight performance and terminal accuracy, reliability, logistics supportability, training, interoperability, and human factors.

o Follow-on Operational Test and Evaluation (FOT&E) (OT-IIIC Phase 2) was conducted on the Land Attack TOMAHAWK weapon system Theater Mission Planning Center (TMPC) to determine the operational effectiveness and suitability of the TMPC with Block 8.1 software. Phase 1 of OT-IIIC was conducted from May through July 1987 at the Commander-in-Chief, Pacific TMPC on Block 8.0 software and was reported in the DOT&E FY87 Annual Report.

o FOT&E (OT-IIIB) was conducted at the Mk 37 TOMAHAWK Weapons System (TWS) to evaluate the operational effectiveness and operational suitability of this weapon system as installed on the CG-47 class cruisers with vertical launching systems and to verify correction of deficiencies from earlier OT&E.

o FOT&E (OT-IIID) was conducted on the Mk 37 TOMAHAWK Weapons System (TWS) to evaluate the operational effectiveness and operational suitability of this weapon system as installed on DD-963 class destroyers with a vertical launching system and to verify correction of deficiencies from earlier OT&E.

o FOT&E (OT-IIIH1) was conducted on the TOMAHAWK Weapon Control System (TWCS, AN/SWG-3) to evaluate the operational effectiveness and operational suitability of Block 1 upgrades to the weapon control system on a vertical launching system ship.

o The second phase of a Chief of Naval Operations project was conducted on the OTH/DC&T system. The first phase was conducted in the Atlantic Fleet operating area in August 1986, and reported in the DOT&E FY87 Annual Re-

port. The second phase was conducted in the Pacific Fleet operating area to determine the effectiveness and operational suitability of the Pacific Fleet system in targeting cruise missiles and other weapons at over-the-horizon ranges.

OT&E ASSESSMENT

The TLAM-D OPEVAL consisted of five test firings at the Pacific Missile Test Center from April 8 to May 27, 1988. The testing consisted of three operational firings (two from a submarine and one from a surface ship) and two combined development and operational test (DT/OT) firings (both from surface ships). The test firings were augmented by seven simulated engagement planning and missile launch tests. The Navy's independent operational test agent, Commander, Operational Test and Evaluation Force (COMOPTEVFOR) determined that the TLAM-D was potentially operationally effective and operationally suitable. The most significant effectiveness deficiencies were not associated with the missile but with mission planning and weaponeering.

FOT&E (OT-IIIC Phase 2) on the Theater Mission Planning Center (TMPC) with Block 8.1 software was conducted at the Commander-in-Chief, Atlantic TMPC from February through May 1988. A total of 12 missions was planned. Six missions were planned, four primary and two alternate, in conjunction with the TLAM-D OPEVAL to assess the capability of the TMPC to properly target, task, weaponeer and plan TLAM-D missions. Two other missions were planned in conjunction with the Navy's operational test launch (OTL) program, one TLAM-C (OTL-50) and one TLAM-N (OTL-41Q). Four missions were randomly selected to actual operational areas, two TLAM-C and two TLAM-N. The testing was limited in that the number of missions produced and flown was insufficient for a valid comparison with mission effectiveness requirements. COMOPTEVFOR concluded that the TMPC with Block 8.1 software has the potential to be operationally effective and operationally suitable. However, major improvements are needed in the area of documentation, procedures, and training. In addition, a better understanding of the conventional land attack TOMAHAWK limitations in all environmental and geographic conditions needs to be deveioped and promulgated.

Follow-on operational test and evaluation (FOT&E) (OT-IIIB) on the Mk 37 TOMAHAWK weapons system as installed on the CG-47 class cruisers with vertical launching systems was conducted in USS *Antietam* (CG-54) at the Pacific Missile Test Center (PMTC) from April 11 to 24, 1988. The testing consisted of three missile firings. The test was limited in that a system operability test (SOT) for the Mk 37 TWS does not exist and therefore could not be evaluated. The launcher control group (LCG) of the Mk 37 TOMAHAWK weapons control system (TWCS) properly initialized all three missiles, and the missiles flew their intended flight path to the target area. In order to increase the Mk 37 reliability data base, the results of the testing on *Antietam* and USS *Spruance* (DD-963) (see OT-IIID below) were combined. COMOPTEVFOR concluded that the Mk 37 installed in a CG-47 class cruiser with vertical launching systems is operationally effective and potentially operationally suitable. Full fleet introduction was recommended following correction of the reliability problems in the TWCS and a safety problem (potential finger injury) with slide release buttons on a computer cabinet.

FOT&E (OT-IIID) on the Mk 37 TOMAHAWK weapons system as installed on DD-963 class destroyers with a vertical launching system was conducted in USS *Spruance* from March 21 to 27, 1988, during the transit to and at the Eglin Air Force Base Sea Range off Florida. The

testing consisted on 12 nonfiring TASM engagements and one TLAM-N firing. The test was limited in that a system operability test (SOT) for the Mk 37 does not exist and therefore could not be evaluated. The launcher control group of the TWCS properly initialized the missile and it flew its intended flight path to the target area. COMOPTEVFOR concluded that the Mk 37 installed in a DD-963 class destroyer with a vertical launching system is operationally effective and potentially operationally suitable. Full fleet introduction was recommended following correction for the reliability problems in the TWCS and the safety problem discussed in the above paragraph.

FOT&E (OT-IIIH1) on the Block 1 software upgrades to the TOMAHAWK weapon control system on a vertical launching system ship (TWCS, AN/SWG-3) was conducted on *Spruance* during the OT-IIID operations described above and on *Antietam* from December 13 to December 15 , 1988, at PMTC. The *Antietam* testing consisted of four nonfiring TASM engagements and one actual TASM firing. The Block 1 upgrade demonstrated the capability to support missile employment in the operations on both ships. COMOPTEVFOR recommended the Block 1 Software Upgrade be approved for full fleet introduction after the cause of the TWCS reliability problems is corrected.

The second phase of Chief of Naval Operations project K310-5 on the OTH/DC&T system was conducted in the eastern Pacific Fleet operating area from July 26-31, 1988. The project was a test of the Navy's ability to provide a composite tactical surface picture adequate to support the employment of cruise missiles and other extended range weapons. The results of this project are still being analyzed and will be reported in the DOT&E FY89 Annual Report.

PART V

AIR FORCE OT&E

AGM-86B AIR LAUNCHED CRUISE MISSILE (ALCM)



SYSTEM DESCRIPTION

The ALCM is an air-to-ground subsonic missile designed for launch with a nuclear warhead from aircraft. The missile is powered by a small turbofan engine in the 600-pound thrust category. Missile navigation is accomplished by an inertial navigation system augmented by a terrain correlation (TERCOM) technique using digital terrain mapping. It is capable of flying mid-altitude, cruise and low-altitude terrain following (TF) missions. The ALCM will fly programmed flight paths at commanded flight modes, speeds, and altitudes. The B-52 can carry a total of 20 ALCMs, 12 externally, with 6 on each of 2 wing pylons, and 8 internally on a rotary launcher (CSRL), which is scheduled for deployment on the B-52H in FY90.

BACKGROUND

The program was initiated in February 1974 and a production decision was made for the ALCM in April 1980. Initial operational capability with the first operational B-52G squadron at Griffis AFB, New York, was declared in December 1982. A requirement for more realistic operational testing during the follow-on operational test and evaluation (FOT&E) conducted by the Strategic Air Command (SAC) led to a Canadian-US agreement for operational testing over the more operationally representative Canadian terrain. The first ALCM test launches over

Canada were completed on February 19 and 25, 1985. SAC's FOT&E program will continue for the life of the missile. Although this program does not include any further major acquisition, DOT&E oversight continues because of the importance of cruise missile weapons.

OT&E ISSUES

Phase II of SAC's, FOT&E of the ALCM, began in July 1983 and will continue throughout the system's life. The critical operational issues as defined in the Test and Evaluation Master Plan (TEMP), approved by OSD in April 1988 are: (1) assess B-52 Integrated Weapon System (IWS)/ALCM accuracy and reliability using the entire stockpile-to-target sequence, (2) assess SAC's mission planning capability to support the B-52 Offensive Avionics System (OAS) and the ALCM, and (3) demonstrate ALCM global cruise. Specific test objectives are designed to (1) provide inputs to SAC planners in determining weapon system accuracy and reliability; (2) verify current operational employment concepts, tactics, and techniques, and identify operational deficiencies; (3) verify adequacy of technical data and equipment used in maintenance, check-out, and operation of the weapon system--including aircrew, software, hardware, and the mission planning system; (4) evaluate performance of the weapon system--to include aircrew, software, hardware, and the mission planning system; and (5) continue evaluation of those areas recommended as a result of previous testing.

OT&E ACTIVITY

SAC continues to conduct the ALCM FOT&E program. As of October 1, 1988, 70 ALCM FOT&E launches had been accomplished. Fifteen of these launches occurred during AFOTEC-conducted Phase I FOT&E from July 1981 through June 1983. The remaining 55 launches have been SAC-conducted Phase II FOT&E tests (July 1983 through September 1988). Of the 10 ALCM test missions flown in FY88, two were over the Canadian Test Route, and the remaining eight were flown over US routes. Test results are reported annually in SAC's B-52 Integrated Weapon System Follow-on Operational Test Report and SAC's evaluation of ALCM performance, which is provided to the Joint Chiefs of Staff. A total of 10 flights are scheduled for FY89, with one through Canadian air space.

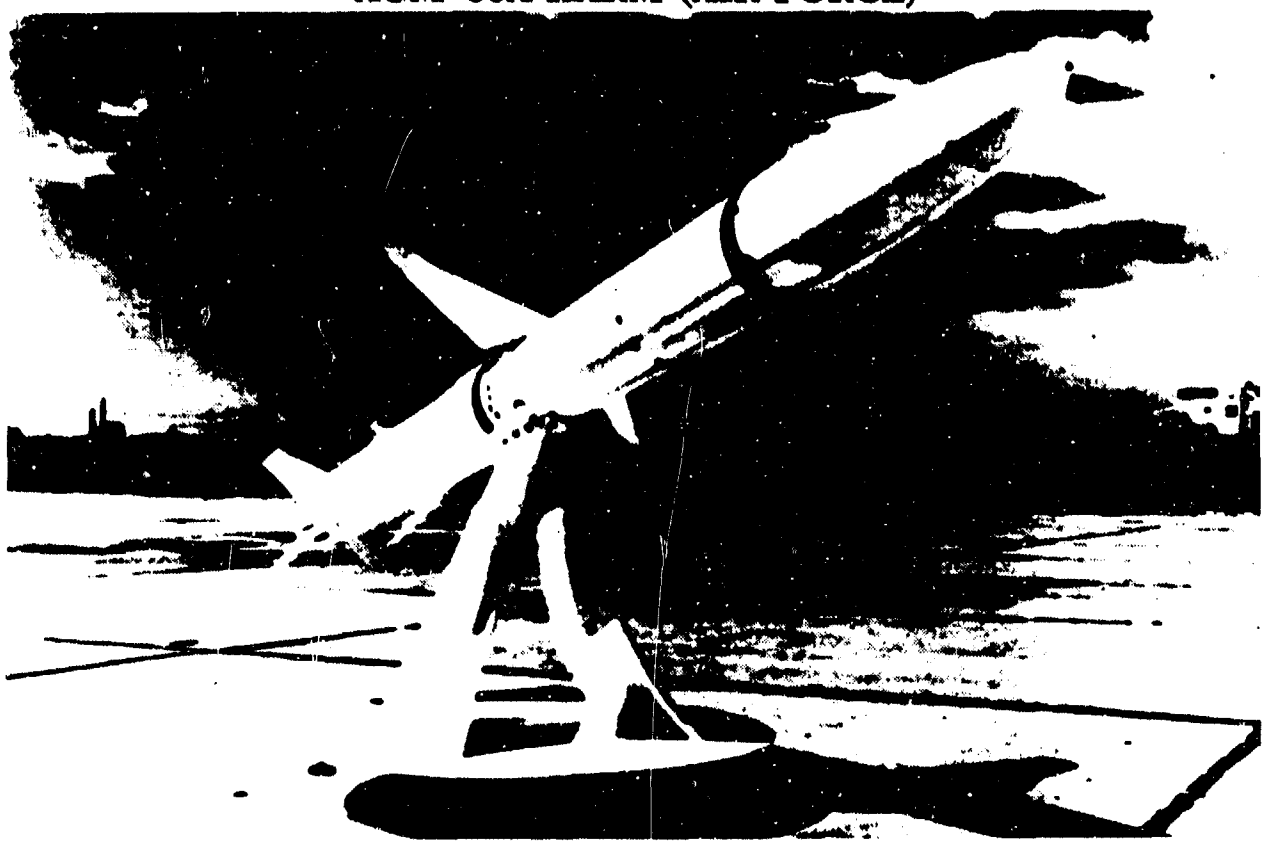
OT&E ASSESSMENT

To date, ALCM operational performance, as demonstrated by FOT&E, has met SAC's requirements for suitability, reliability, and maintainability. The testing accomplished in FY88 did not significantly alter the results reported during previous years. B-52 OAS Block II was tested for the first time during FOT&E Phase II in FY88. Block II of the Offensive Avionics System represents another significant improvement in the OAS/ALCM weapon system. The two Canadian ALCM flights in January 1988 met all their test objectives and were completely successful. Overall, the B-52 OAS/ALCM weapon system continues to be highly accurate and is meeting SAC's operational requirements. Last year's DOT&E direction that the Air Force review ALCM test planning resulted in improvements to several areas of the program, including mission-planning capability, analysis methodologies, and a coherent approach to testing of the entire class of weapons throughout their life cycles.

SUMMARY

ALCM operational performance demonstrated by this FOT&E program shows that the ALCM continues to perform satisfactorily and has met specifications in suitability, reliability, and maintainability. All 10 flights accomplished in FY88 were successful, including two important free-flight missions over Canada. Important results achieved from recent testing confirm significant improvements in the B-52 OAS/ALCM weapon system.

AGM-88A HARM (AIR FORCE)



SYSTEM DESCRIPTION

The High Speed Anti-Radiation Missile (HARM) is an air-to-surface missile designed to suppress or destroy land-and sea-based radars that direct enemy air defense systems. HARM is a design evolution of ARM weapons (Shrike and Standard ARM) and is the primary weapon used on the F-4G Wild Weasel defense suppression weapon system. Performance characteristics include: high speed, large footprint, high sensitivity to weak signals, and software adaptability to the constantly changing threat. HARM weighs 807 pounds. It is 164 inches long and 10 inches in diameter.

BACKGROUND

Joint Navy (lead service)/Air Force initial operational testing of HARM began in 1979 and resulted in full production and USAF initial operational capability in September 1984. Missile deficiencies identified in testing are being addressed through a performance upgrade program and tested in follow-on operational test and evaluation (FOT&E).

OT&E ISSUES

Critical operational issues include guidance to within warhead lethal radius, capability to switch to alternate targets, targeting reaction time, effectiveness in multipath environment, aircrew workload, fratricide avoidance, ECCM environment capability, maintainability/reliability built-in test function and logistical support capability.

OT&E ACTIVITY

The version currently being fielded is called the Block II. Testing of the next software version (Block III) began in December 1988. The next hardware/software version (Block IV) will be competed against a low cost seeker (LCS) version made by a second source. These versions will start developmental testing in early 1989 and operational testing in FY90. The Navy-submitted Test and Evaluation Master Plans (TEMPs) for Block III and LCS were reviewed and approved by DOT&E in November 1988. The Block III test plan was recently approved for the Navy portion of the test.

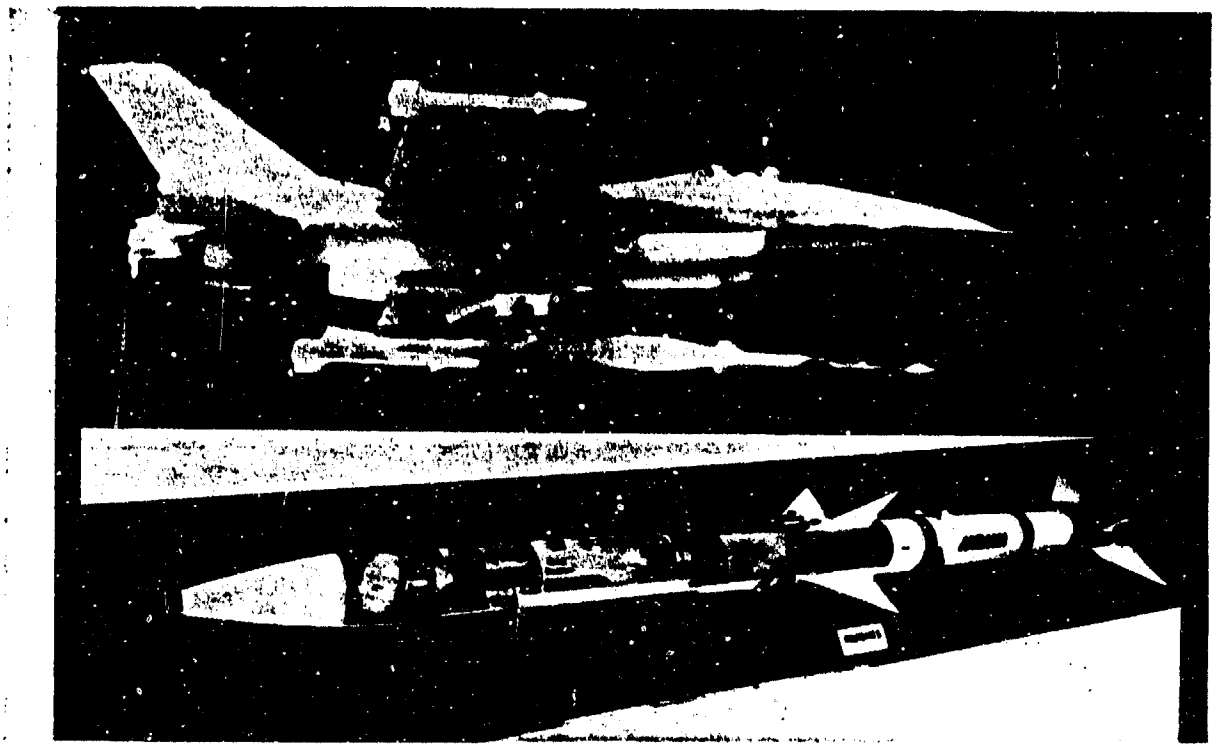
OT&E ASSESSMENT

The first phase of FOT&E was completed in November 1984. It consisted of one missile firing to verify software corrections. The second phase of FOT&E on the Block II began in February 1986. This Air Force phase was finished and reported on in January 1988. It included four missile firings and an extensive captive-carry flight program. The Air Force found several problems that led to the Block III version which will be tested soon. Flight testing was conducted on test ranges at Nellis AFB, Nevada, and the Naval Weapons Center, China Lake, California.

SUMMARY

HARM operational testing has been conducted continuously, with the Air Force and Navy doing separate portions of each phase. Each Service has been critically assessing its own needs, and the resulting changes to the deficiencies are strengthening the system. User requirements for each service are not totally met at this time, but fixes and tests of fixes indicate that the full requirements could be met in these new versions. There are well-planned tests scheduled for the Block III, Block IV, and LCS versions.

AMRAAM (AIM-120A)



SYSTEM DESCRIPTION

The Advanced Medium Range Air-to-Air Missile (AMRAAM) is the next generation all-weather, all-environment, medium-range air-to-air missile system for use by the Air Force, Navy, and NATO forces. AMRAAM is designed to be employed within and beyond visual range. It is intended to provide more firepower and combat utility and effectiveness than the AIM-7 Sparrow, which it is to replace, while significantly reducing aircraft and aircrew vulnerability. Increased average missile velocity provides the capability to outshoot threat aircraft by increasing the separation between the launch aircraft and the target at AMRAAM intercept. The AMRAAM's active radar seeker will provide a launch-and-maneuver capability for increased survivability and multiple target engagement on a single intercept.

BACKGROUND

The AMRAAM program responds to a 1978 Joint System Operational Requirement. Full-scale development (FSD) was initiated in December 1981, and a follower contractor was selected in July 1982. Schedule delays and cost increases slowed the program, leading to an OSD-directed investigation of alternative methods for reducing AMRAAM costs in January 1985. In June 1985, the Secretary of Defense approved a revised program, which incorporated cost-reduction measures and set cost caps. The FY86 National Defense Authorization Act required Secretary of Defense cost certification of the Air Force

production program at $5.2 billion in FY84 dollars, and a full-scale development contract limit of $556 million. The FY87 Authorization Act capped the program at $7.0 billion for 24,000 Air Force and Navy missiles, but allowed adjustment due to congressional actions. The concurrent development test/operational test (DT/OT) program had accomplished 81 firings through November 1988. In November 1988, the Defense Acquisition Board (DAB) recommended continued low-rate production and the release of long-lead funds for Lot III missiles.

OT&E ISSUES

Critical operational issues include autonomous employment ("launch and leave"), multiple kills per engagement, selected target kill in multiple formation, capability against maneuvering targets, effectiveness in the electronic combat arena, aircrew work load, and reliability and maintainability. Specific objectives in each of these areas are designed to ensure that this weapon will meet the exacting demands of the next generation of air-to-air weapons.

OT&E ACTIVITY

AMRAAM initial operational test and evaluation (IOT&E) began in October 1985 with the start of the Captive Carry Reliability Program, Phases I and II (CCRP I and II). The initial operational test and evaluation (IOT&E) portion of combined AMRAAM DT/OT FSD is currently being conducted by the Air Force Operational Test and Evaluation Center (AFOTEC). The IOT&E objectives will be evaluated using data from both development test and evaluation (DT&E) and IOT&E tests, including: (1) mathematical modeling and simulations, (2) maintainability demonstrations, (3) three phases of CCRP, (4) AMRAAM captive equipment (ACE) missions, and (5) live missile firings.

All phases of testing are currently underway. The modeling/simulation effort and maintainability demonstrations have been conducted since the beginning of FSD. Hardware-in-the-loop (HIL) simulations have been used primarily to support software development and the live-fire program; however, separate evaluations have been performed using 18 predefined scenarios to explore several missile capabilities. CCRP II was combined DT&E/IOT&E involving AMRAAM carriage on the F-16. CCRP III is a separate IOT&E evaluation of F-15 carriage. The IOT&E ACE missions began in October 1986 as part of the preparation for the first IOT&E live firing on October 16, 1986. Ninety missile firings were originally planned for FSD, 25 of which were to be dedicated IOT&E launches.

The missiles used through most of DT/OT are FSD production representative missiles. The last four missiles in operational tests, and the additional missiles needed for test refire, will be Lot 1 production missiles.

DOT&E travels to and observes all OT&E profile and/or live-fire missions. All changes to IOT&E shot profiles are reviewed by DOT&E to ensure that there are no losses in OT&E "flavor." DOT&E is briefed prior to all reviews and DAB meetings, and is closely monitoring the final phases of this IOT&E. The updated Test and Evaluation Master Plan (TEMP) is under review at this writing.

DOT&E has requested a "user" evaluation of the tactical utility of AMRAAM. Tactical Air Command will be conducting this operational utility evaluation (OUE) at Nellis AFB, Nevada, in early 1989. It will include flying and computer simulations,

with a strong emphasis on collection and evaluation of flight data.

OT&E ASSESSMENT

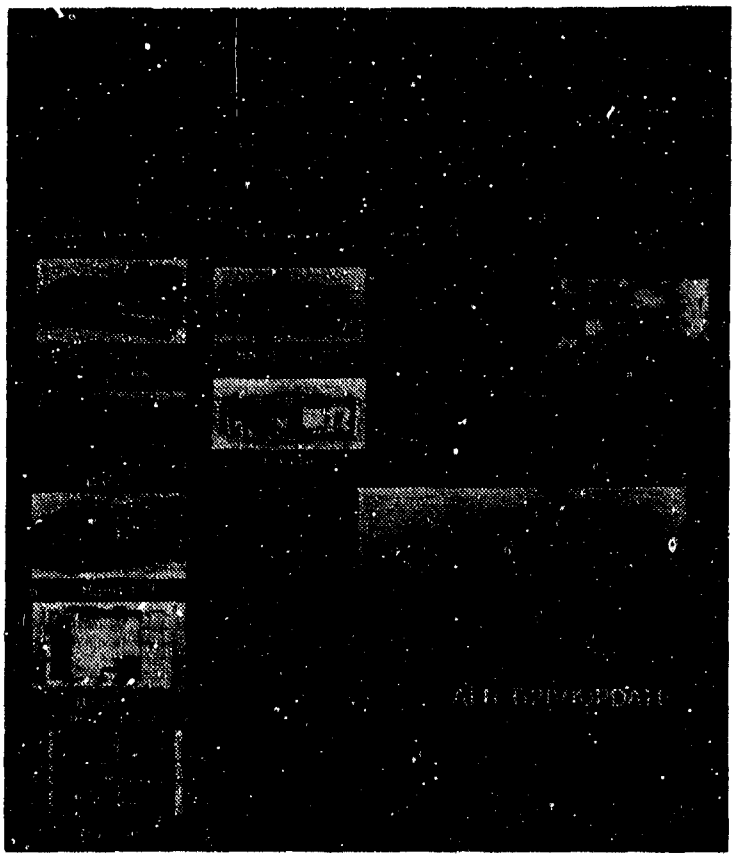
As of this writing, 14 operational live-fire missions have been accomplished in IOT&E since October 1986, with 18 of the scheduled 25 missiles launched. CCRP II was completed in FY87 with 800 hours carriage on the F-16. CCRP III, F-15 carriage, was delayed from FY87, started in April 1988, and suspended in September due to reliability failures. It was rescheduled to start again in December 1988.

IOT&E is now estimated to be completed in mid-1989, approximately a year behind the June 1987 DAB schedule. Many things have contributed to the delay, including drone targets, ECM pods, aircraft software, aircraft availability, and range problems. Currently, however, problems with AMRAAM system software maturity, missile reliability, and some performance issues (e.g., ECCM and multiple targets) are responsible. A May 1988 program review and a subsequent September 1988 follow-up review of AMRAAM test progress resulted in DAB endorsement of the DOT&E's recommendation of continued low-rate instead of full-rate production. The Lot 3 (originally intended to be full-rate production) amount was decreased from 1270 to 900 missiles. IOT&E is continuing as corrections to observed deficiencies become available for testing.

SUMMARY

The AMRAAM program is significantly behind its original schedule, and the full-rate production decision has been delayed until changes/fixes can be accomplished and tested. As deficiency corrections are incorporated, schedule delays reflect the risk involved in doing concurrent DT/OT. Missile reliability, ECCM, multiple targets, and software maturity are the major concerns for which corrections have been identified, but these remain to be tested.

AN/ALQ-62I



SYSTEM DESCRIPTION

The AN/ALQ-62I RWR is a major upgrade to the AN/ALR-62 used on the F-111 and incorporates capabilities to ensure effectiveness in the 1990s. The AN/ALR-62I is used in conjunction with the AN/ALQ-137 jammer.

OT&E ISSUES

Major effectiveness issues are related to threat detection, identification, response time, azimuth accuracy, and interoperability with other on-board avionics and friendly aircraft. Major suitability issues are related to reliability, maintainability, and software supportability.

OT&E ACTIVITY

The Air Force evaluated the operational effectiveness and suitability of the AN/ALR-62I on six effective sorties and 8.3 total flying hours combined with development test results.

OT&E ASSESSMENT

The Air Force assessed the system as meeting operational effectiveness and suitability criteria and awarded a production contract based on this assessment. The DOT&E added the AN/ALR-62I to our oversight list in September 1988. Our review of the operational test results provided by the Air Force indicates that, while the AN/ALR-62I significantly

increases the capability against current threats and threat densities, there are areas of continuing concern. Interoperability with the AN/ALQ-137 needs to be improved prior to fielding the system. Automatic software restarts need to be reduced. The operational tests were limited by unavailable support equipment and required extensive development contractor support.

AN/ALQ-131 BLOCK II AND RECEIVER PROCESSOR



SYSTEM DESCRIPTION

The AN/ALQ-131 Block II with the Receiver/Processor (R/P) Electronic Countermeasures (ECM) Pod is a modular self-protection jamming system designed to protect tactical aircraft against a variety of radar threats. The AN/ALQ-131 Block II with R/P is a major upgrade to the currently deployed AN/ALQ-131 Block I and Block II pods and is one of two Air Force ECM pod configurations. The R/P provides automatic, power-managed, technique tailored pod operation based on received threat signals and threat density. Support equipment at the intermediate level (I-Level) for the AN/ALQ-131 Block II is provided by contractor-developed engineering test support equipment (ETSE). The Air Force has not acquired final automatic test equipment (ATE).

BACKGROUND

The AN/ALQ-131 Block II was operationally tested in FY87, and the results were reported in the FY87 DOT&E Annual Report. The R/P was tested in 1985. Over 300 units of each have been procured.

OT&E ISSUES

The purpose of current operational tests is to assess the enhanced operational effectiveness and operational suitability of the AN/ALQ-131 Block II with R/P over that of the AN/ALQ-131 Block II and with respect to the Air Force statement of need for electronic warfare systems. Six effec-

tiveness issues and five suitability issues will be addressed. The issues relate to interface considerations, increased capability, weapon-system compatibility, and reliability of the integrated system.

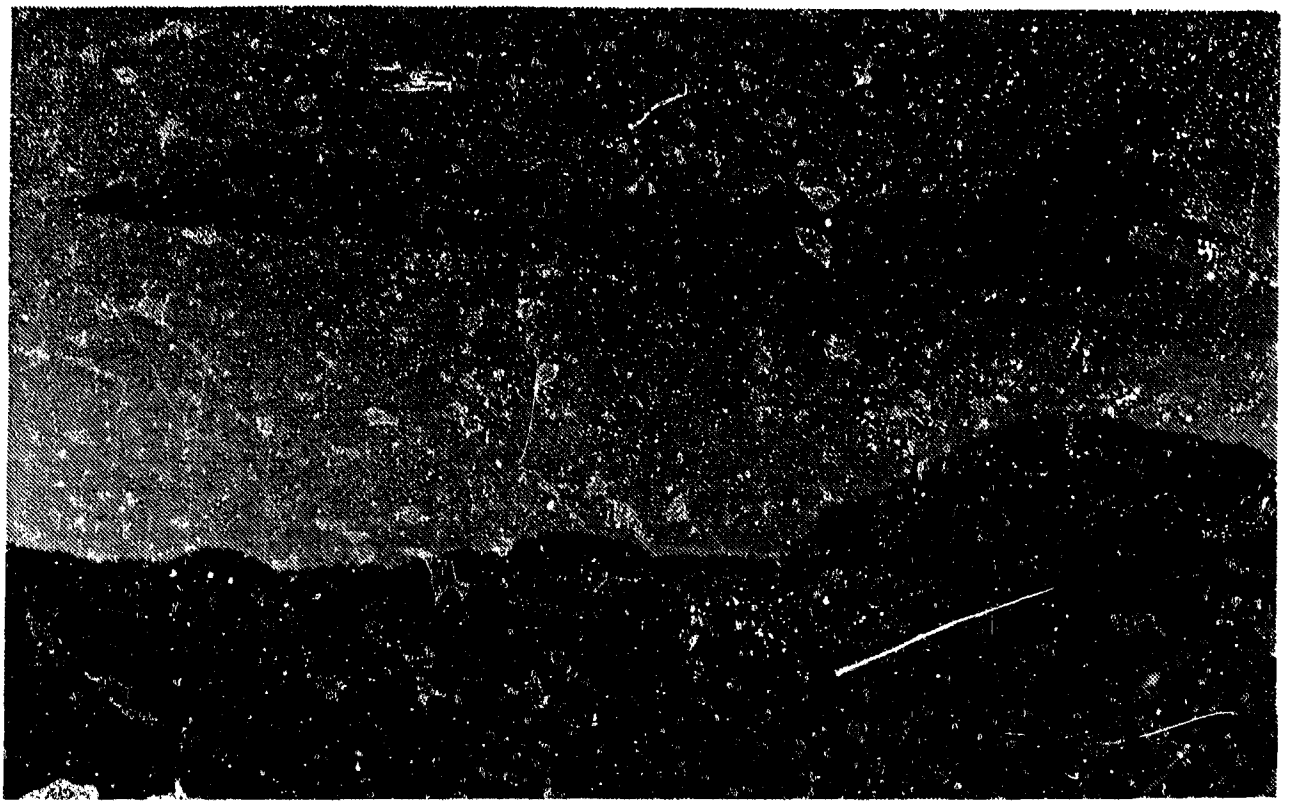
OT&E ACTIVITY

A quick-look flight test was conducted at Eglin AFB, Florida, to verify techniques. Ground simulations at the Air Force Electronic Warfare Evaluation Simulator (AFEWES), Fort Worth, Texas, were completed. Further flight tests at Eglin AFB and Tyndall AFB are scheduled for 1989.

OT&E ASSESSMENT

Insufficient data analysis has been accomplished to provide an assessment at this time.

AN/ALQ-161



SYSTEM DESCRIPTION

The AN/ALQ-161 system is the internally mounted electronic countermeasures system for the B-1B. It includes the tail warning function (TWF) and the countermeasures dispenser function as well as radar warning receiver and jamming functions. Like the tactical systems, the AN/ALQ-161 is reprogrammable. The MOD 1 Block 4.0 system has completed development tests.

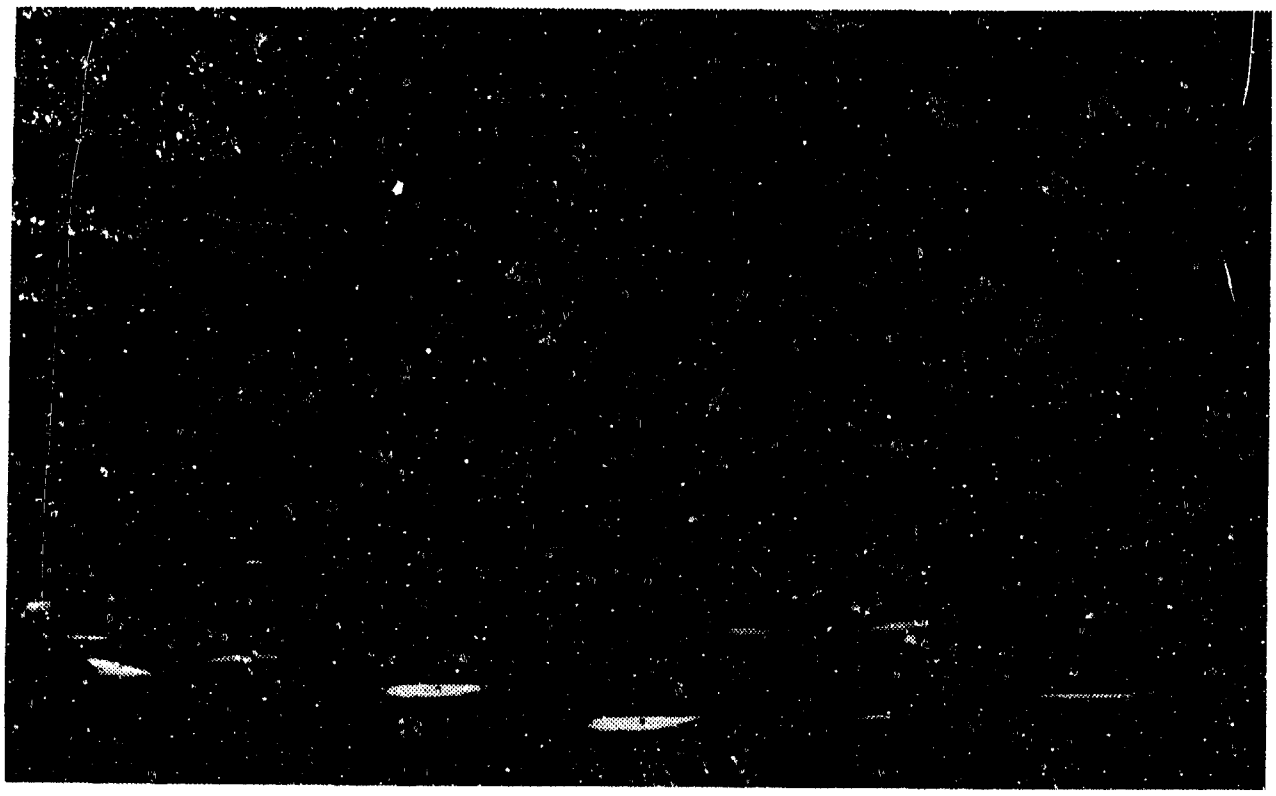
OT&E ISSUES

Because the AN/ALQ-161 does not meet SAC requirements, operational tests are being developed to determine operational capabilities of the existing design. The DOT&E has directed the Air Force to perform operational tests on each element of the AN/ALQ-161 system certified by the system program officer as ready for deployment. Certification of the TWF, dispenser, and Block 4.0 system are expected in 1989.

OT&E ASSESSMENT

The Air Force development activity has provided an assessment of the reduced-capability system. No operational tests have been accomplished to date.

AN/ALQ-172 (V2)



SYSTEM DESCRIPTION

The AN/ALQ-172 (V2) countermeasures set is a power managed, software reprogrammable system that is a major upgrade to the AN/ALQ-117 system used on the B-52. The V2 is installed on the B-52H. Requirements for the V2 are in SAC Statements of Operational Need 3-79 and 10-81.

BACKGROUND

Significant advances in Soviet surface-to-air antiaircraft missiles and airborne interceptor systems threatened the potential mission effectiveness of the B-52 and dictated an upgrade in countermeasures capability. An Under Secretary of Defense for Research and Engineering Memorandum of June 19, 1981, directed service electronic warfare program managers to exercise acquisition strategies tailored to react immediately to counter these new and projected threats.

OT&E ISSUES

The FY88 Follow-on Test and Evaluation had the singular issue of assessing the effectiveness of the AN/ALQ-172 (V2) against advanced threats.

OT&E ACTIVITY

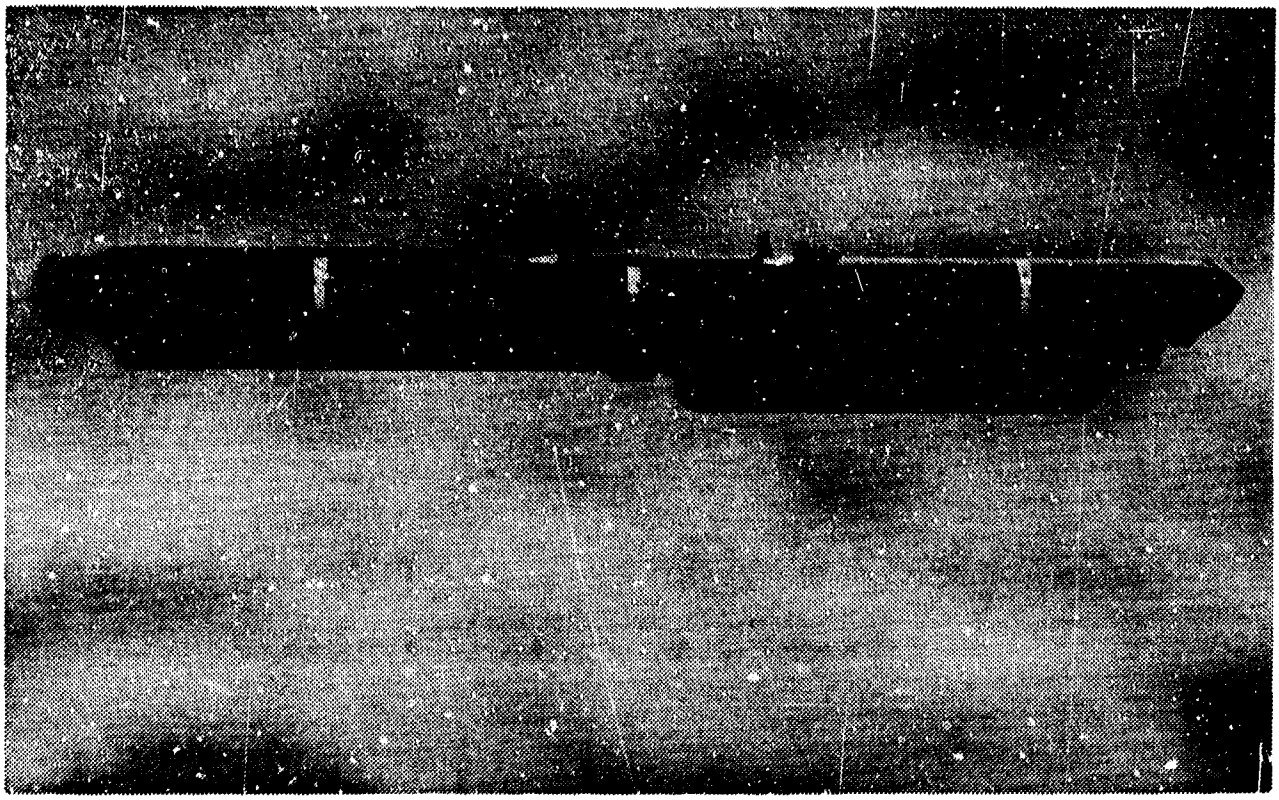
Operational tests were conducted between February 1, 1988, and March 30, 1988. All test activity originated at B-52 main operating bases and returned to the same

base. Eglin AFB, Florida, was the test range.

OT&E ASSESSMENT

The Air Force determined that the AN/ALQ-172 (V2) was effective against the threat as tested, an assessment with which this office concurs.

AN/ALQ-184



SYSTEM DESCRIPTION

The AN/ALQ-184 Electronic Countermeasures (ECM) Pod is a modular self-protection jamming system designed to protect tactical aircraft against a variety of radar threats. The AN/ALQ-184 is a major upgrade to the currently deployed AN/ALQ-119 pod and is one of two Air Force ECM pod configurations. Support equipment at the intermediate level (I-Level) for the AN/ALQ-184 is designated the AN/ALM-233. The AN/ALM-233 is an upgrade to the AN/ALM-126 currently deployed with the AN/ALQ-119.

BACKGROUND

The Air Force Statement of Operational Need (SON) TAF 304-80 defines the requirement for the AN/ALQ-184. Feasibility studies started in 1979, and developmental efforts started in 1981. Operational flight tests were conducted from March 1987 to November 1987 at Eglin AFB, Florida, Tyndall AFB, Florida, and the Naval Weapons Center, China Lake, California. Five developmental items and 70 QRC units had been procured prior to the operational tests. The results of the operational tests were to provide an assessment prior to procurement

of an additional 100 units in 1988, with additional units to be procured later. Extensive simulator testing at the Air Force Electronic Warfare Evaluation Simulator (AFEWES), Fort Worth, Texas, and at the Pacific Missile Test Center, Point Mugu, California, was conducted prior to these tests.

OT&E ISSUES

The purpose of the operational tests was to compare the enhanced operational effectiveness and operational suitability of the AN/ALQ-184 and the AN/ALM-233 to that of the AN/ALQ-119 and AN/ALM-126 with respect to the Air Force statement of operational need for electronic warfare systems. The operational tests had 15 objectives. The six major objectives were: (1) evaluate the capability to provide tactical aircraft selfprotection, (2) assess reliability, (3) assess maintainability, (4) assess the built-in-test (BIT), (5) evaluate the reprogrammability of the pod, and (6) assess the suitability of the AN/ALM-233 support equipment.

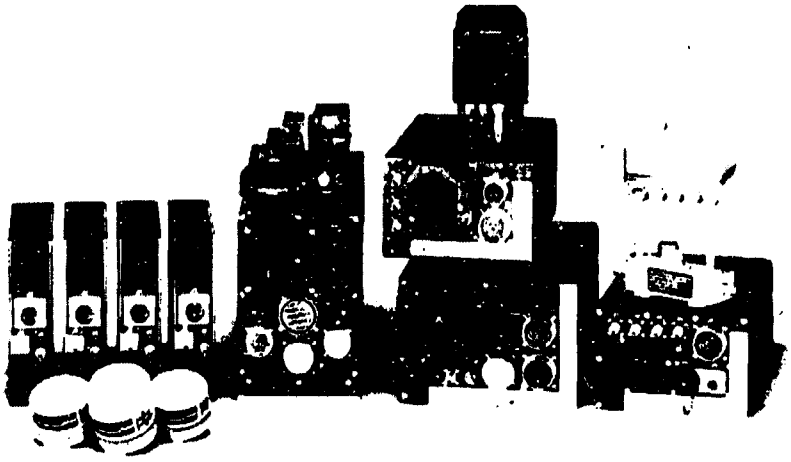
OT&E ACTIVITY

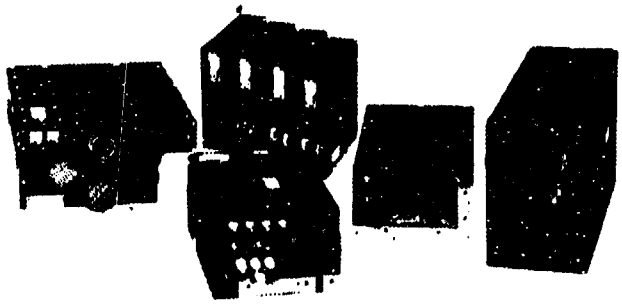
Operational tests were conducted between March 30, 1987, and November 17, 1987, on F-16C, A-10, F-4E and F-4G aircraft. Resource constraints precluded testing all possible aircraft configurations and flight profiles. Consequently, the configuration and profiles were selected as representative of the operational environment and commensurate with the purpose of the operational tests.

OT&E ASSESSMENT

The Air Force assessed the AN/ALQ-184 as significantly more reliable and maintainable than the AN/ALQ-119. The BIT performed as required, and the AN/ALM-233 could be operated by Air Force personnel and was effective and suitable as support equipment for the pod. The pod demonstrated its capability to be reprogrammed on the flight line with a memory loader verifier; however, the Air Force does not have an on-line capability to implement this capability fully. The system was as effective as the AN/ALQ-119, but did not meet the criteria identified in the statement of operational need. DOT&E recommended that the Air Force not proceed with low-rate initial production (LRIP) until the effectiveness deficiencies were corrected and retested. The Air Force procured 100 LRIP systems in 1988 and intends to procure 40 additional LRIP systems in 1989.

AN/ALR-56M AND AN/ALR-74





SYSTEM DESCRIPTION

The AN/ALR-56M and AN/ALR-74 radar warning receivers are designed to be used on the F-16. The systems are intended to be effective in current advanced threat environments.

BACKGROUND

The Air Force decided to compete the Advanced RWR after the AN/ALR-74 was determined to be ineffective in operational tests. An upgraded AN/ALR-74 and a modified AN/ALR-56 were selected for this competition.

OT&E ISSUES

Operational test and evaluation issues cover effectiveness and suitability of the RWRs and their integration into the F-16.

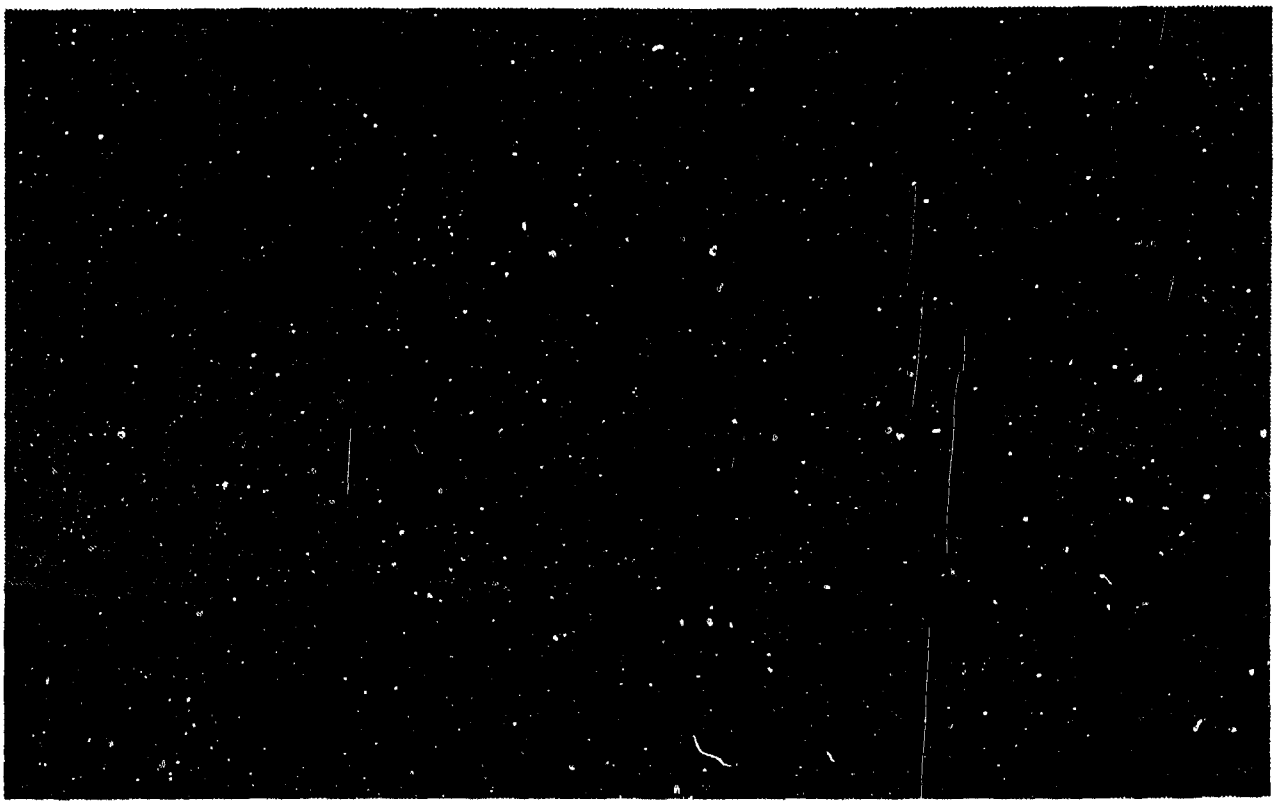
OT&E ACTIVITY

Testing of the AN/ALR-56M and AN/ALQ-74 began in June 1988 on two F-16C aircraft. Dynamic Electromagnetic Environment Simulator laboratory testing was completed in July 1988 using three operationally representative scenarios. RF-4C operational tests were started in September 1988.

OT&E ASSESSMENT

Test results are source-selection sensitive and were reported to the Source Selection Evaluation Board in December 1988.

B–1B STRATEGIC BOMBER



SYSTEM DESCRIPTION

The B–1B is a strategic multirole manned bomber intended to deliver conventional and nuclear gravity bombs as well as to serve as a cruise missile launch platform. The primary role of this aircraft is as a strategic attack penetrator which takes maximum advantage of the combined effects of low altitude, high speed, reduced radar cross section, high clutter, and electronic countermeasures technology contributing to survivability in a projected high threat environment for this long–range combat aircraft.

BACKGROUND

The Defense System Acquisition Review Council (DSARC) process was completed for the B–1A in December 1976, but production and deployment decisions were subsequently cancelled in June 1977. In July 1980, Congress directed the Department of Defense to vigorously pursue full–scale engineering development for a multi role bomber to achieve an initial operational capability (IOC) not later than FY87. When the B–1 program was revitalized it was "baselined" to the B–1A and took advantage of applicable B–1A test data. However, much B–1A design and testing had not been completed at the time of the program's cancellation. This included dynamic response, aircraft structures testing, flying qualities at low speeds and in engine–out conditions, all–weather/ adverse–weather operations, diagnostic tests, and electronic countermeasures. In

addition, the capabilities of the B-1B were expanded to include the development of a new offensive avionics system, expanded ECM coverage, and expanded diagnostics. The B-1B FSD/production contract was signed January 20. 1982, the first flight was on October 18, 1984, and the first delivery to the Strategic Air Command (SAC) was on June 29, 1985. The Air Force declared IOC on October 1, 1986, when the first aircraft was placed on alert status at Dyess AFB, Texas.

OT&E ISSUES

In April 1983, the B-1B began combined development and initial operational test and evaluation (DT&E/IOT&E). As indicated in the current Test and Evaluation Master Plan (TEMP) dated March 1988 (approved by OSD in November 1988), B-1B operational effectiveness testing will evaluate: navigation reliability and accuracy; low-level penetration capability utilizing terrain following radar and terrain-avoidance avionics; survivability by addressing the defensive avionics system's ability to detect, identify, and effectively counter multiple threats in all sectors; the tail warning function's (TWF) ability to detect, display, and provide expendables (chaff/flare) pulse for airborne interceptors and air-to-air missiles; and the delivery of dissimilar weapons on multiple targets. Operational suitability issues are mission reliability and diagnostic capability. Those issues not satisfied during combined DT&E/IOT&E will be addressed in follow-on operational test and evaluation (FOT&E(1)) within operational constraints and limitations.

OT&E ACTIVITY

B-1B aircraft #9, #28, and #40 are the primary aircraft used for combined DT&E/IOT&E at Edwards AFB, California. Activities on these aircraft have emphasized such critical operational features as the offensive avionics system including automatic terrain following, the high resolution ground map function of the offensive radar system, and air alignment. B-1B #1, the first production aircraft, was delivered to Edwards AFB on October 31, 1984. It flew 138 sorties to clear weapons delivery envelopes, demonstrate handling qualities, and carry out offensive/defensive avionics testing. Throughout the flight program, the IOT&E test team has taken an active role in mission development to ensure that the objectives are incorporated and executed in as realistic an operational environment as possible. B-1B #9, the first B-1B capable of heavyweight, cruise missile, and common strategic rotary launcher activities, arrived at Edwards AFB in March 1986. This aircraft has flown 90 sorties, concentrating on performance and weapons testing. Aircraft #28 has flown 62 sorties, primarily to support flutter, vibration, and acoustics testing. B-1B #40 arrived at Edwards on February 16, 1988, to support defensive systems testing. During 1988 it flew 10 sorties. Suitability testing is being driven by the IOT&E test team at Edwards AFB, especially in the areas of technical order verification and munitions handling. Suitability data is growing rapidly through FOT&E(1) efforts at Dyess AFB. FOT&E(1) allows the test team to determine "blue-suit" capability to maintain the B-1B aircraft in an operational environment. FOT&E effectiveness testing started at IOC and is approximately 50 percent complete. The 164 sorties flown so far have been used to gather data on terrain following, Mod 0 defensive performance, weapons delivery, navigation, radar, and cruise performance. While many areas of operational effectiveness are progressing satisfactorily through OT&E, defensive systems testing is still only approximately 9 percent complete. Operational suitability data were gathered from 3,458 sorties (approximately 15,743 flying hours) flown by test team and operational personnel. Overall, the quantitative portion of the suitability evaluation is

80 percent complete, and the qualitative portion is 87 percent complete. The average sortie per available aircraft per day has steadily risen to 0.373 from 0.347 in CY 87. The desired operational requirement is 0.50 at full maturity (200,000 flying hours). Except for defensive testing and portions of cruise missile testing, most IOT&E flight testing should be complete by March. During 1988, the DOT&E staff assistant for strategic programs, an experienced test pilot, and the Director have individually flown operational B-1B test missions to gain firsthand knowledge of its operational capabilities.

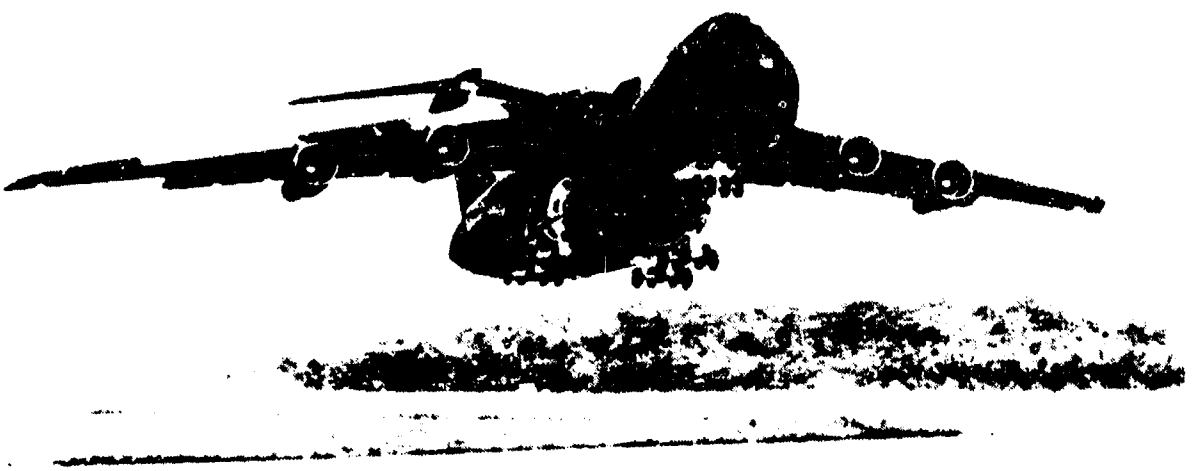
OT&E ASSESSMENT

The B-1B is now operationally deployed at four bases and is fully integrated into the Single Integrated Operational Plan. In its first head-to-head competition with other bombers, the B-1B won several key events in the SAC's annual bombing and navigation competition, Proud Shield '88. Significant progress has been made in the last year on the terrain following and aircraft flight control systems. Recent tests have successfully demonstrated automatic 200-foot flight in the hard-ride mode over rugged mountainous areas at attack airspeeds. Similarly, the stall inhibitor system (SIS I) retrofit is complete and deployed with SAC. However, a wide range of challenges still remain to be resolved in order for the B-1B to be a fully capable weapon system. These problems include aft-bay SRAM release, engine anti-ice, and an instrument landing system that is still not certified down to published minimum approach weather because of unacceptable displays being presented to the pilot. Finally, major deficiencies remain in the defensive avionics suite. Results from flight tests have revealed the AN/ALQ-161 has design deficiencies in the receiver/processor that preclude achieving full operational capability without system modification.

SUMMARY

The B-1B continues to make steady progress towards meeting its operational goals and is presently capable of performing its strategic bomber mission better than any other aircraft in the Air Force inventory. However, the lack of fully developed, operationally tested electronic warfare and tail warning function capabilities are significant deficiencies that directly affect the operational effectiveness of the B-1B. In order to define B-1B EW and TWF capabilities and deficiencies accurately, this office continues to stress the importance of conducting OT&E in as operationally representative an environment as possible.

C-5B AIRCRAFT



SYSTEM DESCRIPTION

The C-5B is a newly produced C-5A which was introduced into the airlift system in January 1986, and incorporates many upgraded subsystems to take advantage of technological advances. Functional performance of the two aircraft is identical, although changes have been made to improve reliability and maintainability, while retaining maximum commonality. With few exceptions, the major components and systems incorporated in the C-5B are the same as those currently in use on the post-wing-mod C-5A. Improvements were incorporated to correct problems discovered in the C-5A since its introduction into the Air Force inventory. These changes include improved corrosion protection and hydraulic subsystems; upgraded avionics, flight controls, and Malfunction Detection, Analysis, and Recording System; and incorporation of the latest engine configuration. System characteristics and performance are virtually the same as the C-5A, with a maximum allowable cabin load of 261,000 pounds, critical field length of 10,400 feet, and an unrefueled range of 2,850 nautical miles.

BACKGROUND

The November 1980 C-X mission element need statement (MENS) and the April 1981 congressionally mandated mobility study (CMMS) established the need for additional airlift capability beyond what was currently available. A decision by the Secretary of Defense during the FY83

budget review placed increased emphasis on near-term improvement in intertheater airlift capability and directed funding for 50 C-5B airlift aircraft. This is a unique program in that it is a sole source, firm fixed price acquisition of a system that had been out of production for a considerable period of time. The first production C-5B was the 82nd aircraft off the old production line. The production contract was awarded in December 1982, and the first C-5B flight occurred in September 1985. The 50th aircraft is to be delivered in March 1989. Previous testing of the C-5B consisted of component testing, subsystem qualification test and evaluation (QT&E), production acceptance test and evaluation (PAT&E), and combined qualification operational test and evaluation (QOT&E). Eighty-nine components have undergone various levels of qualification testing.

OT&E ISSUES

The objective of C-5B testing, conducted by the Military Airlift Command (MAC), was to refine estimates of operational effectiveness and suitability, identify operational deficiencies, propose enhancements, and evaluate system changes from the C-5A. The primary operational issues for this program were: (1) Will the C-5B perform the strategic airlift mission equally as well as the C-5A? (2) Does the C-5B meet the minimum requirement for system-level reliability, maintainability and availability? (3) Is the logistics support for the C-5B adequate to meet mission needs?

OT&E ACTIVITY

C-5B follow-on operational test and evaluation (FOT&E), which began March 15, 1987, and ended March 15, 1988, evaluated operational effectiveness and suitability. Primary emphasis was on completing those objectives not completed during QOT&E; evaluating changes and modifications made to correct deficiencies noted during prior testing; and evaluating reliability, maintainability, and availability.

Two USAF Airlift Center detachments were created, one at Dover AFB, Delaware, and another at Travis AFB, California, to monitor the introduction of this newly produced C-5 into the existing logistics and operational environment. Questionnaires, interviews, investigations, and existing management reporting systems were used to compare the C-5B to the C-5A. Testing of both C-5B and C-5A aircraft was accomplished with line assigned crew members at contingency gross weights of up to 840,000 pounds.

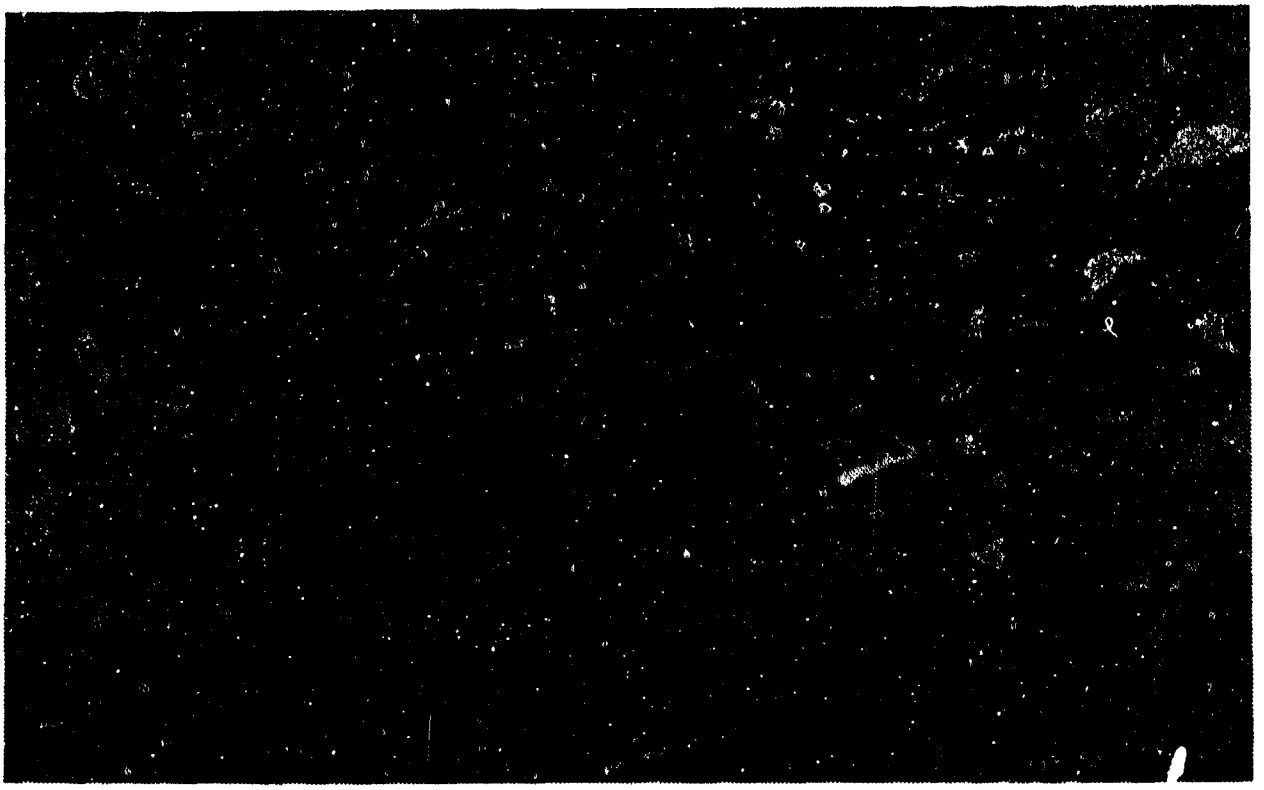
OT&E ASSESSMENT

This office agrees with the major conclusion published in the final Air Force FOT&E report that the C-5B performs the strategic airlift mission better than the C-5A. This system meets the minimum requirements for system-level reliability, maintainability, availability, and logistics support. In addition, the finding that both the C-5A and C-5B can be operated at gross weights of up to 840,000 pounds with operational aircrews will add flexibility to the strategic airlift mission.

SUMMARY

The C-5B performed well during the one-year FOT&E test period (March 1987 to March 1988). Problems in some C-5B unique systems did not deter the aircraft from out performing its older counterpart. Continued attention is needed to ensure that an adequate supply of spare parts is attained. Operations above the normal maximum gross weight of 769,000 pounds were conducted using both C-5A and C-5B aircraft. A contingency gross weight of 840,000 pounds will require some changes to technical data, but will not require any additional aircrew training.

F-15 TEWES UPDATE



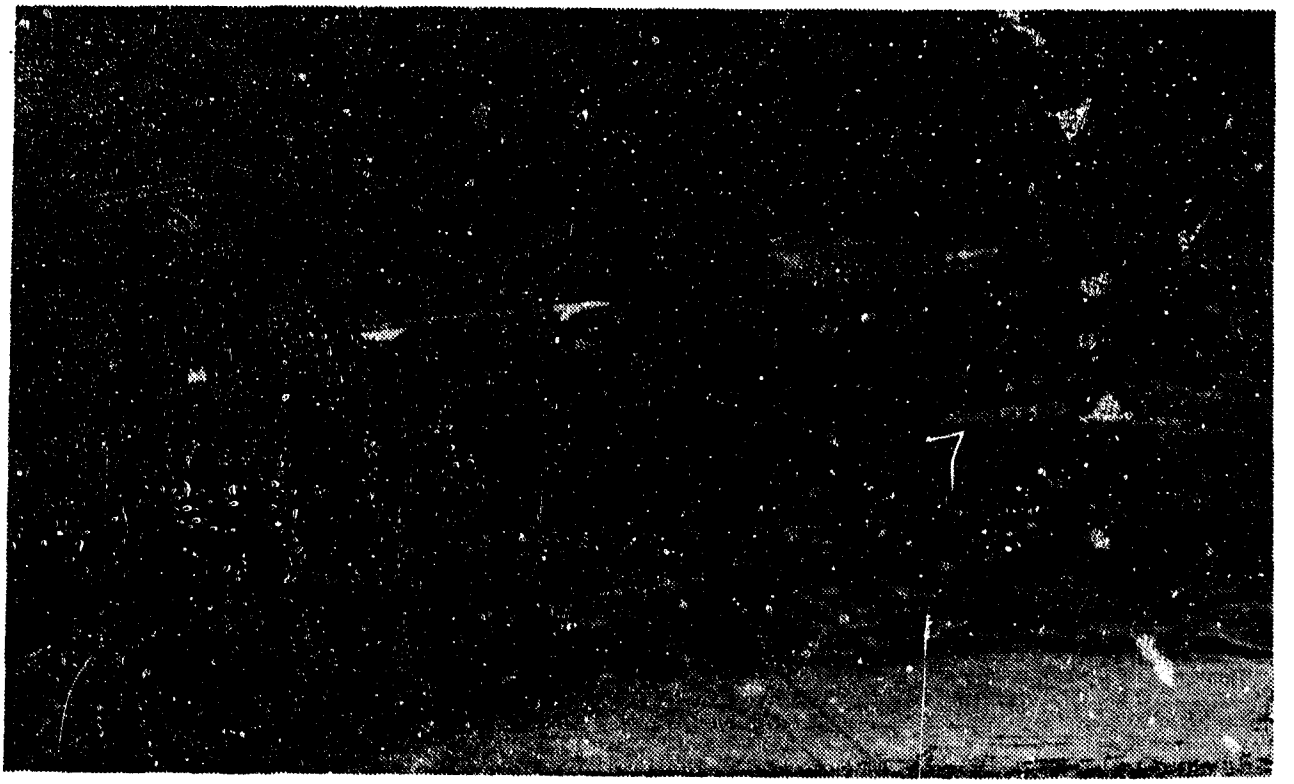
SYSTEM DESCRIPTION

The F-15 TEWES consists of the AN/ALQ-135 jammer, the AN/ALR-56 radar warning receiver (RWR), the AN/ALQ-128 electronic warfare warning set, and the AN/ALE-45 countermeasure dispenser set. The TEWES update consists of major modifications to the AN/ALQ-135 and AN/ALR-56 (AN/ALR-56C) and will be installed in the F-15D and F-15E. The other two items have been previously tested. All elements of the TEWES are internally mounted in the F-15.

OT&E ISSUES

Operational test and evaluation issues for effectiveness and suitability testing have not yet been agreed upon by our office and the Air Force. Operational testing of the AN/ALR-56C is expected to commence in 1989. Delays in the development of the AN/ALQ-135 update have required postponing operational test until 1990.

F-16



SYSTEM DESCRIPTION

The F-16 multimission fighter is a single-engine, lightweight, high performance aircraft, powered by a 25,000-pound thrust class afterburning turbofan engine. It is a tactical fighter aircraft with an air-to-air and air-to-surface multirole capability, and can be deployed with minimum en-route support. The F-16 has high reliability and simplified maintenance procedures to ensure successful operations under austere conditions. The F-16 multinational staged improvement program (MSIP) is part of the continuing modernization of US tactical fighters to reverse the upward trend in higher total investment and operating and support costs. The F-16 is employed in a complementary role with the F-15 in counter-air missions and supplements the surface-attack capabilities of the F-4, F-111, and A-10.

BACKGROUND

Air Force operational testing of the periodic MSIP block updates of the F-16C/D has been underway since the combined development and initial operational test and evaluation (DT&E/IOT&E) was conducted from January 1983 through December 1984. In addition, the Air Force Operational Test and Evaluation Center (AFOTEC) conducted independent F-16C/D IOT&E from January to April 1985 to evaluate F-16 enhancements resulting from the F-16 MSIP. The MSIP consists of phased improvements in F-16 air-to-air and air-to-surface mission ca-

pabilities by incorporating new developments in weapons and sensors. Basic changes in the F-16C/D include an improved radar (AN/APG-68), improved cockpit displays, wide-angle head-up display (HUD), increased computer speed and capacity, and provisions for future incorporation of the advanced medium range air-to-air missile (AMRAAM), the low altitude navigation and targeting infrared for night (LANTIRN) system, the airborne self-protection jammer (ASPJ), the Global Positioning System (GPS), and the ALR-74. The Tactical Air Command (TAC) began a follow-on operational test and evaluation (FOT&E) of the F-16C/D in July 1985. Block 25B F-16Cs were flown and evaluated from July 1985 to February 1986. A subsequent upgrade to the Block 25B operational flight programs (OFP) was the Block 30, which included changes to the air-to-air, air-to-surface, and routine operation computations in the F-16C avionics suite. Testing of F-16C/D Block 30 OFP and some hardware changes was done from February to September 1986 and reported in our FY87 Annual Report. After basic Block 30 testing, additional upgrades (Block 30E) to the aircraft hardware and software were incorporated to further improve capability, decrease pilot workload, and improve training potential. FOT&E F-16 Block 30E operational effectiveness and suitability testing was concluded in FY88 and is briefly summarized here.

OT&E ISSUES

The critical operational effectiveness issues evaluated in F-16 Block 30E FOT&E included assessing the effect of MSIP upgrade on F-16 performance in the operational environment, examining the most effective means of employing the F-16 Block 30E in the air-to-air and air-to-surface environments, identifying the tactical limitations on the F-16C Block 30E, and assessing whether the Block 30E OFP provides the intended capability. Test limitations included munitions, instrumentation, and range/airspace availability at Luke AFB, Arizona, which restricted available scenarios and required test support facilities which caused FOT&E to be done primarily in a desert/mountain environment. There were no AMRAAM missiles available for evaluation with Block 30E software, and the Block 25B airframes used F100-PW-200 engines. In addition, operational effectiveness testing included a separate evaluation of the electronic counter-countermeasures (ECCM) features of the F-16C's APG-68 radar.

The critical operational suitability issue was evaluation of the supportability of the F-16C in the field by Air Force personnel. Limitations to test were the use of interim publications and preliminary technical data. Software documentation was not available for evaluation.

OT&E ACTIVITY

Seven hundred and forty-five sorties were flown by the 57th Fighter Weapons Wing at Luke AFB and Nellis AFB, Nevada, from August 1986 to February 1988 to evaluate operational effectiveness of the Block 30E upgrade to the basic Block 30 system. Deployments were flown to Nellis AFB for live ordnance and special weapons testing and to Eglin AFB, Florida, for live Sidewinder and Maverick missile firings and electronic counter-countermeasure testing. APG-68 radar ECCM testing was accomplished at Eglin, Tyndall, and Nellis Air Force Bases using 91 sorties by the Tactical Air Warfare Center.

OT&E ASSESSMENT

Testing showed that changes incorporated in the Block 30E OFP for routine operations functioned as designed. Changes for programmable clutter and auto identification, friend or foe, while mechanically correct, were difficult to use. Block 30E improvements enhanced air-to-air displays and radar performance. Improved radar

performance greatly enhanced pilot situation awareness, increased detection range, and improved track retention. The basic ECCM capabilities of the APG-68 radar when confronted with noise or deception jamming were identified. Sidewinder missile algorithm accuracy appeared valid.

Improvements in air-to-surface operations were noted in computed weapons delivery for standoff dive/toss mode, maximum toss computations in continuously computed reference point, no solution mechanization, and reversion to barometric mechanization.

Block 30E improvements in radar performance, cockpit controls, and displays reduced task complexity and increased situation awareness. Although Block 30E changes provided a potential for better trained pilots, training feedback is degraded with a single video recorder on an aircraft with multiple displays and complexity.

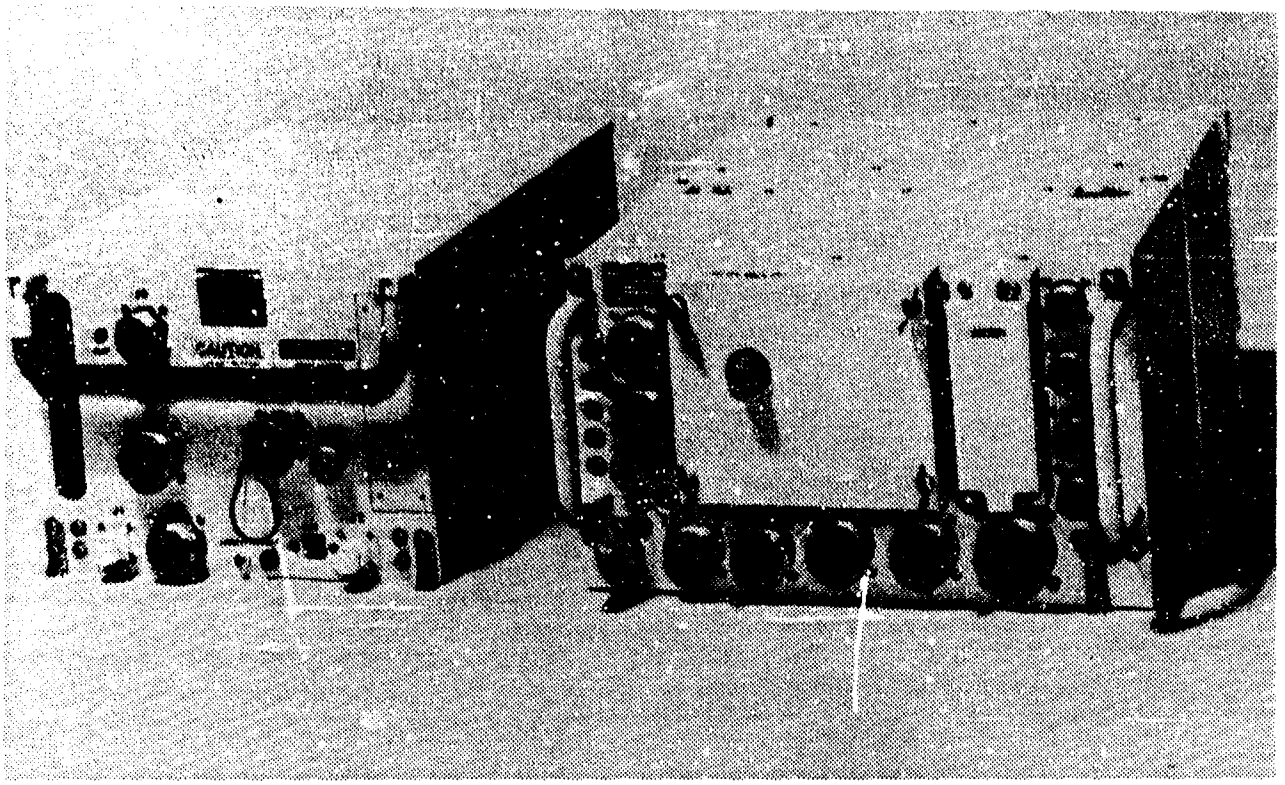
Assessments of F-16C availability, reliability, maintainability, and supportability were based on data gathered from test assets as well as compatible suitability data available from other units employing the same aircraft models. Test results showed that most F-16C operational suitability thresholds were met or exceeded. Exceptions were technical data and qualitative maintainability.

SUMMARY

The Block 30E OFP on the F-16C provided an overall improvement in capability to accomplish current F-16C missions. Significant improvements were noted in air-to-surface, air-to-air, and radar performance. Results of the ECCM testing will be used to correct deficiencies in the current hardware and software of the APG-68 radar. Air-to-surface weapons employment with conventional ordnance was satisfactory although some problems observed in previous testing still remain. Further improvements in weapon delivery employment modes and accuracy with specific weapons are required. Degraded turning performance caused by increased gross weight and leading edge flap schedule continue to detract from operational effectiveness.

Overall F-16C operational suitability is considered satisfactory in most areas. Availability, reliability, and maintainability are satisfactory. Qualitative maintainability was satisfactory except for the unavailability of card pullers. Logistics supportability was satisfactory, except for marginal technical data. Both of these problems should become less significant as the F-16 support system matures.

JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM (JTIDS)



SYSTEM DESCRIPTION

The Joint Tactical Information Distribution System (JTIDS) is a jam-resistant and secure digital communications terminal being developed for integration into various weapons systems and facilities of each Service and allied countries to provide communications (data and voice), navigation, and identification (CNI) capabilities for joint and combined military force operations. A JTIDS configuration designated as the Class 1 terminal has been integrated into Air Force and allied country operational E-3 aircraft. The JTIDS Class 1 terminal has also been integrated into the Air Force operational adaptable surface interface terminal (ASIT) shelters to provide an interface between tactical air control system (TACS) elements and the joint tactical air operations (JTAO) JTIDS network consisting of the E-3A airborne warning and control system (AWACS), F-15 aircraft, and Army air defense components. A smaller and higher capacity Class 2 JTIDS terminal was developed for integration into F-15 aircraft, other-Service key tactical platforms, and eventual replacement of the Class 1 terminals. The Class 2 terminal is bilingual and can process both the new tactical digital information link J (TADIL J) formats and the interim JTIDS message specification (IJMS) messages used by the JTIDS Class 1 terminal to allow JTAO network inter-

operability and enhance mission effectiveness.

JTIDS communications are conducted in a time-division, multiple-access (TDMA) protocol which permits operation on a single net or on multiple nets to share information in near real-time. JTIDS information is broadcast omni-directionally at high data rates and can be received by any terminal within line-of-sight propagation range. Each terminal can be set to select or reject each message according to its need for that information. A JTIDS equipped platform can use on-board navigation, weapons, and radar systems to automatically feed status information into the integrated JTIDS terminal and then to a JTIDS net. Information can include target data; JTIDS platform position, velocity, and status; and command messages.

BACKGROUND

JTIDS is a major defense acquisition program. The Air Force is the lead Service for the program, which combined Navy and Air Force efforts from separate research and development programs in the 1970s. The Air Force and Army developed terminals with the TDMA architecture. In October 1985, the Navy joined with the Air Force to use TDMA modules for integration into selected platforms, excluding the F/A-18. Also in 1985, the Army initiated development of a reduced size and capability Class 2M terminal for integration into Army ground systems. The Army does not plan to use JTIDS in aircraft. Power amplifiers are being added to the Air Force Class 2 terminal to create a Class 2H terminal for use in TACS elements and for replacement of the E-3A AWACS Class 1 terminal. Navy E- 2C, F-14D, and ships will also use a power amplifier with the Class 2. Plans are now being made to develop a lower volume (LV) terminal or multi-function information distribution system (MIDS) for NATO applications and for smaller US aircraft (e.g., F-16 and F/A-18).

An initial operational test and evaluation (IOT&E) of JTIDS Class 2 terminals which were integrated into Air Force F-15 aircraft and Army air defense components was conducted in FY87. This IOT&E utilized the Class 1 equipped E-3A AWACS and JTIDS Class 1 ASIT to form a JTAO network for testing purposes. IOT&E results were intended to provide information for a mid-FY87 low-rate initial production (LRIP) decision. The LRIP decision has been delayed until FY89 to allow the JTIDS terminal contractor time to demonstrate improvements in reliability and to conduct additional field tests of improved JTIDS Class 2 hardware and software with improved aircraft integration.

OT&E ISSUES

Current issues still concentrate on the extent to which IOT&E results can confirm that the items actually tested are effective and suitable in expected JTAO combat scenarios. IOT&E adequacy was significantly decreased by limitations in the quantity and mobility of Army air defense systems resulting from unsuitable JTIDS Class 2 terminal reliability. The inadequate JTIDS terminal reliability resulted in no Army certification of readiness for IOT&E and a reduction in realism of JTAO utilization of JTIDS during the tests. There were limitations inaccurately portraying the threat throughout the IOT&E including the McDonnell Aircraft F-15 manned air combat simulator facility and at Eglin AFB ranges. Performance thresholds for message success rate (MSR) for E-3A AWACS and/or ASIT messages to the F-15 aircraft were evolved over the IOT&E period; one of the two was not always available to the F-15; and the minimum standard for an individual E-3A or

ASIT link was reduced from 80 to 50 percent MSR.

The multi-Service test and evaluation master plan (TEMP) and IOT&E plans were not fully approved by OSD. Efforts are continuing to obtain Air Force submittal of a multi-Service TEMP which includes multi-Service operational field system test data to validate manned simulations and to confirm JTIDS operational effectiveness during JTAO scenarios each with realistic mission scenario representations. Improvements are required in the August 26, 1988 draft TEMP to include additional tests before the planned June 1989 Defense Acquisition Board (DAB) decision on low-rate initial production (LRIP).

OT&E ACTIVITY

A multi-Service test team conducted IOT&E of the JTIDS Class 2 system from August 12, 1986, through April 17, 1987. The Air Force operational Test and Evaluation Center (AFOTEC) was the lead agency for IOT&E activities. Testing was conducted in three phases at three locations. The first phase was conducted from August 12 to September 25, 1986, at the McDonnell Aircraft F-15 manned air combat simulator facility in St. Louis, Missouri, where 243 simulator engagements were conducted. The F-15 flight test phase was conducted at both the Tyndall AFB and Eglin AFB ranges in Florida from December 2, 1986, to April 17, 1987, with 56 flight engagements during Air Force target efficiency tests. The third phase of testing was conducted from February 23 to April 17, 1987, at Eglin AFB, where the Air Force made 25 flight engagements during multi-Service testing. The JTIDS ASIT follow-on operational test and evaluation (FOT&E) was conducted at Duke and Hurlburt Fields, Florida, from November 1986 to April 1987 and provided the TACS interface during Class 2 IOT&E flight testing phases.

Other modeling, simulation, and analyses have been conducted to support or potentially supplement results from field testing. This includes link connectivity analyses with the TAC JAMIT model, data-link vulnerability analyses (DVAL), and modeling by Teledyne Brown Engineering. Test support was also performed by the MITRE Corporation and the Joint Electronic Warfare Center (JEWC). AFOTEC is preparing a report of additional conclusions and analyses of IOT&E data to support planning of future testing to resolve open issues concerning jamming resistance and ground-to-ground propagation.

The JTIDS Class 2 terminal contractor announced in August 1988 that the Class 2 terminal had been improved in reliability through laboratory testing to over 300 hours MTBF as compared to approximately 50 hours laboratory MTBF prior to the IOT&E. Testing in F-15 aircraft is planned for January 1989.

OT&E ASSESSMENT

IOT&E testing, although limited, was adequate to determine that the F- 15's defensive counter-air (DCA) mission was enhanced in a benign Air Force-only DCA environment. F-15 target efficiency flight test results indicated that JTIDS contributed to reducing the proportion of hostile bombers reaching their targets from 72 to 57 percent and increased the proportion of hostiles targeted by F-15s from 45 to 55 percent. These flight test results are not claimed to be statistically significant, but do include the realism of live systems versus the McDonnell Aircraft digital simulation. Improved situation awareness and mutual support were cited by the F-15 test pilots as the major contributors to JTIDS-equipped DCA mission effectiveness. This situation awareness increased the capability to determine hostile formation ge-

ometry. More F-15s were also engaged by hostile fighters during flight tests, reducing F-15 survivability as compared to simulation, which had perfect but unrealistic net tracking of hostiles. Flight tests at Tyndall AFB resulted in an increase in the fraction of F-15s targeted by hostiles from 10 percent without JTIDS to 24 percent targeted when using JTIDS. The McDonnell Aircraft simulation indicated that using JTIDS reduced the fraction of F-15s targeted by hostiles from 45 to 23 percent. Results have not been sufficient, and additional data is likely to be required to conclusively confirm F-15 operational effectiveness in DIA validated jamming threat scenarios and multi-Service JTAO missions. Further, the Air Force requirements for message success rate on key links were evolved over the IOT&E period and require additional Service review to establish appropriate requirements for all platforms. Some system-level issues were raised but not resolved by IOT&E results concerning use of relays, net capacity and management voice techniques and interoperable voice networks, and track correlation accuracy. For example, the known track inaccuracies of the E-3A and CRC were automatically distributed on the JTIDS net and displayed on the F-15 and other JTIDS displays without any indication of the inaccuracy to the viewer.

Testing, although limited, was adequate to determine that JTIDS performance in Army ground air defense missions was neither effective nor suitable. Performance was unsatisfactory for Army ground systems and was marginal to unsatisfactory for similarly affected ASIT systems during tests at Eglin AFB. The Army operations also identified fundamental problems with JTIDS ground-to-ground links due to signal propagation during the multi-Service phase of testing. It became clear that, in a European environment, Army forward links may be reduced and much taller antenna masts and/or additional relays would be required to establish links. ASIT Class 1 operations also identified ground-to-ground link problems. These problems raised questions concerning JTIDS operational effectiveness as a dedicated ground-to-ground data distribution medium for the Army. As a result, earlier decisions by Army doctrinal and material developers are still being reevaluated to determine further direction. The AFOTEC ASIT FOT&E report also recommended additional testing, which has not been completed, to determine key link availability.

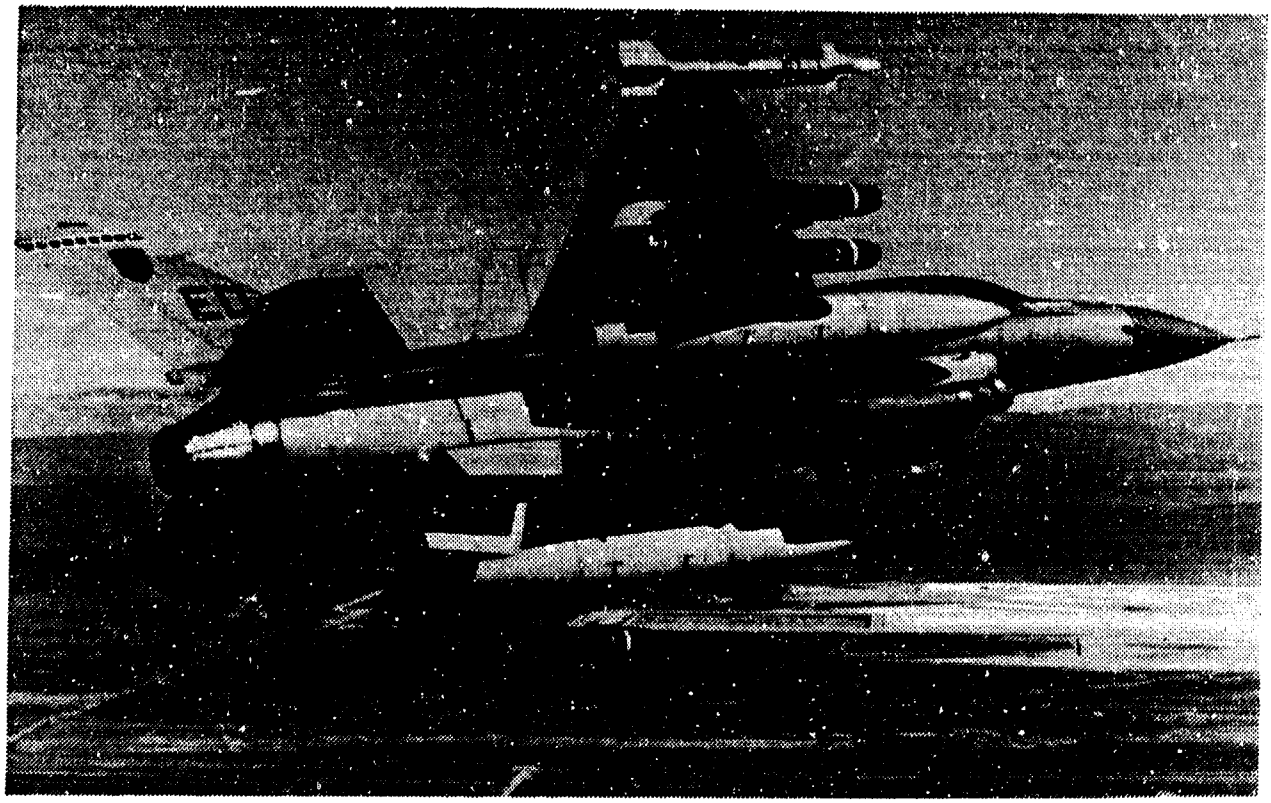
As expected from development testing prior to IOT&E, JTIDS terminal reliability and maintainability performance was not operationally suitable and has received the most attention since completion of IOT&E at Eglin AFB. These deficiencies were detected during development tests at Eglin and contributed to a reduction of IOT&E realism and Army participation in the operational tests. IOT&E mean time between critical failure (MTBCF) was found to be approximately 20 hours as compared to the requirement of 120 hours. The mean time between maintenance was found to be approximately 7 hours as compared to the requirement of 115 hours. The built-in-test was able to detect only 64 of 159 failures and was able to isolate faults to a line replaceable unit only 55 of 159 times. Contractor laboratory testing since IOT&E has improved the laboratory demonstrated hardware reliability to over 300 hours MTBF as of August 1988.

SUMMARY

Limited operational test and evaluation or analysis of additional reports and data may be necessary to clarify system performance, operational implications of ground-to-ground propagation, and key link MSR requirement variations prior to a low-rate initial production (LRIP) decision. AFOTEC is preparing an additional report and data from experiments and

analyses of Class 2 IOT&E data. DOT&E is still reviewing these issues with the Services and other OSD offices in preparation for testing planned to begin in January 1989 and for the DAB planned in June 1989. Additional multi-Service operational test and evaluation will definitely be required to confirm system performance prior to a JTIDS full-rate production decision. DOT&E approval of the TEMP will document these agreements.

LOW ALTITUDE NAVIGATION AND TARGETING INFRARED FOR NIGHT SYSTEM (LANTIRN)



SYSTEM DESCRIPTION

The LANTIRN system is being developed to fulfill the need for a night attack capability in the close air support, battlefield interdiction, offensive counter-air, and air interdiction mission areas. The system is designed for use on F-16C/D and F-15E aircraft and consists of a wide field-of-view (WFOV) head-up display (HUD), a navigation (NAV) pod, and a targeting pod. The head-up display is an electro-optical device which computes flight, navigation, and weapon-delivery information and displays it in the pilot's line of sight. The NAV pod contains a forward-looking infrared receiver (FLIR), a terrain-avoidance radar, and subsystems for servo-control. The targeting pod functions include FLIR imaging, laser designation, precision pointing and tracking, and missile boresight correlation for AGM-65D Maverick missile handoff and lock-on.

BACKGROUND

Combined development test and evaluation/initial operational test and evaluation (DT&E/IOT&E) of the LANTIRN system began in July 1983. The LANTIRN program was restructured in August 1984 as a result of lagging target pod development, budget constraints, and unavailability of F-16 test-bed aircraft.

After program restructuring, IOT&E of LANTIRN began in October 1984 and was

completed in two phases, which ended in April 1986. IOT&E test results supported a full-production decision for the NAV pod, while FOT&E was planned to evaluate corrections to targeting pod deficiencies before making a full-production decision for that LANTIRN component. The DOT&E beyond low-rate initial production report to the Congress and the Secretary of Defense (November 14, 1986) addressed the adequacy and results of the IOT&E of the NAV pod. Our FY86 Annual Report covered the results of the IOT&E of the complete LANTIRN system.

In FY87 the Air Force conducted Follow-on Operational Test and Evaluation, Phase One (FOT&E(1)) from February to July 1987. This focused on the LANTIRN targeting pod. Of the seven effectiveness objectives addressed in IOT&E and FOT&E(1), DOT&E considered two to be satisfactory in this last phase of operational testing--Maverick missile delivery capability and LANTIRN controls and displays. Laser-guided bomb (LGB) delivery capability was considered to be marginal. Unguided weapon delivery testing was incomplete, although the single tested unguided mode of conventional delivery showed satisfactory results. Navigation capability with LANTIRN, survivability, and EOCM vulnerability had been judged satisfactory in previous testing. The capability to integrate the LANTIRN navigation pod into the tactical air forces was evaluated, and F-16 pilot workload was satisfactory for the LANTIRN navigation and terrain following tasks. Integration of the targeting pod was not addressed in FOT&E(1), although pilots using the complete LANTIRN system will require high levels of training to maintain proficiency with the targeting pod. Fighter squadrons using LANTIRN will require increased support in some areas such as weather and intelligence.

The operational suitability evaluation of the entire LANTIRN system was addressed by five objectives in FOT&E(1). DOT&E considered logistics support reliability, mission performance reliability, and availability to be satisfactory. We rated overall system maintainability marginal - primarily because of targeting pod nose/roll section alignment times, coolanol leaks, water intrusion, and built-in test (BIT) mechanization. Contractor maintenance was used throughout the test, and estimates of Air Force capability were made using over-the-shoulder observations. As in previous testing, the logistics supportability evaluation was incomplete because integrated logistics support elements were not available during the test.

Our FY87 Annual Report discussed the results of the FOT&E(1) of the complete LANTIRN system. Based on FOT&E(1) test results and the Director's concerns about test limitations, the Air Force rescheduled the full-rate production decision for the targeting pod to October 1988. The Air Force continued low-rate production for the targeting pod, but did not change FY87 planned production quantities. In October 1988, due to problems with the laser in the production targeting pod, the Air Force again continued low-rate production at the FY87 quantity. The Air Force decided to enter full-rate production and briefed the Director on test progress, after the laser problem was solved in December 1988. A Beyond Low-Rate Initial Production Report on the targeting pod was submitted to the Congress on December 28, 1988.

OT&E ISSUES

At the conclusion of FOT&E(1), the Director, Operational Test and Evaluation, and Air Force officials agreed to 18 decision criteria to be used to assess the progress of LANTIRN testing and correction of deficiencies and test limitations identified in FOT&E(1). Nine of the 18 were concerned with reliability and maintainability issues, and nine focused on aircraft integration and weapon delivery capability.

The reliability issues addressed laser reliability design, improved quick disconnects, improved slip rings, water intrusion, production design coolers, targeting pod/intermediate support equipment, built-in-test fault reporting, targeting pod maintainability verification testing, and targeting pod maintainability improvements. Four criteria were focused on demonstrating production navigation and targeting pods on production F-16 Block 40 and F-15E aircraft. Weapon delivery criteria involved improved LGB delivery capability, demonstration of the wide field-of-view on the targeting pod, F-16/navigation pod weapon delivery, F-16/targeting pod weapon delivery, and F-15E/LANTIRN weapon delivery.

Assessment of LANTIRN suitability has been an OT&E issue because of contractor maintenance on the LANTIRN system. Contractor maintenance in the initial stages of LANTIRN deployment has been the Air Force concept for LANTIRN maintenance since its development. At the direction of the DOT&E, the Air Force will conduct an evaluation of "blue-suit" maintenance capability with the LANTIRN system when production equipment, support equipment, and trained Air Force personnel are available in FY89. In the interim, the Air Force has certified that contractor maintenance and support for the LANTIRN system will be contracted for at a level equivalent to that used during IOT&E.

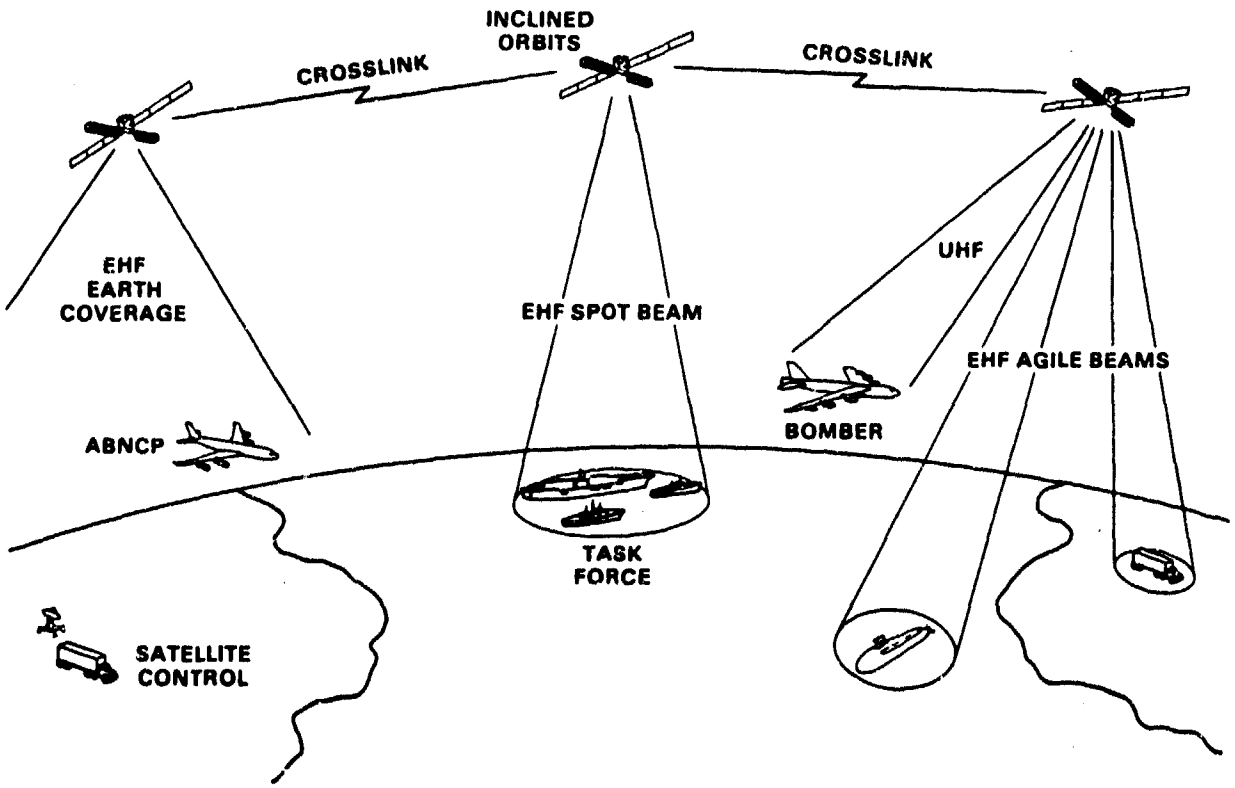
OT&E ACTIVITY

There was no formal scheduled phase of operational testing for LANTIRN in FY88. Developmental testing continued and operational test pilots flew test and training sorties with upgraded FSD LANTIRN pods to maintain currency with LANTIRN and prepare for upcoming IOT&E on the F-15E and F-16 Block 40. Both of these IOT&Es will use the production LANTIRN system. DOT&E staff members monitored suitability improvements and integration/weapon delivery progress as outlined in the decision criteria agreement. The Director flew LANTIRN sorties in both the F-15E and the F-16.

SUMMARY

The LANTIRN system provides a night, single-seat, low-altitude operational capability that does not currently exist in the tactical air forces. In FY87 FOT&E(1) identified deficiencies that required correction and test limitations that needed to be overcome before the Director would support full production of the targeting pod. FY88 testing made considerable progress in both these areas and, in early FY89, LANTIRN testing was adequate to satisfy the 18 decision criteria and support a full-rate decision for the targeting pod. A B-LRIP Report on the Targeting Pod was submitted to the Congress on 28 December 1988.

MILSTAR



SYSTEM DESCRIPTION

Milstar is designed to extend our present military satellite communications (MILSATCOM) capabilities by emphasizing jamming resistance, survivability, and global connectivity for strategic and tactical users, the intelligence community, and secure transmission. It will provide global communications through a constellation of geosynchronous satellites at high and low inclination orbits. This constellation will service networks employing approximately 1900 relatively small and mobile terminals for use on land, sea, and air platforms. The system operates at 44 and 20 GHz, the highest frequencies used in our present MILSATCOM systems. (The Defense Satellite Communications System operates at approximately 8 GHz). Milstar incorporates frequency hopping, interleaving (to reduce scintillation effects from atmospheric nuclear bursts), and the proliferation of its decentralized satellite constellation control stations to enhance its survivability features. Existing user equipment from all services (e.g., teletypes, digital voice terminals, and facsimiles) can connect directly to the automated Milstar terminals to provide "transparent" links between users.

BACKGROUND

Present MILSATCOM systems are not designed to survive a nuclear detonation environment and are susceptible to jamming and antisatellite (ASAT) interceptors. Milstar is designed to survive significantly

higher levels of these threats and to continue to provide minimum essential global communications for periods of many months following the initial exchanges in a nuclear scenario. The Air Force has lead Service development and OT&E responsibility, and all three Services are developing terminals for their respective platforms. Initial production decisions for two of the three segments, space and mission control, were made in November 1984. The third segment, terminals, is in full-scale development, with initial production decisions scheduled for 1989. The first full-scale Milstar production satellite is scheduled for launch in the early 1990s. A surrogate Milstar payload with limited capability was placed into orbit on a FLTSATCOM satellite in late 1986 and is now being employed successfully for development and operational testing of the terminals.

OT&E ISSUES

The major Milstar OT&E issues are: (1) communications resource management, (2) constellation control, (3) system survivability, (4) communications connectivity, and (5) operational suitability. Specific issues resulting from the generally successful OT&E-pertinent activity in FY88 include:

o Multi-Service OT&E planning and the integrated analysis of the results. The Air Force, as lead Service, must improve the coordinated planning of system OT&E pertinent events occurring prior to the first Milstar launch in the early 1990s and the timely analysis (from a systems perspective) of pertinent data as it becomes available. Examples include updates to the validated requirements and the operational concepts, the preparation of an integrated system survivability OT&E plan, the preparation of representative network management protocols to support OT&E, the analysis of existing data to determine operational limitations due to rain at low satellite elevation angles, and the preparation of system early operational assessments.

o Terminal maintainability. This problem was the most prominent issue revealed in the initial Navy terminal OT&E. It includes the viability of the built-in test concept.

OT&E ACTIVITY

Initial OT&E of the Navy Milstar terminal was conducted in March-May 1988. The results demonstrated potential operational effectiveness and suitability, and defined areas for further development effort. A successful demonstration of all three Services' terminals interoperability and compatibility with the orbiting FLTSATCOMEHF Package (FEP) was conducted in July 1988. Simulated operational messages were sent over voice and teletype channels. During 1988, terminals operated successfully with FEP from ship, submarine, aircraft, and ground platforms. All three terminals have operated with a ground-based breadboard Milstar payload.

OT&E ASSESSMENT

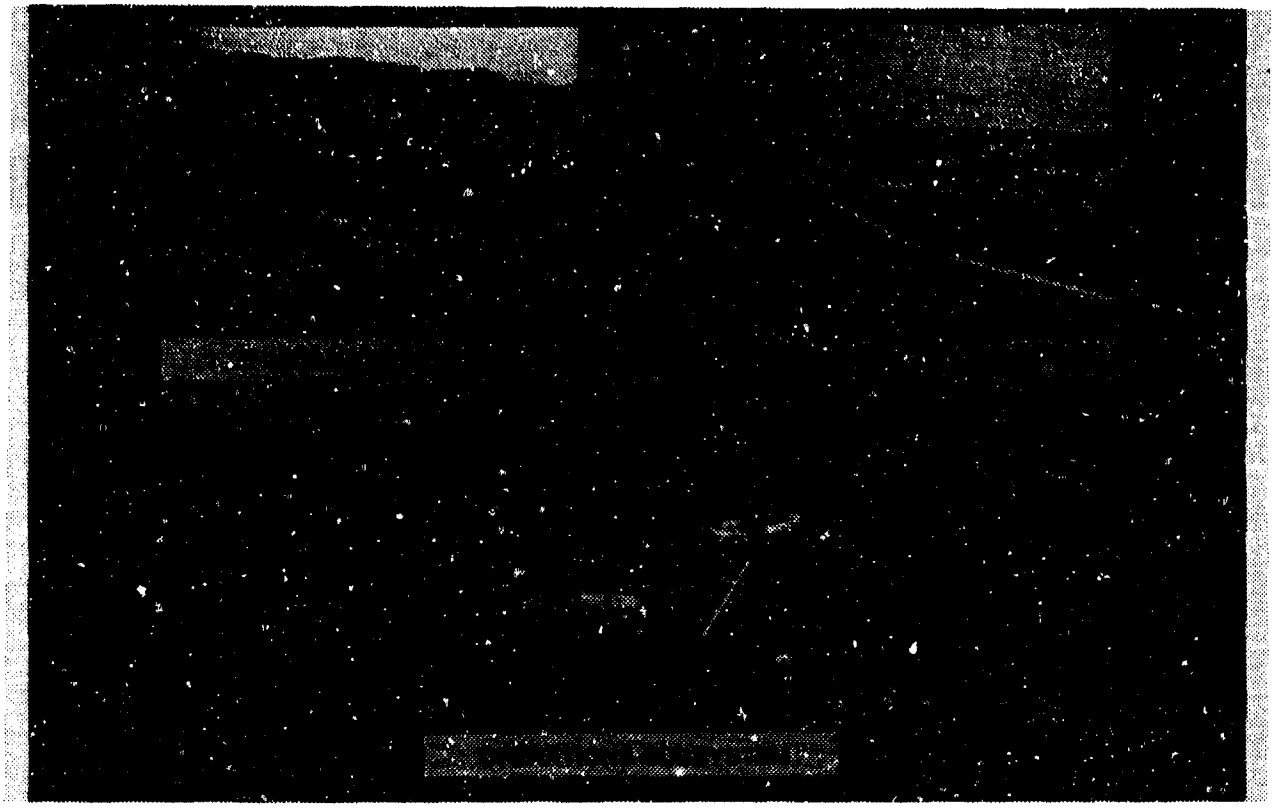
OT&E activities conducted in FY88 (involving the terminals of all three Services and the breadboard satellite payload) provide strong evidence the Milstar system will eventually become operationally effective and suitable. The test activity revealed the need for Navy terminal maintainability improvement. The Navy is currently making a concerted effort to resolve this issue. Little information pertinent to OT&E is available for the space and mission control segments, which are scheduled for integration and test in FY89.

SUMMARY

A substantial number of OT&E activities conducted in FY88 yielded encouraging results and thus indicate no major obsta-

cles to the eventual operational effectiveness and suitability of the Milstar system. The results provided evidence for the successful resolution of a major system requirement: terminal interoperabil-ity and compatibility with the satellite payload. However, before overall system operational effectiveness and suitability can be validated, considerably more OT&E remains to be accomplished, particularly in the space and mission control segments.

OTH–B



SYSTEM DESCRIPTION

The over–the–horizon backscatter radar (OTH–B) provides long–range detection, tracking, and correlation of airborne targets. The system consists of separate transmit and receive antennas and a control system.

BACKGROUND

The current OTH–B has been under development since feasibility demonstrations of an East Coast system in 1981. Individual sectors of the system have been operated by TAC personnel since 1987. Difficulties in integrating sectors have precluded operational tests. Final developmental tests are scheduled to begin in early 1989 and operational testing may begin in 1989.

PEACEKEEPER MISSILE



SYSTEM DESCRIPTION

The Peacekeeper missile is a three-stage ICBM designed to deliver up to 10 MK-21 multiple independently targeted reentry vehicles (MIRVs). The missile is approximately 71 feet long and 92 inches in diameter, and weighs about 195,000 pounds. Peacekeeper is the first US ICBM to use a cold launch exit from its launcher. The first three stages use solid propellants, achieving thrust-vector deflection with single stage movable nozzles. The second and third stage nozzles use specially designed extendible exit cones. The three boost stages produce most of the velocity needed for intercontinental range. The liquid fueled post boost vehicle provides any needed velocity and attitude corrections prior to release of the MK-21 MIRVs. The missile is being deployed in modified Minuteman launch facilities containing operational support equipment to provide communication and launch functions. Operational control is exercised through Strategic Air Command (SAC) personnel in hardened Minuteman launch control centers or airborne launch control centers. This missile represents an improvement over previous ICBMs, being able to deliver more MIRVs per missile over a larger footprint and with better accuracy.

BACKGROUND

Full scale development of this intercontinental missile was initiated in 1979. A four-phase, 20-launch test program was planned. The combined development and

operational test and evaluation (DT&E/OT&E) commenced in September 1982, with ground activities at Vandenberg AFB, California, using an inert missile to verify compatibility of facility and procedures prior to assembly and launch of the first flight missile in June 1983. Phase I of the missile-launch program ended with the successful launch of the fifth Peacekeeper on June 15, 1984. The second phase of testing was completed with the successful thirteenth launch on August 23, 1986. Phase III ended successfully with the sixteenth launch on February 13, 1987. The last phase of flight testing (operational system verification) will be completed with the final three flights. This phase will further verify operational procedures and any configuration block changes.

OT&E ISSUES

Combined DT&E/OT&E is investigating the following issues as identified in the Peacekeeper in Minuteman Silos Test and Evaluation Master Plan (TEMP), approved by OSD in April 1987: (1) mission effectiveness, which addresses targeting efficiency, alert availability, and weapon system reliability; (2) probability of damage, which addresses weapon system accuracy, weapon yield, and target hardness; (3) survivability, which addresses capabilities of the hardware to perform critical functions after being subjected to nuclear weapon effects; (4) weapon system integration, which addresses and verifies interoperability of new and existing systems, support equipment, and facilities; and (5) weapon system operation and support, which encompasses logistics reliability, maintainability, support equipment, transportation and handling, technical data, supply support, and manpower and training.

Two primary system-level measures of effectiveness are used to quantitatively measure the degree to which the system performs its operational task. The first, the Mission Effectiveness Factor (MEF), projects on a total force level the percentage of deployed warheads that would produce a nuclear detonation in their planned target areas during wartime execution. The second, Probability of Damage (Pd), expresses the probability that the resulting nuclear detonation would inflict damage on the intended targets. These are expressed as follows:

MEF = Targeting Efficiency x Alert Availability x Weapon System Reliability. Pd is a function of weapon system accuracy, warhead yield, and target hardness.

From the above relationships, weapon system reliability and accuracy are directly testable and are products of the combined DT&E/OT&E program. Warhead yield and target hardness are provided, respectively, by the Department of Energy and SAC. The remaining areas (survivability, weapon system integration, and system operation and support) are being addressed by qualitative assessments.

OT&E ACTIVITY

Seventeen of 20 planned test flights have been completed at the Western Test Range at Vandenberg AFB, California. The operational system verification phase (Phase IV) of the flight test program is continuing.

Several significant test events of the Common Airborne Launch Control Center (CALCC) were conducted January-May 1988. In January, extensive evaluation of new CALCC software successfully demonstrated Minuteman/Peacekeeper transmit and process commands. In addition, missile status was correctly received and processed by an uplink to the CALCC. An Emergency Rocket Communication System test sequence demonstrated good range capability for the newly modified Pacer Link radio systems. In February 1988, a CALCC flight over Vandenberg AFB successfully demonstrated

Peacekeeper remote retargeting capability. A flight test in April 1988 demonstrated successful relay transmissions between the CALCC and the airborne launch control center.

A dry run test of the eighteenth missile flight test (FTS-18) for the CALCC was flown in May 1988. This flight entailed demonstrating all launch and contingency procedures for an FTS-18 launch using the CALCC. Both flight and ground personnel were involved in this test, and successfully accomplished a simulated launch count using a ground test missile. Although three flights still remain in the test program, DOT&E agrees with the Air Force that it is prudent to delay these flights until development activity and resolution of anomalies are complete. However, DOT&E continues to stress the importance of completing the remaining flights as soon as possible. FTS-18 is scheduled for the first quarter of 1989 and will evaluate operational software and hardware. FTS-19 and 20 are scheduled during the last quarter of 1989.

OT&E ASSESSMENT

We evaluate reentry vehicle accuracy in terms of circular error probable (CEP). Although during testing some reentry vehicles impacted slightly outside the pre-specified circle size, the overall CEP is within that circle. We consider three of the 17 missions flown to date to have been operationally representative in terms of hardware, software, and procedures. The composite accuracy on those three was also within the specified CEP value. The calculated mission effectiveness factor exceeds SAC requirements. Probability of damage (Pd) calculations for all 17 flights resulted in a value which is also better than that specified by SAC. The calculated Pd for the operationally representative missions also exceeds the SAC requirement. Tests of the CALCC demonstrated the capability to transmit critical launch commands. Delays in deliveries of operational inertial measurement units (IMUs), which plagued the system last year, are no longer a problem. All but three operational Peacekeeper missiles are in place in their designated silos. The final three should be delivered by the end of CY88.

SUMMARY

Although some engineering tasks remain and there is a continuing effort to correct the small impact errors experienced, accuracy and reliability during flight are exceptional. The need to supply operational units with operational guidance systems has delayed the remaining three test launches. Specific delays were caused by poor reliability of the accelerometer in the IMUs. Overall, the OT&E for Peacekeeper in Minuteman silos is progressing satisfactorily. The next launch, FTS-18, is expected to answer several of the remaining OT&E questions. Specifically, this flight will determine if the Peacekeeper can be launched by the CALCC aircraft and if satisfactory relay capability can be demonstrated from one CALCC to another. It will also demonstrate a missile launch using battery power.

TACIT RAINBOW



SYSTEM DESCRIPTION

The Tacit Rainbow is an attack missile system which is capable of searching out and attacking enemy radar targets in such mission areas as defense supression, counter air, interdiction, and close air support. Elements of the system include the missile, mission planning systems, and a rotary launcher for the B-52. The missile is programmable before launch and can loiter while waiting for targets. The Tacit Rainbow missile will be carried externally on the Navy A-6E and internally on the Air Force B-52.

BACKGROUND

Tacit Rainbow was initiated as a directed sole source program in July 1981 for full-scale development (FSD) of a low-cost, modular, autonomous missile capable of searching out and attacking enemy air defense radars. FSD was authorized in June 1986. Tacit Rainbow contractor development testing began in April 1987. The DOT&E approved the initial TEMP for Tacit Rainbow in November 1987. Combined DT/OT was scheduled to begin in October 1987, but has been delayed for more than a year due to technical problems encountered in contractor testing.

OT&E ISSUES

To date, operational test planning has identified critical issues for evaluation which include guidance, availability, reliability, lethality, interoperability, compatibility, sortie generation, and mission plan-

ning. DOT&E considers known limitations to test to be excessive.

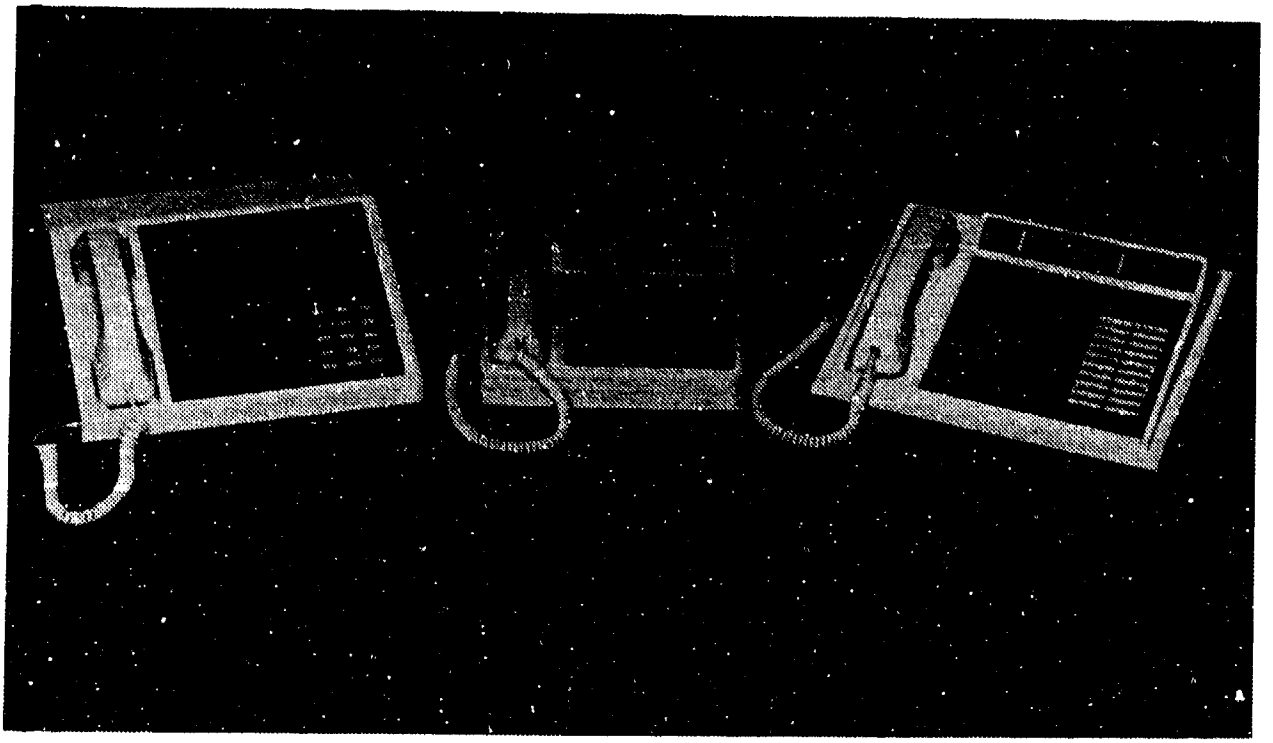
OT&E ACTIVITY

There has been no operational test and evaluation of Tacit Rainbow in FY88 or prior years. IOT&E is scheduled to begin in FY89.

PART VI

NATIONAL SECURITY AGENCY OT&E

SECURE TELEPHONE UNIT – THIRD GENERATION (STU–III)



SYSTEM DESCRIPTION

The Future Secure Voice System (FSVS) program was initiated by the National Security Agency (NSA) to significantly enhance the security of US telephone communications. The FSVS consists of various types of Secure Telephone Unit (STU) terminals and Key Management System (KMS) elements. FSVS STU terminal types are the low cost terminal (LCT), or STU–III/LCT, offered in Type I and Type II versions (described below); STU–III/Cellular, to provide secure cellular radio telephones; the Automatic Remote STU (ARSTU), to provide a red switch interface; the STU–IIIA, a STU–II compatible version; and the STU–III/MPT, a mobile version ruggedized for aircraft and mobile platforms. The KMS includes the Key Management Center (KMC) and Key Material Ordering and Distribution Centers (KMODC). A KMS Rekey Simulator (RKS) was used at the KMC for test purposes during operational test and evaluation.

The hub of the KMS is the KMC for the National Security Agency, and the communications security (COMSEC) custodians or other personnel responsible for local issue and control of terminals and keying materials for users. For Type I terminals, two keying options are available (seed key and operational key). Either of the two keying options can be loaded into an EEPROM embedded in a plastic material that is shaped like an automobile ignition key and called the KSD–64A. The

user's terminal is keyed by proper use of the KSD-64A, which has been loaded with keying material for transfer to the terminal. The KSD-64A becomes the crypto ignition key (CIK) for the terminal after transfer of the keying material. Rekeying requires interaction with the KMS and/or local COMSEC custodian.

Type I terminals offer full security up to and including Top Secret and compartmented levels. Type II terminals are intended for the protection of unclassified national security-related traffic and privacy, and are interoperable with Type I terminals.

STU-III/LCT-I is a microprocessor-based secure voice/data terminal being developed and manufactured by three vendors: AT&T, Motorola, and RCA. These equipments are interoperable and can operate as a "Plain Old Telephone System" (POTS) for unsecured analog transmission. Proper use of a KSD-64A CIK enables the terminals to achieve secure voice or data operation at 2.4 Kilobits per second (Kbps), using a linear predictive coding (LPC) voice algorithm designated the LPC10e. The AT&T terminals can operate at 4.8 Kbps in secure voice or data modes when communicating with another AT&T terminal. The National Security Agency indicates that future enhancements will include the requirement for all terminals to include 4.8 Kbps capability, and that Motorola plans to include a 9.6 Kbps rate capability in 1989. Higher data rate terminal design is related to data transmission capability and the continuing efforts to improve secure voice quality.

BACKGROUND

The FSVS program was initiated in March 1984 in response to the widely recognized need to significantly enhance US telephone security. In September 1985 the Secretary of Defense issued a tasking to survey telephone security requirements. Service/agency required characteristics/capabilities and planned operational quantities were consolidated and promulgated by the Joint Chiefs of Staff. The National Security Agency established a test program for the STU-III/LCT to implement the September 1985 tasking of the Secretary of Defense: "Instead of the traditional and extensive cycle of Service developmental/operational testing and evaluation, the Director, NSA shall conduct an accelerated test program of the STU-III equipments." The National Security Agency strategy included four phases of testing, including vendor acceptance testing, system integration at the FSVS interoperability test bed, field testing, and a market determination/user acceptance phase.

The STU-III/LCT acquisition program represented a considerable departure from traditional acquisition strategies, coupling market-driven competition with an integrated development, test, and procurement process to achieve initial prototype fielding of the system in 1987. The strategy strongly emphasizes streamlining the acquisition process through creation of vendor incentive to build a high-quality product and provide responsive service in order to remain competitive in the marketplace, including DoD. The strategy, however, did not initially include adequate independent operational test and evaluation in accordance with 10 U.S.C. 138.

The DOT&E designated the FSVS STU-III program for oversight in April 1986 and began efforts to increase the use of independent user-representative test agents for operational test and evaluation in the field. This effort led to the submission of an NSA prepared Test and Evaluation Master Plan (TEMP), which included an Air Force TEMP and the Air Force's 1815th Operational Test and Evaluation Squadron (OTES) detailed test plan. DOT&E also worked with the independent operational test agents of the Army and Navy to obtain, in February 1988, accep-

tance of the combined operational testing as structured by NSA and the Air Force in their combined TEMP and detailed test plan. The Army and Navy will also conduct separate tests of the STU-III in their unique applications and for interoperability with other agencies.

OT&E ISSUES

Critical operational issues include: Does STU-III work over all required transmission media? Does STU-III integrate and operate in all required environments? Does STU-III meet security requirements and provide effective security of the information to be protected? Does STU-III interface with other communications system elements? Critical suitability issues include: Can the STU-III be operated and maintained safely with the plans, training, manuals/data, facilities, and the tools and test equipment provided? Does the STU-III meet the established reliability and maintainability criteria?

Limitations noted during OT&E included the maturity of the terminals and KMS, which was reflected in the terminal lock-up and zeroization. A full operational KMS with involvement of local COMSEC custodians who will process and control terminals and keying material is required to realistically assess field system operation. Multi-Service and NSA COMSEC material handling aspects and logistics support plans were not evaluated under operational conditions. Operational use of contractor personnel requires clarification. These limitations do not invalidate the test results, but require resolution in the planning and approval of follow-on operational test and evaluation.

Operational effectiveness and operational suitability issues remain to be resolved by follow-on operational test and evaluation of the STU-III/LCT-I and new emerging components in the FSVS program. A new TEMP and new operational test plans are required for the follow-on operational test and evaluation.

OT&E ACTIVITY

The independent field phase of STU-III/LCT-I (operational test and evaluation of the STU-III) was conducted by the Air Force Communications Command (AFCC), 1815th Operational Test and Evaluation Squadron (OTES) at 24 sites throughout the Pacific and the Continental US during the period April-June 1988. Operational test and evaluation was conducted in accordance with the approved Qualification Operational Test and Evaluation (QOT&E) plan. The 1815th OTES prepared an interim test report (August 1988) which was released to Headquarters Air Force by AFCC on September 9, 1988. The Air Force Operational Test and Evaluation Center (AFOTEC) monitored the QOT&E and concurred in the overall conclusions of the QOT&E report. These reports have been reviewed by NSA. NSA reported results of its four test phases, data from the various Service and NSA activities, and other related testing in a report dated August 15, 1988.

The DOT&E prepared a beyond low-rate initial production report in accordance with 10 U.S.C. 138. This report, dated November 15, 1988, was forwarded to Congress by the Secretary of Defense on December 12, 1988.

OT&E ASSESSMENT

The DOT&E overall assessment of FSVS operational effectiveness is marginal for the system as tested, including the test planning and conduct of tests with the KMS and STU-III/LCT-I terminals. Marginal implies less than satisfactory, but not unsatisfactory; the equipment demonstrates capability and can be used, but it needs improvement. KMS operation, to include the COMSEC custodian personnel, and improved voice quality are critical operational effectiveness issues for resolu-

tion in the follow-on operational test and evaluation. Although limited, the QOT&E and NSA test results confirm that the STU-III/LCT-I has strong potential to be operationally effective for POTS and secure voice communications.

Service reports were also prepared to identify terminal malfunctions, deficiencies, and shortfalls. Twenty-five reports were submitted during QOT&E. Eleven were rated mission essential and involved two equipment problems of system lock-up and system zeroization. During lock-up, the terminal was not usable as a POTS or a secure terminal until the power was removed and reapplied. The RCA terminals locked-up four times and the AT&T terminals twice. Terminals zeroized overnight and prevented their use as secure terminals until receipt of new keying material. The AT&T and Motorola terminals zeroized twice and the RCA terminal once. NSA indicates that all vendors have corrected these two problems by changes in software which is available in terminals scheduled for European tests which started September 26, 1988. The DOT&E assessment is that the vendor changes should be evaluated by the 1815th OTES during the European tests and results included in the report on these tests.

Objectives for operation in airborne applications were not determined, but will be conducted and reported later. Objectives for operations in tactical applications were not determined, but have been assessed and reported as feasible for the 2.4 Kbps data rates by the Joint Tactical Command, Control, and Communications Agency (JTC3A) based on technical testing through July 1988 at Fort Huachuca, Arizona.

Subjective comments and observations by QOT&E personnel were provided on special features or options of the various terminals. The AT&T terminal provided 4.8 Kbps operation with another AT&T terminal. It also provided frequency offset, which was used in Korea to compensate for poor quality lines. In addition, the AT&T terminal provided Hayes compatible commands for operation of the internal modem. The Motorola terminal was most compact. It offered POTS operation without power, and had one-button transferring to halfduplex operation. The RCA terminal incorporated the overseas requirements in Continental US terminals and had simultaneous two/four wire operation capability.

The DOT&E overall assessment of FSVS operational suitability is marginal for the system as tested, including the test planning and conduct of tests with the KMS and STU-III/LCT-I terminals. Marginal implies less than satisfactory but not unsatisfactory; the equipment demonstrates capability and can be used, but it needs improvement. KMS operation to include COMSEC custodian personnel and improved planning for life-cycle support are critical operational suitability issues for resolution in the follow-on operational test and evaluation.

Independent operational testing, although limited, was adequate to assess operational effectiveness and operational suitability of the STU-III/LCT-I. Follow-on operational test and evaluation is required to confirm correction of deficiencies which resulted in the marginal ratings, to assess enhancements, and to assess all emerging FSVS terminals with the KMS and COMSEC custodians.

Test planning has improved in the last year, but requires continued attention to complete plans for the required follow-on operational test and evaluation of the corrections for deficiencies noted during QOT&E, and confirmation of operational effectiveness of enhancements and emerging STU-III components in the FSVS program. KMS operation, to include the COMSEC custodian personnel and improved voice quality, are critical opera-

tional effectiveness issues for resolution in the follow-on operational test and evaluation. Although limited, the QOT&E and NSA test results confirm that the STU-III/ LCT-I has strong potential to be operationally effective for POTS and secure voice communications.

Limitations included the maturity of the terminals and key management system, which was reflected in terminal lock-up and zeroization. A full operational KMS with involvement of local COMSEC custodians who will process and control terminals and keying material is required to realistically assess field system operation. Multi-Service and NSA COMSEC material handling aspects and logistics support plans were not evaluated under operational conditions. Use of contractor personnel needs to be clarified. These limitations do not invalidate the test results, but will require resolution in the planning and approval of follow-on operational test and evaluation.

DOT&E representatives observed testing at selected sites, observing KMC operations and visiting AFCC and 1815th OTES test sites during testing.

SUMMARY

Independent operational testing, although limited, was adequate to determine operational effectiveness and suitability as marginal for the systems tested. Marginal implies that the system is usable but needs improvements. Observed terminal reliability and usability have been acceptable. The system has strong potential to be operationally effective and suitable.

Follow-on independent operational test and evaluation is required. Improved interoperable secure voice quality, KMS operation (to include the user COMSEC custodian personnel), and maintenance plan completion and implementation are critical issues for resolution in the follow-on independent operational test and evaluation.

The FSVS remains on our list of DoD programs designated for operational test and evaluation oversight. A new FSVS TEMP and new operational test plans are required for follow-on operational testing of STU-III/LCT-I and new emerging components in the FSVS program.

PART VII

B-LRIP REPORTS

B-LRIP REPORTS

FY88 AND FIRST QUARTER, FY89

Director, Operational Test & Evaluation Beyond Low-Rate Initial Production Reports on:

CV Inner-Zone Antisubmarine Warfare Helicopter (April 1, 1988)*

MH-53E Helicopter (May 11, 1988) VII-1

S-3A Weapon System Improvement Program (WSIP) (S-3B) (June 13, 1988)*

Bigeye Chemical Bomb (August 30, 1988)*

OH-58D Army Helicopter Improvement Program (AHIP) Scout/Reconnaissance Role (September 9, 1988)*

Secure Telephone Unit - Third Generation (STU-III) (November 15, 1988) VII-19

Mobile Subscriber Equipment (MSE) System (December 5, 1988) VII-31

MK 48 Advanced Capability (ADCAP) Torpedo (December 8, 1988)*

M9 Armored Combat Earthmover (M9 ACE) (December 14, 1988) VII-43

Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) Targeting Pod (December 19, 1988) VII-55

***These reports are classified and have been removed from this document. They are included in the classified version of this report and are available for review on a need-to-know basis.**

DEPARTMENT OF DEFENSE

OPERATIONAL TEST AND EVALUATION REPORT

ON THE

MH-53E HELICOPTER

MAY 11, 1988

OFFICE OF THE SECRETARY OF DEFENSE

WASHINGTON, D.C. 20301-1700

OPERATIONAL TEST
AND EVALUATION

11 May 1988

OPERATIONAL TEST AND EVALUATION REPORT
ON THE
MH-53E HELICOPTER

The Office of the Director, Operational Test and Evaluation has completed its assessment of the MH-53E helicopter. This report is being submitted in fulfillment of the provisions of 10 U.S.C. 138 because, in the judgment of the Director, the Navy proceeded beyond low-rate initial production when it recently committed to procure eight additional MH-53Es. Procurement in prior years consisted of 17 MH-53Es of the total planned buy of 32.

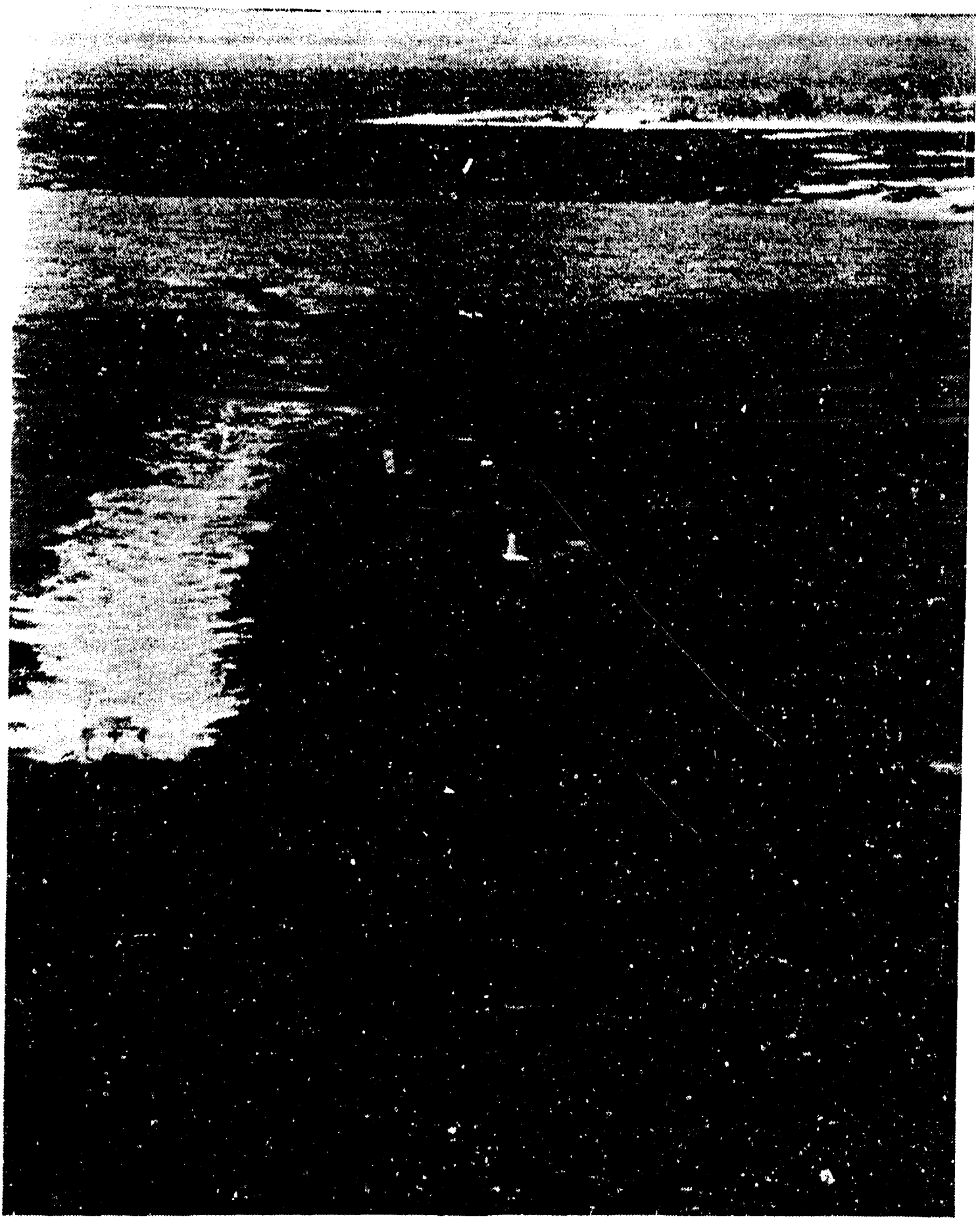
The MH-53E's recent follow-on operational test and evaluation (FOT&E) was adequate to assess the operational effectiveness and suitability of the production MH-53E helicopter in its primary mission of streaming, towing, and recovering airborne mine countermeasures (AMCM) equipment. Limitations to test primarily involved the inability to evaluate corrections to previously identified major deficiencies. Because of the long lead times required to make these corrections, they were not available for evaluation during this most recent phase of testing.

As tested in FOT&E, the MH-53E was considered only marginally operationally effective and not operationally suitable. The inability to precisely navigate and numerous major suitability problems directly affected the MH-53E's operational effectiveness. Significant problems, some of which require long-term solutions, in reliability, maintainability, compatibility, interoperability, safety, and human factors resulted in the MH-53E being not operationally suitable. Recent positive actions have been taken by the Navy to correct some of the deficiencies through procedural and hardware changes. The procedural changes observed by a DOT&E representative appear effective. These procedural changes, planned hardware changes, and the inherent capability of the MH-53E clearly indicate the potential for satisfactory effectiveness and suitability in the AMCM mission.

A description of the MH-53E and the operational tests conducted, together with amplifying information on operational effectiveness and suitability, follows.

John E. Krings
Director

Attachment:
As stated



MH-53E Helicopter Towing AMCM

SYSTEM DESCRIPTION

The MH-53E is a modified version of the Navy and Marine Corps CH-53E. The CH-53E, in turn, is an improved/growth version of the Navy/Marine Corps H-53 A/D transport helicopter. Both the CH-53E and MH-53E feature a third engine, a larger diameter rotor, seven (versus six) main rotor blades, an uprated main transmission, and greater maximum gross weight and payload capability over the H-53 A/D. The CH-53E is currently in full production, while the MH-53E has remained in low-rate production (four in FY87) after the initial procurement in FY86 of 12 MH-53E aircraft. Seventeen of a planned 32 MH-53Es have been funded.

There is approximately 80% commonality between the MH and CH aircraft, with the main rotor, engines, transmission and basic airframe being essentially the same. Modifications to the CH-53E airframe that are required for an MH-53E are the following: enlarged fuel sponsons, rear escape hatches, equipment stowage box tow boom, boom back-up structure, winch control system, mounting provisions for a mission navigation system, Mk 105 refueling provisions, egress lighting, tow cable guillotine provisions, airborne mine countermeasures (AMCM) mirrors, tension-skew indicator (pilot's primary cockpit indication of tension and skew angle of the AMCM device), dual digital automatic flight control system (AFCS), composite tail rotor, 90 degree stub ramp, doppler navigation system, and a second radar altimeter.

The MH-53E was developed to replace the RH-53D as the Navy's AMCM platform. According to the Decision Coordinating Paper, approved in April 1978, the MH-53E was to be fully capable of employing all AMCM equipment, and to provide the increased tow tension required by proposed AMCM devices, increased time on station, and improved mission reliability.

The MH-53E is capable of daylight-only towing of various mine countermeasures equipment in the mine sweeping or mine hunting roles. During testing, the MH-53E used the Mk 103 mechanical mine sweeping device, Mk 104 acoustic AMCM device, Mk 105 magnetic AMCM sled, AQS-14 minehunting sonar, SPU-1-W magnetic orange pipe, and ALQ-141 countermeasures set. In addition, the aircraft has the capability of performing vertical onboard deliveries and other special missions as assigned.

TESTING ADEQUACY

Initial operational test and evaluation (IOT&E) of the MH-53E was completed on 31 July 1984. A limited production decision for 12 MH-53E aircraft was made in April 1985, based on the results of initial development testing and IOT&E. Technical evaluation was completed 8 November 1985 and operational evaluation (OPEVAL) was completed 25 April 1986. Results of OPEVAL on a prototype MH-53E (modified CH-53E) were briefed to the Director, Operational and Evaluation, and reported in the DOT&E FY86 Annual Report. At that time, the MH-53E was judged operationally effective, given possible operational limitations, and not operationally suitable. The Director stated to the Navy that the OPEVAL test results did not support full production of the MH-53E until identified discrepancies were corrected and verified in further operational testing.

A Milestone IIIB decision, which considered the OPEVAL test results, was made by the Navy on 7 November 1986. The Navy approved the MH-53E for fleet introduction, approved limited production (four aircraft) for FY87, and directed follow-on operational test and evaluation with production aircraft for verification of deficiency corrections.

After the Milestone IIIB decision for low-rate production, the Navy directed follow-on operational test and evaluation (FOT&E) to verify correction of safety, human factors, training, and documentation deficiencies observed in OPEVAL. Assessment of the operational effectiveness and suitability of "interim" solutions to the problems of operating with one engine out, excessive main and tail rotor bearing wear, and excessive noise was also directed. The testing of aircraft availability (a previous major deficiency) during FOT&E was waived when a snap-ring bearing improvement program could not be incorporated in production-representative MH-53Es in time to complete FOT&E.

The T64-GE-419 engine upgrade for greater thrust, tension-skew indicator (TSI) improvements, and intercommunications system (ICS) modifications to provide for an active noise reduction system were documented limitations to test (and were not available for testing). They require long-term solutions which are scheduled for testing during FY89 and FY90. Improved rotor bearings and snap-ring bearing collars were anticipated to be available for test. However, they were not available and were rescheduled for testing in FY89.

The Test and Evaluation Master Plan (TEMP) outlining the updated near- and far-term test plans for the MH-53E was approved by the Director, Operational Test and Evaluation, in September 1987. The Navy's test plan for FOT&E was briefed to and approved by the Director in October 1987. The Director noted in his test plan approval memo that, because the planned test could not verify corrections to deficiencies which required long-term solutions, the probable test results would still not support a full production decision. The test site was visited by a DOT&E observer during the conduct of the test and the progress and results of testing at that time were briefed by the Navy's Test Director. Subsequent to testing, a DOT&E observer flew on an MH-53E training mission during which the stream, tow, and recovery of the Mk-103 mechanical mine sweeping device were accomplished. A DOT&E observer also saw the shore launch and recovery of the Mk-105 magnetic AMCM sled.

FOT&E of the MH-53E was conducted by Commander, Operational Test and Evaluation Force (COMOPTEVFOR) at NAS Norfolk, Virginia, from 19 October to 20 November 1987 using Helicopter Mine Squadron Twelve (HM-12) flight crews and maintenance personnel in accordance with the TEMP and test plan approved by the Director, Operational Test and Evaluation. One production aircraft was available for AMCM missions from 19 October to 29 October 1987. From 29 October to 9 November 1987, three production aircraft became available for AMCM. Only one AMCM suite consisting of the devices shown below was available for testing.

A total of 159.2 flight hours were distributed as follows:

Mk 103 Mechanical Minesweeping Device	35.3
Mk 104 Acoustic AMCM Device	7.0
Mk 105 Magnetic AMCM Sled	7.4
AQS-14 Minehunting Sonar	1.2
SPU-1-W Magnetic Orange Pipe	3.5
ALQ-141 Countermeasures Set	3.5
Helicopter Inflight Refueling	0.8
Familiarization	100.5

Evaluation of accurate navigational capability, which is required for effective AMCM, was not accomplished during this test due to chronic failure of the Raydist mission navigation equipment.

Shipboard operations were not accomplished in this phase of test and, therefore, corrections to deficiencies observed in earlier testing of shipboard operations could not be verified. Completion of operational shipboard compatibility and interoperability is scheduled for FY89 and FY90.

The limitations to test were significant and had a major impact on the test and evaluation results. However, they did not preclude a final assessment of the MH-53E's operational effectiveness and suitability with regard to its current production configuration.

The Director concluded the OPTEVFOR evaluation report was of high quality and accurately reflected the results of testing.

OPERATIONAL EFFECTIVENESS AND SUITABILITY

Follow-on operational test and evaluation (FOT&E) of the MH-53E's operational effectiveness in its primary airborne mine countermeasures (AMCM) mission was so limited by the major suitability problems that three of five effectiveness issues could not be resolved. Complete resolution of the suitability problems will require long-term efforts in development and testing. In the meantime, the MH-53E is considered only marginally operationally effective, although recent changes in AMCM stream and recovery procedures and aircraft employment techniques may improve effectiveness.

Effectiveness test objectives for operational effectiveness included the capability of the MH-53E to stream, tow, and recover all current and certified developmental AMCM towed bodies and verifying correction of previously identified OPEVAL deficiencies. The capability of an add-on mission navigation system (Raydist), which is not part of the aircraft's basic avionics system, to support the AMCM mission was also assessed. One other operational effectiveness objective assessed the capability of the MH-53E to refuel in-flight from a ship while hovering.

The capability of the MH-53E to deploy/stream and recover the AMCM equipment was qualitatively assessed by observation of airborne streaming and recovery evolutions for the Mk 103, Mk 104, AQS-14, ALQ-141, and SPU-1-W AMCM devices and shore launch and recovery of the Mk 105 sled.

The MH-53E's operational effectiveness was directly affected by compatibility with current AMCM devices and procedures. Because the MH-53E is a larger, heavier, and more powerful aircraft than the RH-53D, its increased rotor downwash and noise levels have a greater impact on AMCM mission performance. The highest levels of mission degradation occurred during AMCM stream and recovery operations. The majority of the compatibility problems observed in these phases of the mission were assessed as safety and human factors issues when aircrews attempted to work around difficulties encountered in flight.

High rotor downwash caused both device and cable oscillations which, in turn, resulted in cable entanglements, aircraft strikes, degradation of electrical connections to the streamed device, and hazardous conditions for the crew. These problems, in combination with high acoustic noise levels which degrade aircrew communications during flight, raise serious concerns and, in several instances, were causes for mission aborts.

Operational effectiveness was also affected by an uncorrected compatibility deficiency from previous testing (recoverability with single engine failure while towing devices), which caused the Navy to lower allowable fuel weight, thereby limiting the helicopter's AMCM on-station time. This limited on-station time significantly reduces or eliminates tow time for some AMCM configurations, particularly in warm climates.

Effectiveness is also impacted by excessive acoustic noise levels, which was a previously observed and uncorrected deficiency from OPEVAL. Excessive noise levels degraded aircrew communications, which affected mission accomplishment and flight safety. Safe and effective mission accomplishment requires constant, clear communications between the pilots' cockpit and the crewmen's work area at the rear of the aircraft cabin, which is an open-air environment. This loud and potentially harmful noise, which affects the entire cabin area, is generated by the main gear box, engines, and rotor downwash. An interim Navy resolution addresses this issue by making special provisions for protection of aircrew hearing including additional ear protectors and limits on duty time in high noise areas of the aircraft. During this test, aircrew evaluations showed that eighty percent of the aircrew felt noise levels at some location inside the aircraft were uncomfortable, while twenty percent said noise was not a problem. Seventy percent indicated that a problem with the intercommunications system (ICS) occurred which interfered with their jobs. In most cases, this required repeated ICS volume or boom mike adjustments, or physically repositioning within the aircraft in order to make a clear transmission. Increased attention to and recent improvements in applying passive noise reduction techniques appeared to make a positive step towards reducing the effect of the high noise level on mission accomplishment, safety, and hearing conservation. This has been accomplished by ensuring each aircrewman's helmet is properly fitted in combination with ear plugs. During a Mk 103 AMCM flight, the DOT&E observer noted the cabin noise levels were lower than anticipated and at no time during the entire mission were there any communication difficulties between the pilots and aircrewmen.

Operational effectiveness during streaming and recovery was also assessed for the interface (interoperability) between the MH-53E and the subsystems with which it must operate. The interoperability problems noted with the AMCM equipment generally involved oscillations of the AMCM devices due to rotor wash and/or unseated cables which caused hazards to the crew, the airframe, and potential interference with the tail rotor. AMCM configurations and interoperability deficiencies for each device

tested were documented. Generally, the reason these problems occurred was inadequate procedural and design integration of the MH-53E with the AMCM equipment that did not account for all the variables interacting in the mission environment (aircrew experience, tools used, procedures, pilot technique, on-station weather, sled tension, etc.). Despite the basic configuration similarity of AMCM equipment between the RH-53D and MH-53E and the high experience level of aircrewmen (the vast majority of the aircrewmen who participated in testing were instructors used to train fleet entry aircrewmen on AMCM equipment and procedures), numerous interface problems still occurred (RH-53D procedures and techniques were employed for the MH-53E). Some have the potential for major damage to equipment, including the airframe, and serious injury to crew members. New procedures, which were recently developed for the MH-53E to improve the capability to stream and recover the AMCM equipment, were observed by a DOT&E representative. These new procedures appear to have made significant progress in addressing the helicopter/AMCM interface deficiencies and have a high potential to demonstrate increased operational effectiveness and suitability.

After the AMCM equipment was streamed, the MH-53E was assessed to be operationally effective in towing the Mk 103, Mk 104, Mk 105, AQS-14, ALQ-141, and SPU-1-W.

Operational effectiveness was also qualitatively assessed with regard to human factors. Numerous problems were observed with cockpit gauges, status lights, and indicators that did not meet the requirements necessary for pilots and copilots to conduct their job assignments effectively. In the cabin area, the location, space, or other characteristics of aircraft equipment presented or caused hazards to personnel and other equipment. Many maintenance and aircrew tasks were inordinately difficult to perform.

Operational effectiveness was assessed with regard to safety features. Safety testing was conducted continuously during the test period. The most significant hazards were due to poor compatibility and interoperability of AMCM equipment with the MH-53E in its operational environment. Some of the problems associated with interoperability, safety, and human factors can be mitigated by increased familiarity with the aircraft/equipment problems and improved MH-53E AMCM streaming and recovery procedures and techniques, as was seen on a Mk 103 tow mission by a DOT&E observer.

In addition to the MH-53E's capability for streaming, towing and recovering AMCM devices, the aircraft's operational

effectiveness was intended to be assessed by determining the capability of an add-on navigation system (which is not part of the aircraft's basic avionics suite) to support the AMCM mission and to verify previously identified deficiencies. The accuracy of the currently used Raydist (contractor's trademark name) navigation system was to be measured by flying minefield tracks with reference to a known geographical point. On sixteen separate flights designed to measure navigational accuracy, the Raydist system was inoperable and, therefore, considered not effective.

These three operational effectiveness objectives - streaming, recovery, and navigational accuracy - in the MH-53's primary mission of AMCM encountered major problems during evaluation efforts in this test. Consequently, the integrated weapon system could not be considered operationally effective for the conduct of the primary AMCM mission until the navigation system is improved or replaced (the Navy has indicated a replacement effort is currently underway) and the major suitability issues of reliability, maintainability, compatibility, interoperability, safety, and human factors are further examined and resolved.

One other operational effectiveness objective, the capability of the MH-53E to refuel from a ship while hovering in flight, was assessed during this test. The aircraft demonstrated the capability to conduct daytime, visual flight conditions, hookups and refueling in flight with the USS JOUETT. Power degradation did occur during refueling, when 30 minutes of flight at low altitude resulted in the aircraft marginally meeting engine power requirements due to salt spray ingestion.

Operational suitability of the MH-53E was observed and evaluated in 9 areas (reliability, maintainability, logistics supportability, compatibility, interoperability, training, human factors, safety and documentation). Reliability of the MH-53E was measured continuously during test operations to determine the probability of completing a 4-hour AMCM mission in its intended operational environment without a critical or major failure. (A critical failure prevents the system from performing its mission. A major failure causes the system to lose some operational capability and degraded mission accomplishment.) The demonstrated mean flight hours between failures (MFHBF) was 2.9 hours based on 54 critical or major failures in 159.2 flight hours, with the criterion being 7.6 hours. The 54 failures consisted of 16 Raydist failures and 38 non-Raydist failures. Of these latter 38, nine were bearing failures.

The demonstrated 4-hour mission reliability for FOT&E was 0.26 based on 54 failures, with a criterion of 0.59.

The Raydist equipment, which was intended to provide adequate capability for pilots to navigate with the accuracy required to locate and mark mines in a simulated mine field. failed in all 16 flight events designed to test navigation accuracy. Because the Raydist equipment never worked and is not the planned final configuration navigation equipment, the inclusion of the Raydist failures biases the estimate of MH-53E reliability. Excluding Raydist failures from the calculations, the demonstrated MFHBF was 4.2 hours (criterion 7.6 hours) and the demonstrated 4-hour mission reliability was 0.39 (criterion 0.59).

A second characteristic of the MH-53E identified in previous testing was the high failure rate of the main damper, pitch control, and tail link bearings. A fix for the bearing failure problem is in development, but has not yet been instituted in the MH-53E. If both Raydist and bearing failures are excluded from the reliability calculations, the estimate of MFHBF is 5.5 hours, and the estimated 4-hour mission reliability is 0.48. These numbers reflect a system containing a 100% reliable replacement navigation system and better bearings with a zero failure rate. Real world projections of anticipated MFHBF and mission reliability will be between those observed and 5.5/.48.

Operational suitability was also quantitatively evaluated by determining the maintainability of the MH-53E in the intended operational environment and verifying correction of OPEVAL deficiencies. Aircrews and maintenance personnel documented all failures discovered during ground maintenance, preflight, post-flight, or in flight. Descriptions of the failures, troubleshooting procedures, corrective actions, and appropriate times (repair times, maintenance man-hours, time awaiting parts) were documented.

The demonstrated mean time to repair (MTTR) was 3.1 hours based on 117.8 hours to repair 38 critical and major failures, with a criterion of 2.1 hours. The minimum repair time was 0.4 hours and the maximum was 7.0 hours. Many hours were spent during testing attempting to fix the Raydist system, but it was never fully operational. This time was not included in the calculations in order to obtain a more accurate reflection of the MTTR.

One third of the repairs were completed within the criterion time of 2.1 hours. Seventy-five percent of the repairs were completed in less than 4.2 hours, and 25% required more than 4.2 hours.

In addition to the quantitative maintainability results above, a number of qualitative issues were noted that relate to aircraft maintainability. Scheduled maintenance was high because

of 14/28-day inspections, 15/25/50-hour inspections, and 100-hour phases. When conducting extensive tow operations, the squadron performed the 15-hour inspection on a nightly basis because of the high bearing failure rates associated with this environment. Additionally, corrosion prevention requirements were increased due to high levels of salt spray exposure when towing AMCM devices.

Maintainability was also affected by the incomplete implementation of the logistic support effort, causing further delay in the maintenance cycle. The time spent awaiting parts accounted for a significant portion of the downtime for OPEVAL and FOT&E.

Evaluation of availability in the previous OPEVAL demonstrated a significant deficiency versus criterion primarily due to the high wear rate of main and tail rotor pitch control and damper bearings, which, coupled with time-consuming maintenance procedures, led to excessive downtime and maintenance costs for the MH-53E.

Availability was not evaluated during FOT&E because an interim corrective action to a previously identified major deficiency (improved snap-ring bearings) was not available.

Evaluation of the logistics supportability of the MH-53E showed that maintenance planning, supply support, equipment, and special tools were major problems. The planning for scheduled aircraft maintenance is complicated by the 15-hour damper bearings inspection and the detailed corrosion inspection due to salt spray. Maintenance planning becomes even more difficult when operating from a ship. Because of restrictions placed on the MH-53E when operating with some classes of ships, a great deal of maintenance may have to be done topside.

The MH-53E-peculiar parts support program was identified as having numerous problems. Of the 1,280 MH-53E-peculiar parts that had been identified as of 15 October 1987, 32% (404 items) had not been contracted for. A consequence of the large number of non-contracted items has been the procurement of parts on an emergency basis (one-time buy). This procedure inevitably led to increased costs and delivery time which impacted supply support. Of the 876 contracted items, 55% (482 items) had been shipped, 44% (386 items) were scheduled to be shipped by January 1989, and 1% (eight items) were scheduled for shipment after January 1989.

An example is the automatic flight control system (AFCS) computer. As of 9 November 1987, HM-12 had experienced seven AFCS computer failures. Although turnaround time was fast (2 days),

there were no test sets available for the computer at either the Organizational Level or Intermediate Level. The availability of the computers to this point has depended on the ability of Sikorsky to pull "spares" off the production line.

A number of problems also appeared in the warranty program. Again, a prime example was the AFCS computer. In each instance of a computer failure, a replacement had to be obtained from Sikorsky and the failed computer shipped back to Sikorsky for repair. Although turnaround time was short for the computer failures, this was not true for all warranted items and a deployed squadron would be faced with potentially long downtime for its aircraft.

Some support equipment was in short supply or not available (e.g., a fuel quantity test set required for phase inspections). One development test set model exists, and it was held by the Sikorsky technical representatives, not by the squadron.

Support equipment (winches, racks, davits, etc.) required for the AMCM mission was in critically short supply. During FOT&E, these shortages limited aircraft availability for AMCM to one of the three MH-53Es possessed by HM-12.

The compatibility of the MH-53E with its operational environment was previously discussed with regard to operational effectiveness. With regard to suitability, the evaluation showed evidence of physical and functional incompatibility. Aircrew members and maintenance personnel documented qualitative evidence of incompatibility on questionnaires. As discussed, the MH-53E's increased rotor downwash and noise levels had a greater impact on mission performance than is seen with the current RH-53Ds. The highest levels of degradation occurred during AMCM stream and recovery evolutions.

Mission delays and aborts occurred at a great frequency during AMCM missions. High rotor downwash, which caused AMCM device oscillations, and noise levels, which degraded aircrew communications, were considered the primary causal factors. In 52% of AMCM flights, a mission abort or significant delay was observed. In 82%, an abort, significant delay, or other degradation occurred. An abort resulted in mission termination. A significant delay occurred when a problem developed which reduced available on-station tow time by more than 25 percent over that planned to be available. An "other degradation" occurred when rotor downwash or noise resulted in equipment damage or personnel injury, but did not result in a significant delay.

Compatibility problems with the tested AMCM devices were documented, but not all AMCM device configurations were tested. The sample size of AMCM events was not large, and further testing is required to define the full effect of rotor wash and noise on the MH-53E and its resultant hazardous conditions to personnel to see how effectively each AMCM device can be employed.

Interim Navy operational restrictions due to a previously identified and uncorrected OPEVAL deficiency (recoverability with a single engine failure under tow) limited beginning fuel weight and, in turn, decreased available AMCM on-station time. Recoverability with a single engine failure is an inherent problem for all helicopters involved in the AMCM mission due to extended flight operations at low altitude and low airspeed, in particular while towing. The MH-53E's capability to recover from a single engine failure is reduced because the increased fuel capacity is achieved through enlarged fuel sponsons which cannot be jettisoned. The fuel weight limit was defined as that necessary to give the MH-53E a dual engine hover in ground effect capability before AMCM stream and tow could commence. It was applicable to routine or training AMCM missions and was intended to increase aircraft survivability during AMCM operations in the event of an engine failure. Its effect on mission effectiveness is to significantly reduce or eliminate tow time with some AMCM configurations in warm climates, which is incompatible with mission requirements.

Salt spray ingestion caused by rotor downwash during tow, which caused an unacceptable loss of engine power, was an uncorrected deficiency from OPEVAL. No power losses were observed during tow, although the downwash did cause salt spray clouds to form. Power degradation was observed during hover in-flight refueling.

Excessive noise levels which degraded aircrew communications was also an uncorrected OPEVAL deficiency. The problems caused by this noise were discussed earlier in the section on operational effectiveness.

Operational suitability was assessed with regard to interoperability or the adequacy of the interface between the MH-53E and the subsystems with which it must operate. Evidence of interoperability problems, which did or could potentially degrade mission effectiveness, were noted as aircrew members and maintenance personnel qualitatively documented interoperability deficiencies on questionnaires.

As previously discussed, these interface problems concerned oscillations of AMCM devices, device assembly strikes on the airframe, unseated cables, and damage to the devices. These observed problems may be mitigated by new AMCM/MH-53E procedures and aircraft maneuver techniques which are being developed as the aircraft matures.

Restrictions on shipboard operations were identified during OPEVAL as a major interoperability issue. In general, elevator use, hangar deck parking, and flight deck spot became more restricted as the ship size became smaller and may affect aircraft maintainability and availability. No shipboard operations were conducted during FOT&E. Further testing is scheduled in FY89 and FY90.

Training was assessed continuously during project operations. Aircrew and maintenance/support personnel provided qualitative comments on the training they had received. Problems were noted, including the fact that the use of the RH-53D to supplement MH-53E AMCM tow training did not fulfill MH-53E requirements due to substantial differences between the airframes.

Human factors were assessed as test participants qualitatively recorded their observations of MH-53E human factors features in questionnaires. It was determined that certain cockpit gauges, status lights, and indicators did not meet the requirements necessary for pilots and copilots to conduct their job assignments effectively. The cabin area in AMCM-configured aircraft contained features which unnecessarily inhibited aircrew movement, interfered with job assignments, or created potential hazards from flying objects. Many maintenance and aircrew tasks were inordinately difficult to perform. Also, the AFCS coupler did not provide the designed features under certain environmental conditions. This problem increased the amount of human interaction required to fly the aircraft.

The adequacy of MH-53E safety features was qualitatively assessed and recorded continuously throughout the test period. Operations were halted when any unsafe or potentially unsafe condition was encountered by test participants. Aircrews and maintenance personnel reported 41 specific safety hazards in which personnel injury or aircraft damage occurred, or was believed highly likely to occur. These assessments were made based on the situation, system knowledge, and their experience.

Six major safety deficiencies were noted, which included hazards to aircrew and equipment due to poor compatibility and interoperability of AMCM equipment, deficiencies which aggravated

the potential for injury due to a fall, emergency egress deficiencies, an aircraft environmental control deficiency, fuel system design deficiencies which presented hazards, and hazards from high aircraft noise levels in the tow environment.

Additionally, the survivability of the MH-53E in case of a single engine failure under tow remained an uncorrected safety deficiency. Interim provisions restricted the aircraft to conducting routine and training tow missions at two-engine hover in ground effect gross weight. This required reducing fuel on board and decreased the flight time available to conduct towing. The reduced aircraft weight improved aircraft survivability by effectively increasing fly-out capability of the aircraft with the two remaining engines.

Documentation was assessed for adequacy and accuracy continuously during project operations. Some maintenance publication work packages and the MCM configuration publication were not available. Other publications contained numerous errors.

In summary, the operational effectiveness of the MH-53E was significantly affected by major limitations to test regarding compatibility, and observed operational effectiveness was marginal. Nine of 9 suitability issues were evaluated as unsatisfactory, and another, availability, was not tested because corrections were not in place. The MH-53E is not operationally suitable.

CONCLUSIONS

Follow-on operational test and evaluation of the MH-53E in its primary mission was conducted in a constrained manner due to the severe limitations imposed by compatibility and interoperability problems observed in earlier testing. Earlier testing had identified major problems which required long-term resolution, including the need for an engine upgrade, modifications for an active noise reduction system in the intercommunications system, and improvements to the tension-skew indicator and rotor bearings.

Interim solutions anticipated for all of these problems did not operate satisfactorily or were not yet available for test. In addition, the mission navigation system needed for effective AMCM operations experienced numerous and continual failures.

The limitations to test and the results observed in FOT&E lead to the conclusion that the MH-53E, as tested, is marginally effective in its primary mission of AMCM and is not operationally suitable. Although the MH-53E demonstrated successful AMCM tow capability once the mine countermeasures gear was streamed, the integrated weapon system is only marginally operationally effective for the conduct of the primary AMCM mission until the add-on navigation system capability is improved or replaced and the major suitability issues of reliability, maintainability, compatibility, interoperability, safety, and human factors are further examined and resolved in future testing.

The solutions to several of these issues are considered to be long-term and will be given continued close attention by DOT&E. Recent positive actions have been taken by the Navy to correct some of the deficiencies through procedural and hardware changes. The procedural changes observed by DOT&E appear effective. These procedural changes, planned hardware changes, and the inherent capability of the MH-53E clearly indicate a potential for satisfactory effectiveness and suitability in the AMCM mission.

DEPARTMENT OF DEFENSE

OPERATIONAL TEST AND EVALUATION REPORT

ON THE

SECURE TELEPHONE UNIT - THIRD GENERATION (STU-III)

15 NOVEMBER 1988

OPERATIONAL TEST AND EVALUATION REPORT ON THE SECURE TELEPHONE UNIT - THIRD GENERATION (STU-III)

The Office of the Director, Operational Test and Evaluation has completed its assessment of the STU-III Low Cost Terminal - Type I (STU-III/LCT-I). This report is being submitted in fulfillment of the provisions of 10 U.S.C. 138.

The operational test and evaluation of the STU-III was limited but adequate to assess the operational effectiveness and suitability of the STU-III/LCT-I in operational facilities. The testing was conducted in as realistic an environment as could be achieved within the limitations on the total system maturity and the equipments made available for test.

As tested, the STU-III/LCT-I demonstrated a marginal capability to conduct secure and plain old telephone system (POTS) operations. The marginal rating is based on two equipment problems (terminal lock-up and zeroization) and lack of full operations with the Key Management System (KMS). The secure voice quality did not meet all user criteria, but quality was subjectively assessed as an improvement over current narrowband secure voice systems.

The STU-III/LCT-I demonstrated marginal ability to meet operational suitability criteria. The marginal rating is based on three deficiencies (training and manuals, logistics support, and lack of procedures for local issue and control of terminals and keying material).

The National Security Agency indicates the vendors have taken action to correct lock-up, zeroization, and manuals. They also plan to improve secure voice quality in future equipments by incorporation of higher data rate voice techniques. An overall assessment is that the STU-III/LCT-I has strong potential to be an operationally effective and suitable system after completion of the deficiency corrections and incorporation of enhancements.

A description of the STU-III and the adequacy of the tests conducted, together with amplifying information on operational effectiveness and suitability, follows.

John E. Krings
Director

SYSTEM DESCRIPTION

The Future Secure Voice System (FSVS) program was initiated by the National Security Agency to significantly enhance the security of U.S. telephone communications. The FSVS consists of various types of STU terminals and Key Management System (KMS) elements. FSVS terminal types are the STU-III/LCT, offered in Type I and Type II versions (described below); STU-III/Cellular, to provide secure cellular radio telephones; the Automatic Remote STU (ARSTU) to provide a red switch interface; the STU-IIIA, a STU-II compatible version; and the STU-III/MPT, a mobile version ruggedized for aircraft and mobile platforms. The KMS includes the Key Management Center (KMC) and Key Material Ordering and Distribution Centers (KMODC). A Rekey Simulator (RKS) is available and was used for test purposes during the operational test and evaluation.

The hub of the KMS is the key management center (KMC) for the National Security Agency and the communications security (COMSEC) custodians or other personnel responsible for local issue and control of terminals and keying materials for users. For Type I terminals, two keying options are available (seed key and operational key). Either of the two keying options can be loaded into an EEPROM embedded in a plastic material that is shaped like a car ignition key and nomenclatured KSD-64A. The user's terminal is keyed by proper use of the KSD-64A which has been loaded with keying material for transfer to the terminal. The KSD-64A becomes the crypto ignition key (CIK) for the terminal after transfer of the keying material. Rekeying requires interaction with the KMS and/or local COMSEC custodian.

Type I terminals offer full security up to and including Top Secret and compartmented levels. Type II terminals are intended for the protection of unclassified national security-related traffic and privacy and are interoperable with Type I.

STU-III/LCT-I is a microprocessor-based secure voice/data terminal being developed and manufactured by three vendors: AT&T, Motorola, and RCA. These equipments are interoperable and can operate as a Plain Old Telephone System (POTS) for unsecured analog transmission. Proper use of a KSD-64A/CIK enables the terminals to achieve secure voice or data operation at 2.4 Kilobits per second (Kbps) using a linear predictive coding (LPC) voice algorithm designated the LPC10e. The AT&T terminals can operate at 4.8 Kbps in secure voice or data modes when communicating with another AT&T terminal. The National Security Agency indicates that future enhancements include the requirement for all terminals to include 4.8 Kbps capability, and that Motorola plans to include a 9.6 Kbps rate capability in 1989. Terminal data rate is related to data transmission capability and the efforts to improve secure voice quality.

TESTING ADEQUACY

The independent field phase of STU-III/LCT-I operational test and evaluation of the STU-III was conducted by the Air Force Communications Command (AFCC), 1815th Operational Test and Evaluation Squadron (OTES) at 24 sites throughout the Pacific and the CONUS during the period 18 April 1988 to 16 June 1988. Operational test and evaluation was conducted in accordance with the approved Qualification Operational Test and Evaluation (QOT&E) plan. The 1815th OTES prepared an interim test report dated August 1988 which was released to Headquarters Air Force by AFCC on 09 September 1988. The Air Force Operational Test and Evaluation Center (AFOTEC) monitored the QOT&E and reported concurrence with the overall conclusions of the QOT&E report on 21 September 1988 to Headquarters Air Force. The reports have been reviewed by the National Security Agency.

The National Security Agency established a test program for the STU-III/LCT to implement the 16 September 1985 guidance of the Secretary of Defense: "Instead of the traditional and extensive cycle of Service developmental/operational testing and evaluation, the Director, NSA shall conduct an accelerated test program of the STU-III equipments." This guidance reflects the competitive, market-driven nature of the program with its unique acquisition strategy, and the fact that it was not structured as a traditional requirements-driven development. It resulted in a testing strategy which was more concentrated and streamlined in nature than the typical, traditional testing efforts. The National Security Agency strategy included four phases of testing to include vendor acceptance testing, system integration at the FSVS interoperability test bed, field testing, and a market determination/user acceptance phase. The strategy did not, however, include adequate independent operational test and evaluation in accordance with 10 U.S.C. 138. The National Security Agency reported results of their four test phases, data from the various Service and Agency activities, and other related testing in a report dated 15 August 1988.

The Director, Operational Test and Evaluation designated the FSVS/STU-III program for test and evaluation oversight in April 1986 and began efforts to increase the use of independent test agents for operational test and evaluation. This effort led to the submission of a National Security Agency Test and Evaluation Master Plan (TEMP) which also included an Air Force TEMP and the 1815th QOT&E plan. The Director, Operational Test and Evaluation also worked with the independent operational test agents of the Army and Navy to obtain their approvals in February 1988 of the combined operational testing as structured by NSA and the Air Force in their TEMPs and the more detailed 1815th QOT&E plan.

Independent operational testing, although limited, was adequate to assess the operational effectiveness and suitability of the STU-III/LCT-I. Follow-on operational test and evaluation is required to confirm correction of deficiencies which resulted in the marginal ratings, to assess enhancements, and to assess all emerging FSVS terminals with the KMS and COMSEC custodians.

Limitations included the maturity of the terminals and key management system which was reflected in the terminal lock-up and zeroization. A full operational KMS with involvement of local COMSEC custodians who will process and control terminals and keying material is required to realistically assess field system operation. Multi-Service and Agency COMSEC material handling aspects and logistics support plans were not evaluated under operational conditions. Use of contractor personnel needs to be clarified. These limitations do not invalidate the test results, but will require resolution in the planning and approval of follow-on operational test and evaluation.

During the Air Force OT&E Testing, calls were placed from the following sites:

Pacific Test Sites:

Andersen AFB Guam	18 April 88	-	29 April 88
Hickam AFB HI	18 April 88	-	24 June 88
Det 1 SPCM Maui HI	18 April 88	-	29 April 88
Yokota AB Japan	2 May 88	-	13 May 88
Misawa AB Japan	2 May 88	-	13 May 88
Woomera Australia	2 May 88	-	13 May 88
Kadena AB Japan	16 May 88	-	29 May 88
Clark AB RP	16 May 88	-	29 May 88
San Miguel RP	16 May 88	-	29 May 88
Osan AB Korea	30 May 88	-	10 June 88
Taegu AB Korea	30 May 88	-	10 June 88
Elmendorf AFB AK	30 May 88	-	3 June 88
Shemya AFB AK	6 June 88	-	10 June 88

CONUS Test Sites:

Langley AFB VA	18 April 88	-	24 June 88
Mather AFB CA	18 April 88	-	24 June 88
George AFB CA	18 April 88	-	22 April 88
Hanscom AFB MA	6 June 88	-	10 June 88
Peterson AFB CO	2 May 88	-	6 May 88
Kirtland AFB NM	25 April 88	-	29 April 88
Scott AFB IL	16 May 88	-	20 May 88
Hurlburt AFB FL	23 May 88	-	27 May 88
Offutt AFB NE	9 May 88	-	13 May 88

Director, Operational Test and Evaluation support contractor personnel observed testing at selected sites. A staff member of the Director, Operational Test and Evaluation observed the KMC operations and visited AFCC and 1015th test sites during testing.

OPERATIONAL EFFECTIVENESS

The QOT&E phase of independent operational test and evaluation was a test of production representative STU-III/LCT-I terminals that were operated by 1815th OTES personnel at selected sites throughout the Pacific and CONUS. The terminals were operated over representative telephone circuits in order to evaluate the terminal operational effectiveness. Operational missions were not employed and technical testing techniques were employed to quantify performance such as voice quality.

The 1815th QOT&E report summarizes operational effectiveness as marginal based on the systems tested. Voice quality in secure voice tests did not meet user requirements to compare with the quality of plain old telephone system (POTS) voice. Subjective assessments were that the secure voice quality is improved over current narrowband secure voice systems. Terminal lock-up and zeroization were two equipment problems noted. The National Security Agency indicates that they are planning to incorporate an interoperable higher data rate (4.8 Kbps) in all terminals and that Motorola plans a 9.6 Kbps rate. They also indicate that the lock-up and zeroization problems are corrected in later terminals which can be tested in planned European testing.

A discussion of the 1815th OTES report on operational effectiveness issues follows with the Director, Operational Test and Evaluation assessments.

Effectiveness Objective E-1 evaluates the capability of the STU-III terminals to operate over government-owned, leased, and commercial switched telephone networks as well as the existing unsecure telephone equipment.

The QOT&E rated this area as marginal for Subobjectives E-1.5 and E-1.7 concerning operations in the secure mode over DCS and commercial switched telephone circuits. The threshold score of 91% using the Modified Rhyme Test (MRT) was not met. AT&T achieved 86% accuracy, Motorola 82% accuracy, and RCA 88% accuracy in the 2.4 Kbps mode over the DCS. The accuracy over commercial switched telephone circuits was 85% for AT&T, 82% for Motorola, and 88% for RCA. Each terminal met or exceeded the 91% figure for POTS operations. The QOT&E requirement was based on MIL Standard 1472C, and a user requirement for 91% MRT over operational media. The National Security Agency refers to back-to-back laboratory scores of 88 voice intelligibility in accordance with the DoD Diagnostic Rhyme Test (DRT). The Director, Operational Test and Evaluation assessment is that STU-III/LCT-I secure voice quality is marginal in the 2.4 Kbps back-to-back mode and does not improve by use of operational communications media. The AT&T 4.8 Kbps secure voice did subjectively improve voice quality in back-to-back operations but is not confirmed by QOT&E operational data.

Effectiveness Objective E-3 evaluates the methods of keying or rekeying the STU-III. The QOT&E rating of satisfactory is in consideration of the subobjective E-3.4 rating of unsatisfactory for evaluation of the established procedures for issuing and controlling operational keys. The test director reviewed local procedures for issuing and controlling operational keys. Results are that half of the test sites had no information or instructions for the STU-III/LCT-I. The Director, Operational Test and Evaluation assessment is that this is a limitation of the operational testing to date, and operation of the KMS with interaction at the local COMSEC custodian for issue, control, and operational use of the terminals and keying material system should be confirmed in follow-on operational test and evaluation.

Service reports were also prepared to identify terminal malfunctions, deficiencies, and shortfalls. Twenty-five were submitted during QOT&E. Eleven were rated mission essential and involved two equipment problems of system lock-up and system zeroization. During lock-up, the terminal was not usable as a POTS or a secure terminal until the power was removed and reapplied. The RCA terminals locked-up four times and the AT&T terminals twice. Terminals zeroized overnight and prevented their use as secure terminals until receipt of new keying material. The AT&T and Motorola terminals zeroized twice and the RCA terminal once. The National Security Agency indicates that all vendors have corrected these two problems by changes in software which is available in terminals scheduled for European tests which started 26 September 1988. The Director, Operational Test and Evaluation assessment is that the vendor changes should be evaluated by the 1815th OTES during the European tests and results included in the report of these test results.

The subojectives for E-1 evaluation of the capability to operate as well as an existing unsecure telephone equipment were rated satisfactory for E-1.1, voice operations in POTS mode over the DCS; E-1.3, voice operations in POTS mode over commercial switched networks; E-1.6, data in secure mode over the DCS; and, E-1.8, data in secure mode over commercial switched networks. AT&T terminals added the capability to pass plain text data over the DCS and commercial switched networks, E-1.2 and E-1.4.

Establishment of secure communications within the required time was satisfactory (E-2).

Subobjectives under E-3 evaluation of the methods of keying or rekeying were rated satisfactory for manual keying (E-3.1); for electronic keying, which impressed everyone who observed the rekey effort (E-3.2); and, duplication of CIKs up to the maximum allowed (E-3.3).

Objective E-4 evaluated the security protection of all terminals as satisfactory by demonstrations of automatically downgrading to the highest common authorized security classification, notification to the user of lowered common security classification, and capability to deny access to CIKs that have been identified as compromised.

Objective E-5 evaluated the Motorola terminal satisfactory for reversion to POTS operation without external power. AT&T and RCA terminals did not provide this capability. The National Security Agency indicates that AT&T and RCA will provide this capability in future terminals.

Objectives for operation in airborne applications was not determined, but will be conducted and reported later. Objectives for operations in tactical applications were not determined, but have been assessed and reported as feasible for the 2.4 Kbps data rates by the Joint Tactical Command, Control, and Communications Agency (JTC3A) based on technical testing through July 1988 at Ft. Huachuca, Arizona.

Subjective comments and observations by QOT&E personnel were provided on special features or options of the various terminals. The AT&T terminal provided 4.8 Kbps operation with another AT&T terminal. It also provided frequency offset, which was used in Korea to compensate for poor quality lines. In addition, the AT&T terminal provided Hayes compatible commands for operation of the internal modem. The Motorola terminal was most compact, offered POTS operation without power, and had one-button for transferring to the half-duplex operation. The RCA terminal incorporated the overseas requirements in CONUS terminals and had simultaneous two/four wire operation capability.

The Director, Operational Test and Evaluation overall assessment of operational effectiveness is marginal for the FSVS as tested, including the test planning and conduct of tests with the KMS and STU-III/LCT-I terminals. Marginal implies less than satisfactory but not unsatisfactory; the equipment demonstrates capability and can be used, but it needs improvement.

The test planning has improved in the last year but requires continued attention to complete plans for the required follow-on operational test and evaluation of the corrections for deficiencies noted during QOT&E and confirmation of operational effectiveness of enhancements and emerging STU-III components in the FSVS program. KMS operation, to include the COMSEC custodian personnel, and improved voice quality are critical operational effectiveness issues for resolution in the follow-on operational test and evaluation. Although limited, the QOT&E and National Security Agency test results confirm that the STU-III/LCT-I has strong potential to be operationally effective for POTS and secure voice communications.

OPERATIONAL SUITABILITY

The QOT&E phase of independent operational test and evaluation was a test of production representative STU-III/LCT-I terminals that were operated by 1815th OTES personnel at selected sites throughout the Pacific and CONUS. The terminals were operated over representative telephone circuits in order to evaluate the terminal operational effectiveness. Operational missions were not employed and technical testing techniques were employed to quantify performance such as voice quality. The logistics supply capability was not in place and contractor personnel were utilized for repair and trouble shooting as required in order to complete the test. Final plans have not been made for use of contractor maintenance or warranties.

The 1815th QOT&E report summarizes operational suitability as marginal based on the systems tested. The suitability of life-cycle support channels to support operational requirements was undetermined. Operational Suitability in the Air Force test report was rated marginal. The assessment was based upon comments from participants in the OT&E process and observations of members of the 1815th OTES conducting the Air Force test. The National Security Agency report did not cover total user system suitability issues, but did discuss those related to the STU-III/LCT-I terminal which they developed and procured.

The 1815th report on operational suitability issues follows with the Director, Operational Test and Evaluation assessments.

Suitability Objective S-1 assesses the suitability of life-cycle support channels to support operational requirements.

The Air Force rated this area as undetermined. Although there were no provisions for life-cycle support in place for the QOT&E, the vendors provided replacement terminals when notified. They provided a toll-free phone number for service information to CONUS test personnel. This toll-free phone service was not available to the test directors overseas.

Suitability Objective S-3 assesses the suitability of user manuals. Suitability Objective S-5 assesses the suitability of training for the STU-III.

The QOT&E rated these areas as marginal for manuals and unsatisfactory for training. The training assessment is related to the manuals in that some users had problems in configuring the terminals due to the readability problems with some of the manuals. The National Security Agency reports that revised manuals are being prepared. The Director, Operational Test and Evaluation assessment is that training is one of the areas which needs to be resolved by Service and Agency approval of their maintenance plans. Follow-on operational test and evaluation is required to confirm operational suitability.

Suitability Objective S-6 assesses the established procedures to issue and control STU-III terminals. This objective is related to Effectiveness Subobjective E-3.4 for established procedures for issuing and controlling of operational keys.

The QOT&E rating for S-6 is marginal based on a review of current procedures to issue and control the STU-III/LCT-I terminals. The E-3.4 rating was unsatisfactory for established procedures for issuing and controlling of operational keys. The Director, Operational Test and Evaluation assessment is that this is a limitation of the operational testing to date, and operation of the KMS with interaction at the local COMSEC custodian for issue, control, operational use, and operational support of the terminals and keying material system should be confirmed in follow-on operational test and evaluation.

Suitability Objective S-13 evaluates the self-diagnostic capability of the STU-III.

The QOT&E rates this objective as undetermined. Terminal difficulties were to be analyzed using self-diagnostics of each terminal. However, error code definitions were not provided by RCA, and the AT&T and Motorola code listings were provided two weeks before completion of the test but not evaluated. The Director, Operational Test and Evaluation assessment is that self-diagnostics issues need to be resolved by Service and Agency approval of their maintenance plans and follow-on testing.

Suitability Objective S-8 evaluated the reliability of STU-III as satisfactory based on a mean time between critical failure of 7000 hours as compared to a 3000-hour requirement. Human engineering, S-11, was satisfactory and no special tools were required (S-4 satisfactory). Installation was satisfactory.

The Director, Operational Test and Evaluation overall assessment of operational suitability is marginal for the FSVS as tested, including the test planning and conduct of tests with the KMS and STU-III/LCT-I terminals. Marginal implies less than satisfactory but not unsatisfactory; the equipment demonstrates capability and can be used, but it needs improvement.

The test planning has improved in the last year but requires continued attention to complete plans for the required follow-on operational test and evaluation of the corrections for deficiencies noted during QOT&E and confirmation of operational suitability of enhancements and emerging STU-III components in the FSVS program. KMS operation to include COMSEC custodian personnel and improved planning for life-cycle support are critical operational suitability issues for resolution in the follow-on operational test and evaluation. Although limited, QOT&E and National Security Agency test results confirm that the STU-III/LCT-I has strong potential to be operationally suitable for POTS and secure voice communications.

CONCLUSION

Independent operational testing, although limited, was adequate to determine operational effectiveness and suitability as marginal for the systems tested. Marginal implies that the system is useable but it needs improvements. Observed terminal reliability and useability have been acceptable. The system has strong potential to be operationally effective and suitable.

Follow-on independent operational test and evaluation is required. Improved interoperable secure voice quality, KMS operation to include the user COMSEC custodian personnel, and maintenance plan completion and implementation are critical issues for resolution in the follow-on independent operational test and evaluation.

The FSVS remains on the Director, Operational Test and Evaluation list of designated DoD programs for operational test and evaluation oversight. A new FSVS TEMP and operational test plans are required to approve the follow-on operational testing of STU-III/LCT-I and new emerging components in the FSVS program.

DEPARTMENT OF DEFENSE

OPERATIONAL TEST AND EVALUATION REPORT

ON THE

MOBILE SUBSCRIBER EQUIPMENT (MSE) SYSTEM

December 5, 1988



OFFICE OF THE SECRETARY OF DEFENSE

WASHINGTON, D.C. 20301

TEST AND EVALUATION
COMMITTEE

5 December 1988

OPERATIONAL TEST AND EVALUATION REPORT
ON THE
MOBILE SUBSCRIBER EQUIPMENT (MSE) SYSTEM

The Office of the Director, Operational Test and Evaluation has completed its assessment of the Mobile Subscriber Equipment (MSE) Follow-On Operational Test and Evaluation (FOT&E). This report is being submitted in fulfillment of the provisions of Title 10 USC 138.

The FOT&E was adequate to support an assessment of MSE effectiveness and suitability to perform its mission of providing a division-area communications system and supporting mobile and static users with voice, data and facsimile communications. The test scenarios consisted of both scripted events and a free play tactical exercise designed to replicate traffic and sizing conditions associated with actual combat and to address specific contract performance requirements.

The MSE system represents an innovative approach to the military acquisition process and is the first system to be procured under a streamlined acquisition strategy designed to shorten the time normally required for acquisition. In a relatively short period of time the MSE Non-Developmental Item (NDI) strategy has fielded a complete division set of equipment. DOT&E considers the operational suitability and effectiveness of MSE to be adequate at this level of maturity. DOT&E will insist the Army conduct a series of verification tests and assessments of an operational nature to ensure that identified problems are corrected and appropriate means are in place to withhold funds if the corrections are not accomplished satisfactorily. This process will ensure that the items delivered are both operationally effective and suitable.

A description of the MSE system and the adequacy of the testing conducted, together with amplifying information on operational effectiveness and suitability follows.

JOHN E. KRINGS
Director

SYSTEM DESCRIPTION

The Mobile Subscriber Equipment (MSE) system is a complete tactical communications system that is designed to satisfy the essential area communications at Division and Corps level throughout the Army. The system has as its objective provision of highly mobile secure digital communications capable of providing users with voice, data, and facsimile service. The system is automatic, self organizing, and uses flood search routing to enable subscribers to retain their telephone number and enter the network regardless of their location on the battlefield. MSE is intended to provide commanders and their staff with a much more mobile communications capability not available with the present system. Figure 1 is a diagram of a 4 node Division deployment scheme.

The system consists of five functional areas which interoperate with each other providing a digital grid network communications service supporting the Corps and Division areas. A brief description of each functional area follows.

a. Subscriber Terminals. The Subscriber Terminal functional area provides telephone, data and facsimile service. The Digital Non-Secure Voice Terminal (DNVT) is a tactical push-button telephone which incorporates a data port for connecting either facsimile or digital device terminals. The DNVT permits entry into the MSE telephone switching network.

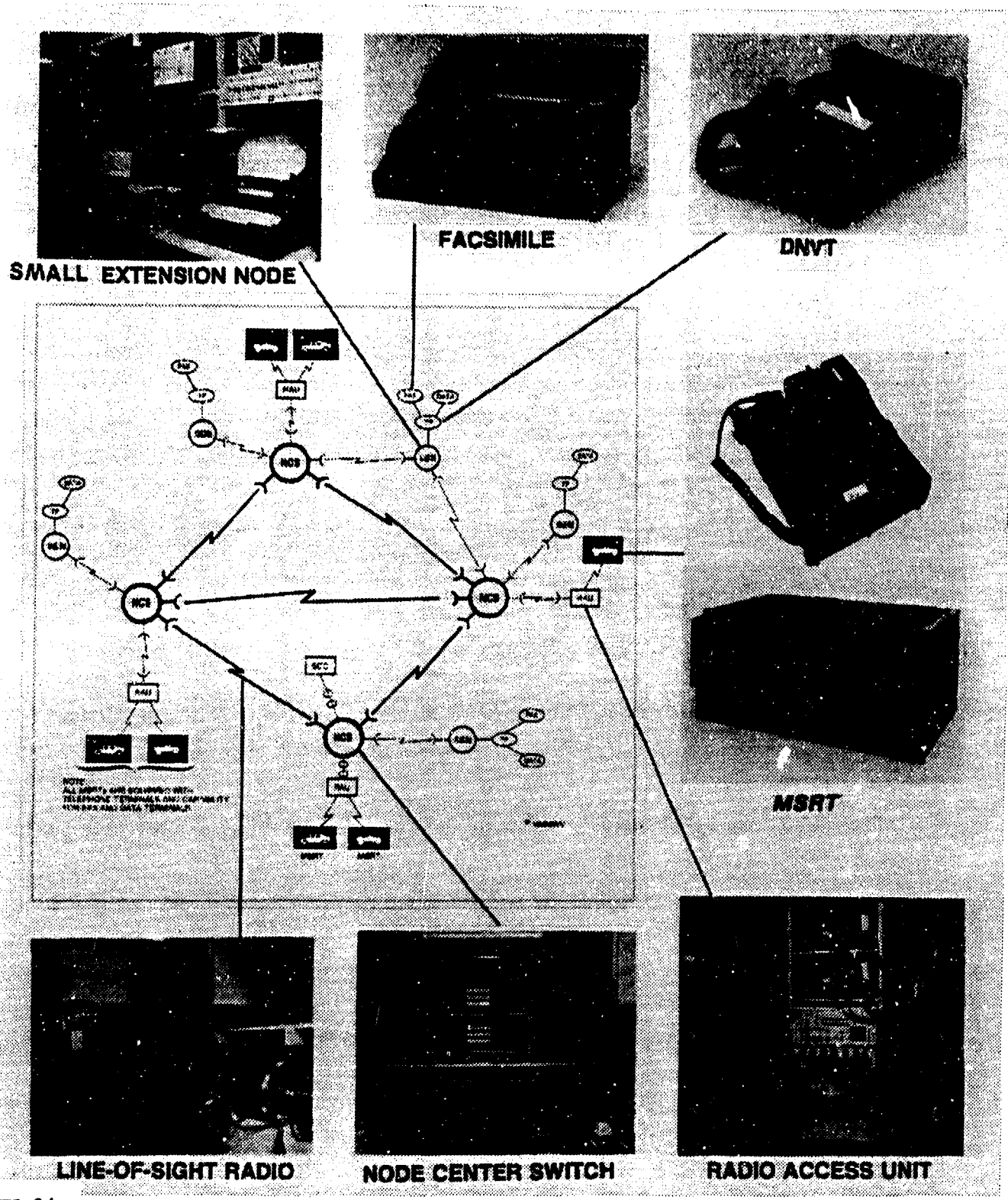
b. Mobile Subscriber Access. The Mobile Subscriber functional area provides access to the MSE telephone switching system from tactical, mobile, vehicular telephones called Mobile Subscriber Radio Telephones (MSRTs). The MSRT permits mobile subscribers secure voice or data access to the MSE switching system throughout the tactical area of operation. The MSRT is a mobile radio transceiver which gains access to the MSE network through Radio Access Units (RAUs) which are connected by wire or radio to the MSE Node Center Switches (NCSs).

c. Wire Subscriber Access. The Wire Subscriber Access functional area provides wire telephone subscriber service to local area users using Large Extension Node (LEN) or Small Extension Node (SEN) switches. The LENs or SENs provide long-distance service to other local area switches via Line of Sight (LOS) radio links to MSE Node Center Switches (NCSs). The NCS switches (4 per Division and 42 per Corps) form the grid network area coverage communications system for the MSE network.

d. Area Coverage. The Area Coverage functional area provides the grid network communications in support of the Division or Corps area. The grid network is composed of 4 node Center Switches (NCS) per Division (42 per Corps). Access to the grid network is provided either through the Radio Access Units (RAUs) which support the mobile telephone system, or through the Large/Small Extension Nodes (LEN/SEN) which support the wire subscribers. An automatic digital network permits access to the MSE network from anywhere within the area of operation from either the mobile radios or the wire subscriber telephones.

e. System Control. The System Control functional area provides an automated capability for system management, technical support and circuit/network planning of the MSE network. The System Control Center (SCC) consists of a management shelter, a technical support shelter and a planning shelter. At Division level only the management and technical support shelter are employed.

FIGURE 1 - MSE 4 Node Division Deployment Scheme



BACKGROUND

The MSE program used a competitive Non-Development (NDI) acquisition strategy which was designed to take advantage of available technology and avoided a lengthy developmental period. In July 1984 the Army released a solicitation package to industry which supported the NDI approach. The contract was subsequently awarded to General Telephone and Electronics (GTE) and signed in December 1985. The Army exercised its Option Year 1 decision coincidentally with its decision to let the basic contract. Option Year 2 was awarded in February 1987. Option Year 3 is preceded by operational testing which will determine the operational effectiveness and suitability of the system and will be used to support approval of award of Option 3.

Throughout the program DOT&E has been actively involved in the test planning process to include review of the Test and Evaluation Master Plan (TEMP), the Test Design Plan (TDP), and on-site observations of the preparatory testing accomplished at the contractor's facilities and at Ft. Hood, Texas. DOT&E also attended numerous test planning meetings and conducted on-site observations during the FOT&E. DOT&E required the inclusion of operational testing as part of the MSE acquisition strategy prior to the execution of the MSE Option 3 award. DOT&E's review of the test plans resulted in the inclusion of a limited baseline comparison and a limited assessment of MSE performance under EW conditions.

TESTING ADEQUACY

DOT&E is satisfied that the MSE Follow-On Operational Test and Evaluation (FOT&E) at Ft. Hood, Texas was adequate to support an assessment of the system's operational effectiveness and suitability although limited by deficiencies outlined below. This assessment is based upon DOT&E's active involvement in the review and approval of the Test and Evaluation Master Plan (TEMP) as well as other test planning documentation, on-site observations of the preparatory testing accomplished both at the contractor's facilities and at Ft. Hood during the Destination and Final Acceptance Testing (DFAT). DOT&E also observed the pre-test training, reviewed the contractor support plans, conducted on-site observations during the FOT&E and conducted an independent review of the U.S. Army Operational Test and Evaluation Agency's (OTEA's) Interim FOT&E Independent Evaluation Report (IER). DOT&E attended MSE Quarterly reviews, Test Integration Working Group (TIWG) meetings and other key MSE program meetings. DOT&E required the inclusion of operational testing as part of the MSE acquisition strategy prior to the execution of the MSE Option III award. DOT&E's review of the test plans resulted in the inclusion of a limited baseline comparison and a limited assessment of the MSE performance under EW conditions.

The FOT&E was scheduled to follow the Army's acceptance of both the MSE equipment and the contractor provided user training. DOT&E supported the inclusion of a division-level CPX prior to acceptance of MSE equipment

and training. Based upon observations of MSE performance during the CPX, DOT&E encouraged the Army to delay the start of FOT&E until the Army was confident that the MSE system could satisfy the requirements. In May 1988the Army began combined field testing, on-site analysis, and corrective actions to identify and correct MSE system deficiencies. After a three-month delay and substantial improvements to the MSE system, the Army conducted the MSE FOT&E from 9 August 1988 through 25 October 1988.

The FOT&E was conducted by the 1st Cavalry Division at Ft. Hood and the test consisted of three phases summarized as follows:

Phase One (Pilot Test) - This phase consisted of a two week pilot test designed to demonstrate a successful test network and conduct typical test scenarios in order to evaluate the data collection, processing, reduction and analyses activities. All objectives of this phase were met.

Phase Two (Record Test) - This phase of the test was the primary source of all data collected during FOT&E. It consisted of a six week period during which a series of scripted scenarios was run to exercise the communications network under operationally realistic tactical loads. Additional scenarios were also included to assess the MSE system compliance with contract specifications. Side tests were conducted to examine a number of specific system features. During this phase, traffic loads applied to the network resulted in an analysis of over 190,000 calls. In addition, over 800,000 data forms on System Performance, Reliability, Availability, and Maintainability (RAM), System Suitability and Manpower and Personnel Integration (MANPRINT) were collected and analyzed.

Phase Three (Command Post Exercise) (CPX) - The third phase involved the major elements of the 1st Cavalry Division in a 96-hour CPX which provided an opportunity to evaluate the MSE system in a realistic free-play environment using scenario driven live traffic loads.

The following is DOT&E's assessment of the FOT&E test limitations and their impact:

1. Limited hardware availability constrained the opportunities for:

   Division-level (4 node) operational testing prior to an Option III contract award; and

   Corps-level operational testing of 42 nodes after all the acquisition decisions had been made.

DOT&E insisted that early operational testing was critical to the successful acquisition of the MSE system. It was determined that a division-level test would provide valuable insights into system performance prior to the Option III award. Additional follow-on testing will be required to assess corps-level performance.

2. Computer Models were to be used to predict Corps level performance based upon the FOT&E test results. This prediction was to be conducted as outlined below.

The computer models were to be used to predict the operational performance of the 4 node division network.

The FOT&E test results were to be compared to predicted MSE performance.

If the predicted performance was confirmed by the test results, the model would then be used to predict the 42 node corps network.

Suspected software problems identified during FOT&E and the current status of the models do not support their use to predict corps performance at this time.

DOT&E's assessment of this limitation is that extrapolation of model results to predict corps-level performance would, at best, provide little to reduce the risk associated with an Option III award. The problems identified during FOT&E must be corrected and operational testing conducted to verify the corrections. DOT&E will require additional follow-on testing to verify corps-level performance.

3. Testing was limited by weather, the terrain, the size of the deployment area, the quantity of equipment available to represent the threat and and FCC frequency restrictions. DOT&E's assessment of the impact of weather, terrain and area size on the adequacy of the test and the ability to assess MSE system performance is that the impact was minimal. DOT&E assessed the testing of the threat to be inadequate.

The EW test results are inconclusive and the Army's MSE EW Advisory Council has recommended extensive additional testing. DOT&E considers MSE EW performance to be a critical issue. Of the three major Army communications systems (SINCGARS, ADDS-EPLRS, JTIDS, AND MSE) only MSE is being procured without an active Anti-Jam (A/J) capability (this was a conscious decision by the Army). DOT&E will require an assessment of MSE's vulnerability to threat jamming.

4. The Army expected problems with the MSE COMSEC key management plan that was used during FOT&E. One of the purposes of the FOT&E was to gather data to assess adequacy of the COMSEC key management plan and recommend modifications. While FOT&E accomplished this task, the DOT&E assessment is that additional operational testing is required to confirm the adequacy of the revised COMSEC key management plans.

5. Interoperability testing used the early production version of the SINCGARS radio, which uses a separate KY-57 COMSEC device. The Integrated COMSEC (ICOM) SINCGARS (AN/VRC-90) radios, the AN/TCC-42 circuit switch and the SB-3865 switchboard were not available for FOT&E. DOT&E considers the impact of using the Non-ICOM SINCGARS radio to be minimal, as the interface with MSE is the same. However, when these three systems become available, DOT&E will require that the interfaces with MSE be confirmed by test.

6. MSE-SINCGARS co-site interference testing only examined the procedures to be used when an MSE MSRT and SINCGARS or VRC-12 radio are co-located. Essentially, these procedures require that one system be turned off to preclude co-site interference. The Army FOT&E Independent Evaluation Report simply indicates that, if the procedure is followed, it effectively eliminates co-site interference. The test and the IER do not address the operational impact of turning off one of the systems or the advisability of co-locating the two systems if one has to be disabled. DOT&E's assessment is that additional operational testing is required to determine the operational impact of the co-site interference problem in a highly mobile combat environment.

OPERATIONAL EFFECTIVENESS AND SUITABILITY

The MSE system has been defined as an Non-Developmental Item (NDI) acquisition. It is the first system to be procured under a streamlined acquisition plan designed to shorten the normal acquisition process. Within three years the Army has fielded a complete division set of equipment. While DOT&E is concerned about the problems identified during FOT&E, the number and severity of the problems were fewer than expected. The DOT&E assessment took into consideration the magnitude of the MSE program, the relatively rapid deployment of a complete division set of equipment and its early exposure to an operational test.

The Army assessment has shown that not all user requirements were met, but from a user perspective, the system is effective, suitable and better than the current system. On the basis of FOT&E results the Army has judged the system to be operationally effective and suitable. DOT&E is concerned with MSE performance and suitability as evidenced by the FOT&E results. These test results and concerns are outlined in the following paragraphs.

1. The Army identified the following three critical operational issues:

A. CORPS-LEVEL PERFORMANCE: Corps-level performance was not assessed in the Army's IER. It should be noted that an FOT&E test limitation indicated that limited hardware availability precluded testing a corps-level network. DOT&E accepted this test limitation and accepted a division-level FOT&E in order to provide an early assessment of the MSE system prior to the award of Option III. FOT&E resulted in the early identification of problem areas which affect both corps and division-level performance. While the TEMP indicated that computer models were to be used to extrapolate division-level FOT&E results to assess MSE performance effectiveness at corps-level, the Army Interim IER does not address the extrapolation of test data to assess corps performance. DOT&E considers that modeling at best can only augment operational test results. DOT&E will require additional operational testing of the MSE system to determine its performance at corps level.

The FOT&E results reinforce the need for early operational testing and support the need for additional follow-on testing to include corps-level to confirm both the effectiveness of the corrective actions resulting from the FOT&E and to determine MSE's corps-level performance.

The 90% Call Completion Rate (CCR) criterion was not met in the division-level (4-node) network tested during FOT&E. The Grade of Service (GOS) recorded during FOT&E ranged from 53% to 79%. The impact of a corps-level network on the GOS is not known and must be determined by test when sufficient hardware is produced. The military significance of the failure to meet the 90% criterion cannot be assessed at this time, but a rigorous comparison of the MSE performance with the current capability under similar conditions is not possible using the current FOT&E data. However, the majority of test player personnel regarded the GOS obtained to be adequate.

Several of the system deficiencies identified during the FOT&E appear to be software related. The impact of these apparent software problems on corps-level performance (or the software changes required to correct these problems) must be determined. DOT&E will require operational evaluation of the impact of software corrections.

B. SYSTEM RESTORATION; The 90% criterion was met for restoring an extension node within 20 minutes when lowering the antenna mast was not required. The criterion of 40 minutes (90% of the time) when the mast was required to be lowered was not met. However, it was accomplished within the time criterion 84% of the time. The interim Army IER contains no information on the impact of this deficiency or the cause of the excessive time. The full operational impact of the failure to meet the criterion must be determined.

C. INTEROPERABILITY: The Army reported that "the criteria for interoperability with Echelons Above Corps (EAC), NATO and adjacent corps were not met while the criterion for interoperability with commercial systems was met. The primary cause for not meeting the criteria were the lack of interoperability training and lack of operational procedures. The situation was compounded by the fielding sequence which provides the MSE to divisional units and the doctrine which places the responsibility for interfacing with supported divisions on corps and higher signal units. These units have never seen nor been trained on MSE and were forced to experiment on proper settings and hookups. The technical interface between MSE and other systems appeared to work."

The contractor delivered equipment met specifications but, when employed in an operational environment, the soldiers could not install the required interfaces. The cause of the failure was not the technical interface but rather, insufficient documentation and operator training. DOT&E will require test confirmation that this failure has been corrected.

2. With regard to the issues identified by the Army as "supporting" or "not critical" the following synopsis is provided:

A. EW PERFORMANCE: As noted in the limitations section, Electronic Warfare (EW) testing during FOT&E did not provide sufficient data to assess MSE performance under jamming. EW was an "investigative" issue, and the MSE system was purchased under an NDI strategy without an active Anti-Jam (AJ) capability. Clearly, an assessment is required. This is the only major communication procurement program which does not incorporate an active A/J capability. DOT&E will require further operational test and evaluation of MSE Anti-Jam capability.

B. RELIABILITY: Significant in the Reliability Availability and Maintainability (RAM) area are the FOT&E Operational Availability (Ao) values reported on the MSE major assemblages. In all cases the major MSE assemblages exceeded the criterion values. The observed mean Ao for all major assemblages was 0.974. While the operational availability and

reliability criteria were satisfied for all major assemblages, the Large Extension Node (LEN) was judged unreliable by the operators and test personnel. Frequent system anomalies caused "catastrophic" failures which required reinitialization of the major circuit switches. These anomalies occurred 47 times during FOT&E. DOT&E considers the operational impact of these anomalies to be unacceptable. Furthermore, the impact of these failures on a corps network of 42 nodes must be determined. These identified problems appear to be inconsistent with the system meeting the criteria for availability and reliability. The criterion of 30 minutes for the system's maintainability, as measured by the Mean Time to Repair (MTTR) was not met. The average MTTR for all assemblages was 149.25 minutes. DOT&E will require additional follow-on testing to ensure correction of these deficiencies.

C. MANPRINT: The analysis of the Manpower and Personnel Integration (MANPRINT) issue indicates the MSE assemblages generally provide for efficient operation and maintenance by typical soldiers and that manning levels are adequate. Training was considered inadequate. However, this deficiency was recognized as early as April 1988, and significant changes have already been implemented. DOT&E will require that corrective actions on MANPRINT findings be verified through further operational testing.

D. SYSTEM MOBILITY: The criterion for 30 minute set up and tear down times was not met. However, the MSE system demonstrated that it could be set up and torn down almost twice as rapidly as the current system. A comparison of the MSE system with the current system's installation/integration times (time to establish node-to-node connectivity) also favors the MSE system by a wide margin. DOT&E considers the mobility of the system at division level adequate.

E. MSE-MSRT SINCGARS CO-SITE INTERFERENCE: Developmental Testing (DT) identified significant co-site interference problems between the MSE Mobile Subscriber Radio Telephone (MSRT) and the SINCGARS Combat Net Radio (CNR). In response to the DT testing results, operational procedures were developed which required the operator to turn one system off when using the other. FOT&E simply confirmed that the procedure was effective in eliminating the co-site problem. It did not address the operational impact of turning one system off to avoid interference or the advisability of co-locating two systems when one is required to be turned off. DOT&E considers that co-site testing to date indicates a potentially severe problem which requires additional testing to adequately assess.

F. SYSTEM CONTROL CENTER (SCC): The MSE System Control Center (SCC) was found to be of little use in its current physical configuration, and its system management capability is operationally deficient. This equipment is used to manage an MSE network. Since the SCC cannot operate effectively in a 4 node network, DOT&E judged it to be of little assistance in the control of a 42 node network. DOT&E requires that the performance of the SCC be further tested operationally in both the division and corps configurations to verify that planned modifications are effective and suitable.

CONCLUSION

The MSE program represents an innovative approach to the military acquisition process. MSE is the first system to be procured under a streamlined acquisition plan designed to shorten the normal acquisition process. In a relative short period of time, the MSE NDI procurement strategy has fielded a complete division set of equipment. While the MSE system is not without problems, it has experienced far fewer problems than may have been expected, particularly in light of the magnitude of the MSE NDI acquisition process. The Army is initiating a plan to correct deficiencies identified during FOT&E. The MSE system will clearly undergo substantial changes as these corrections are implemented and new problems are identified.

While DOT&E is concerned about the problems identified during FOT&E, its assessment also takes into consideration: the magnitude of the MSE program; the relatively rapid acquisition and deployment of a complete division set of equipment; and the early exposure of the system to a major operational test. The Army acknowledges that not all user requirements were met. However, a large majority of the FOT&E test participants judged MSE to be much better that the current system.

Given the nature of the system, the deficiencies identified during FOT&E and the necessity to ensure system effectiveness at the corps-level in an EW environment, DOT&E will insist that the Army conduct a series of verification tests and assessments of an operational nature to ensure problems identified are corrected and appropriate means are in place to withhold funds if the corrections are not accomplished satisfactorily. This process will ensure that the items delivered are operationally effective and suitable.

OFFICE OF THE SECRETARY OF DEFENSE

WASHINGTON, D.C. 20301-1700

OPERATIONAL TEST
AND EVALUATION

14 DEC 1988

OPERATIONAL TEST AND EVALUATION REPORT ON THE M9 Armored Combat Earthmover (M9 ACE)

The Office of the Director, Operational Test and Evaluation has completed its assessment of the M9 ACE. This report is being submitted in fulfillment of the provisions of 10 USC 138.

The operational test and evaluation of the M9 ACE was adequate to provide the information necessary to reach a production decision for the system. The testing was conducted in as realistic an environment as could be achieved.

As tested, the M9 ACE demonstrated an operationally effective capability to carry out its mission of earthmoving in support of combat engineer tasks. Its productivity is enhanced by better survivability and responsiveness than the medium bulldozer system it is to replace. Operational suitability of the M9 ACE has been markedly improved by an aggressive and effective series of engineering changes; its reliability exceeds criteria, and its maintainability is expected to exceed criteria when corrections based on previously successful configurations are applied.

A description of the M9 ACE and the adequacy of operational tests conducted, together with amplifying information on operational effectiveness and suitability follows.

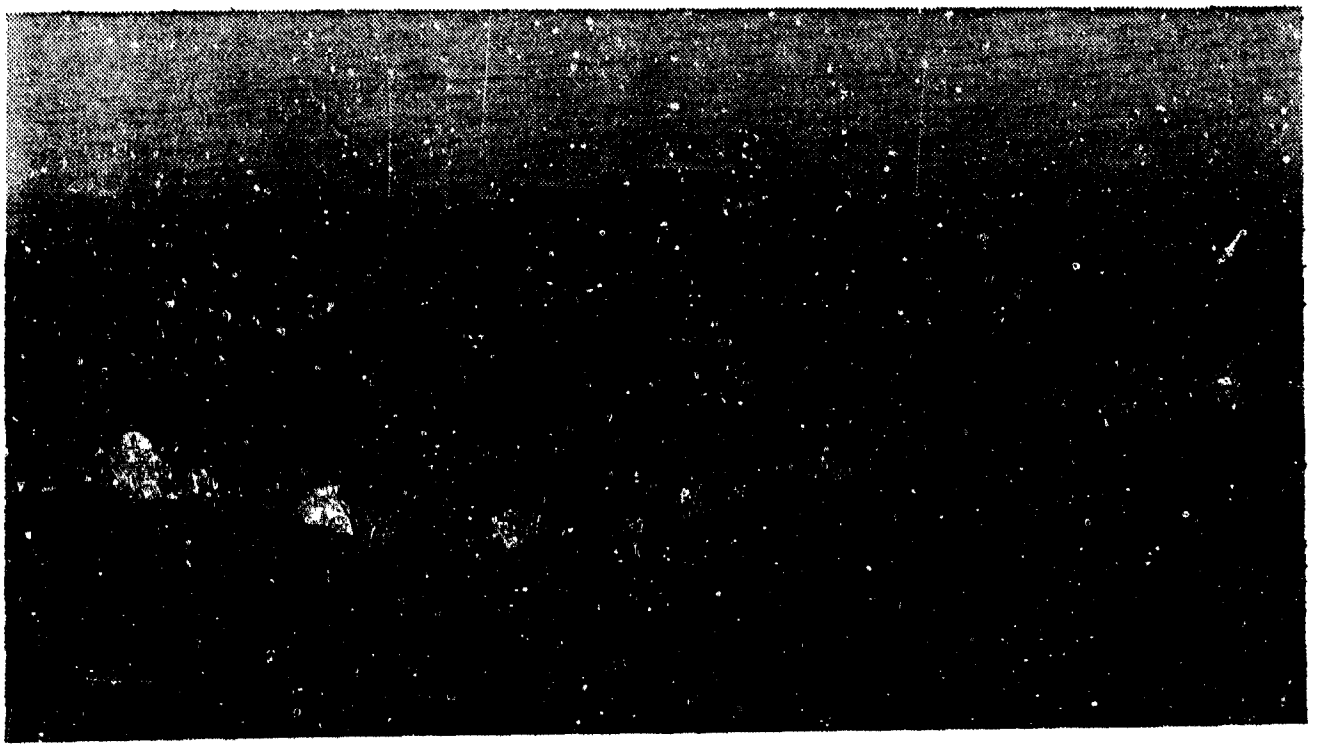
John E. Krings
Director

SYSTEM DESCRIPTION

The M9 Armored Combat Earthmover (M9 ACE) is a tracked, lightly armored, amphibious, combat engineer vehicle designed to perform dozing, scraping, rough grading, towing, and limited hauling missions. It was developed to perform the engineer tasks of survivability (e.g., prepare fighting positions for tanks), mobility (e.g., breach antitank ditches), and countermobility (e.g., dig antitank ditches).

The M9 ACE has a hydraulic suspension system that operates in two modes: sprung, used for travelling; and unsprung, which allows the vehicle to be raised, lowered, or tilted for working. The front portion of the vehicle is an open-top box known as the scraper bowl or ballast compartment. The front of the bowl is opened or closed by raising or lowering the apron with its integral dozer blade. The bowl is filled with earth by raising the apron and moving forward while scraping. Dropping the apron retains the earth in the bowl for use as ballast to improve dozing capability. The ballast is emptied by raising the apron and pushing forward with a hydraulic ejector which forms the rear wall of the bowl.

The M9 ACE is designed to negotiate cross-country terrain, attain 29 miles per hour road speed, swim at 3 miles per hour, and be air transported in C-130 and larger aircraft. It provides radio communication, chemical and biological protection for the operator, and a smoke obscuration capability.



M9 Armored Combat Earthmover (M9 ACE)

TESTING ADEQUACY

M9 ACE development started in 1958 under the program name Universal Engineer Tractor; the current name was adopted in 1980. Oversight by the office of the Director, Operational Test and Evaluation (DOT&E) began in 1984. Following an extended series of tests, reviews, and changes, 15 M9 ACE's were built under a 1982 contract In 1983 the Department of the Army directed that a scheduled Initial Production Test at Aberdeen Proving Ground, MD, be expanded in scope to include a concurrent Force Development Test and Experimentation intended to provide operational test data prior to further contract award. A Follow-on Evaluation was conducted in 1985 and an Initial Production Test Operational Phase was conducted in 1988. The test plan for the Operational Phase was approved by the Director, Operational Test and Evaluation, and DOT&E observed the conduct of the test. The three-test sequence provided data adequate to assess M9 ACE operational effectiveness and suitability.

Initial Production Test/Force Development Test and Experimentation (IPT/FDTE) (April to June 1984)

The FDTE operational portion of the overall test was conducted at Aberdeen Proving Ground, MD by the US Army Armor and Engineer Board. Three of the 15 vehicles produced under the 1982 contract were used by soldiers of the proper military occupational specialty (MOS) for 847 test hours under operational conditions. The vehicles were maintained by soldiers of the proper MOS who received contractor training, supplemented by advice from the contractor when maintenance manual or procedural problems were encountered. Mission performance; reliability, availability, and maintainability (RAM); human factors engineering; and correction of previously noted deficiencies were addressed. Simulations were conducted to support evaluation in two areas: worksite trafficability and to establish a job-related basis for assessment of the relationships of productivity, reliability, and maintenance down time. Test limitations were noted in maintenance manuals that were incomplete or outdated and in vehicle hull dimensions that were not in compliance with the Technical Data Package, leading to damage by mechanical interference between the vehicle hull and track. The limitations did not significantly affect the evaluation and, in fact, contributed to the conclusion that thorough testing in an operational environment was needed.

Follow-On Evaluation (FOE) (March to June 1985)

In August 1984 the Vice Chief of Staff, Army, directed that a side-by-side comparison of the M9 ACE and the D7 dozer system be conducted to resolve uncertainties remaining after the IPT/FDTE described above. The D7 system includes the standard medium crawler tractor, the M916 truck tractor, and the M172A2 lowbed semitrailer. The FOE conducted at Ft. Hood, TX, by the US Army Training and Doctrine Command Combined Arms Test Activity, employed seven of each system; the M9 fleet accumulated 1573.8 operating hours; the dozers 1420.6 hours; the truck tractors 975 hours; and the trailers 381.6 hours. Mission performance, amphibious capability, survivability/ vulnerability, RAM, training, logistics, human factors, and safety were addressed. Modeling and wargame analysis were required in conjunction with test results to evaluate survivability/vulnerability. Vulnerability of the M9 ACE and D7 systems was obtained by Ballistics Research Laboratory/Army Materiel Systems Analysis Activity (BRL/AMSAA) from panel shots and modeling; engagement probabilities were obtained from results of a Scenario Oriented Recurring Evaluation System (SCORES) Europe wargame analysis conducted by the Combined Arms Operational Research Activity (CAORA) with subject matter experts from the US Army Armor, Infantry, and Engineer Schools. Responsiveness values (movement rates) were obtained from the AMSAA Army Mobility Model as well as from test data. There were no test limitations that affected assessment of effectiveness and suitability.

Initial Production Test Operational Phase (June to August 1988)

This test phase was conducted at Aberdeen Proving Ground, MD, under the control of USAOTEA and US Army Test and Evaluation Command Combat Systems Test Activity. Six M9 ACE vehicles were operated and maintained through direct support level by soldiers of the proper military occupational specialty. A total of 1805.8 operating hours were attained under typical operational conditions. The purpose of the test was to address concerns remaining following the 1985 FOE described above. These concerns were: unsafe hatch, low RAM, reduced productivity, transition from a Technical Data Package to production, and effectiveness of engineering changes (53) made as a result of previous testing. No modeling or simulation was used in conjunction with this test. There were no significant test limitations affecting operational effectiveness or suitability assessment.

The test sequence described above was sufficient to sequentially identify deficiencies, shortcomings, and faults and to prove the adequacy of corrective actions applied in all

important areas. In five relatively minor areas (hose identification, plastic windshield, addition of an impact wrench, modification of track retainer, and battery access) test results were inconclusive, incomplete, or show the correction to be marginally successful. Testing to determine the affects of electromagnetic interference and electromagnetic pulse have not been accomplished; these tests are technical in nature, but the results may have operational implications.

OPERATIONAL EFFECTIVENESS AND SUITABILITY

The 1984 IPT/FDTE and the 1985 FOE were conducted using what are considered to be pre-production prototypes; the 1988 Operational Phase of the IPT was conducted with low-rate initial production (LRIP) vehicles. All testing was accomplished by soldier operators and mechanics (through the direct support level) of the proper military occupational specialty under conditions simulating combat engineer operation in accordance with an approved operational mode summary/mission profile.

Operational testing addressed six critical operational issues: mission performance; survivability; reliability, availability, and maintainability (RAM); logistical support; human factors; and safety. In addition, DOT&E concerns expressed after the 1985 FOE were addressed specifically in the Operational Phase of the 1988 IPT.

Test missions in all cases involved performance of engineer tasks of survivability (e.g., prepare fighting positions for tanks), mobility (e.g., breach antitank ditches), and counter mobility (e.g., dig antitank ditches). Scenarios were constructed to attain proportional allocation of activities in accordance with an operational mode summary. The bulk of this, 44%, was dozing; traveling and grading were each 22%; the remainder, in decreasing order, were haul, scrape, swim, winch, and tow.

The results of the test series led to the following findings:

Mission Performance M9 ACE mission performance comprises dozing, travel, scraping, hauling, grading, towing, swimming, and winching. The M9 ACE was intended by design to have bulldozing characteristics comparable to the medium size crawler tractor which it is to replace. The 1984 IPT/FDTE tested only the M9 ACE; the evaluation conducted following the test extracted data from earlier comparison tests, which were somewhat clouded, and inferred that M9 ACE productivity in earthmoving was from 40% to 70% of D7 capability.

Based on these results the Vice Chief of Staff, Army, directed that a thorough operational test comparing the M9 ACE and D7 systems be conducted; this was done in the 1985 FOE. This test showed an overall edge in digging for the D7, with the greatest superiority in digging of antitank ditches, for which the D7 system took three hours to dig a 100-meter ditch and the M9 ACE took four hours. Other task differentials were of minor tactical significance. A valid comparison of the two systems, however, must go beyond a simple review of earthmoving capability (measured in either cubic yards per hour or time to

complete a specific task) and must incorporate availability (a product of reliability and maintainability), system survivability, and system responsiveness. An integrated assessment of this type showed that the M9 ACE's superiority in moving rapidly between scattered tasks and in survivability more than compensated for the D7's digging advantage. An element of major concern for the Operational Phase of the 1988 IPT resulted from an engineering change applied following the FOE to eliminate the transmission output shaft failure mode. Theoretically, this change could reduce the M9 ACE speeds in reverse and thus reduce productivity. This concern was allayed when the Operational Phase demonstrated no change in digging capability (within ± 6%) for the modified M9 ACE in comparison with an M9 ACE in 1985 FOE configuration.

In other aspects of mission performance, the following was found:

Worksite trafficability. In the 1984 FDTE and earlier testing at Aberdeen Proving Ground, MD, an M9 ACE tendency to become stuck while digging was noted as a major potential problem. This was addressed specifically in the 1985 FOE, where it was found that the M9 ACE and D7 systems got stuck with equal freguency when doing comparable jobs. Thus it is clear that getting stuck is a thing that happens in these operations and is not a problem created by the M9 ACE itself.

Amphibious operations. The 1985 FOE showed that the M9 ACE can swim in calm water at the 3-mile-per-hour speed criterion and can enter and exit the water on natural stream banks with slopes of 20%, and at pre-existing ramps with slopes of 13%. Both the M9 ACE and the D7 got stuck more than half the time while constructing ramps into the water, possibly due in part to techniques used. Further, time to prepare to swim is long: 2.5-hours at the 1984 IPT/FDTE and 1.7 hours at the 1985 FOE. These considerations, coupled with an unknown controllability in moving water, lead to the judgement that the M9 ACE should be expected to swim in tactical operations only when absolutely necessary. Since the approved operational mode summary only calls for swimming 2% of the time, this is of little import.

Radio communications. In the 1984 FDTE and the 1985 FOE radio communications were ineffective or marginal, respectively. In both tests the radio was located in the right rear corner of the vehicle. As a result, the operator had to leave his operating station to change frequencies, and the 32-foot cable connecting the radio to the operators station was frequently damaged, with engine removal required for cable replacement. In addition, the box the radio was in blocked

ready access to the batteries. For the 1988 IPT, as one of 53 engineering changes, the radio was relocated to a position at the rear of the operator's station. This allowed ready access to all radio controls at all times, eliminated the cable-failure problem, and freed the area above the batteries for a folding stowage box. This change is considered to be operationally effective and suitable.

Fuel capacity. The criterion for carrying enough fuel for 200 miles of secondary road travel has mission performance application and was addressed in the 1985 FOE. It was found that under convoy conditions on secondary roads the M9 ACE could travel between approximately 150 and 170 miles on a tank of fuel; thus fuel cans would have to be carried to meet the criterion. Since such a trip would be planned in advance, the provision of the extra fuel is not seen as a problem, and stowage space in the bowl would be available since the vehicle would be unballasted. In terms of ordinary mission accomplishment, all testing has shown that the vehicle carries enough fuel to complete the usual 10-12 hour mission. Fuel capacity is thus judged to be adequate.

Survivability. The USAOTEA independent evaluation of the 1985 FOE provides an extensive examination of comparative survivability of the M9 ACE and D7 systems. Using test data in combination with simulation and wargame results (cited under the Test Adequacy section above), the evaluation showed the M9 ACE to be much more survivable than the D7 system. A force remaining projection showed that initial sets of 25 M9 ACEs and 25 D7 systems would be reduced to 20 and 4 systems, respectively, at the end of 10 days of combat operations. These figures do not account for system restoration or rebuild. The outcome is reasonable: the M9 ACE has armor similar to the M113 Armored Personnel Carrier; the D7 system (bulldozer, truck tractor, and semitrailer) has no armor, and presents larger total and vulnerable areas. The better survivability characteristics improve M9 ACE mission performance by avoiding high system loss rates.

The M9 ACE hatch, which is there because of survivability considerations, was both a DOT&E concern following the 1985 FOE and one of the 53 engineering changes addressed prior to the 1988 IPT. The concern arose from human factors and safety attributes. In its original design, the hatch was both very difficult to open or close and had an insecure latch. It was completely redesigned prior to IPT. During IPT, hatch opening and closing force requirements were found unacceptable; this was attributed to improper adjustments. Attempts to properly adjust the hatch in accordance with the manual did not correct the problem. A revised adjustment procedure was developed following the test, and the hatch then

demonstrated acceptable force requirements. However, the revised procedures have not yet been tested for operational durability purposes. This aspect, along with several others enumerated in the conclusion section below, should be checked before fielding the system, but none presents a risk so great as to preclude full production.

Reliability, availability, and maintainability (RAM).

The comprehensive and aggressive program to improve RAM of the M9 ACE has been successful. Reliability is better than the criteria and should improve still more with additional changes yet to be applied. Maintainability as tested in the IPT does not quite meet the criteria but is expected to with the additional changes.

Following the 1984 FDTE, RAM shared the spotlight with mission performance as an area of major concern. At that time following a pattern established in earlier testing, hydraulic devices, lines, and fittings were the largest single source of system failures, and required more maintenance man-hours than any other components. Mean time between operational mission failures was 22 hours, and the maintenance ratio was 0.64 man hours per operating hour. Both figures were unilaterally determined by USAOTEA since the only approved failure definition and scoring criteria at that time addressed hardware only. The 1984 USAOTEA evaluation quantified the productivity improvement that could be realized by correcting RAM problems. The 1985 FOE did not repeat the hydraulic system failure history, apparently due to engineering changes and improved quality control. However, it did reveal a critical failure mode in transmission output shafts, with five failures. The maintenance burden associated with this was judged to be unacceptable. Despite several changes made to the M9 ACE system following the 1984 FDTE, operational reliability showed only a slight improvement in the 1985 FOE with a projected value of 26 mean hours between operational mission failures. The projection took into account the anticipated effectiveness of corrections to be applied. The maintenance ratio projected was 0.68 manhours per operating hour, a slight degradation from the 1984 FDTE. Coupled with the transmission output shaft failure mode, these figures led to 29 engineering changes to improve reliability and maintainability. The efficacy of these changes is demonstrated by results of the 1988 IPT: 31 mean hours between operational mission failures as tested, with projections of 54 (elimination of failures supported by historical information) to 80 (based on expected effectiveness of all fixes); and maintenance ratios of 0.50, 0.37, and 0.32 for the same categories (tested, historical information, and all fixes), respectively.

Logistical Support. Road wheel usage continues as the majcr logistical support problem. Usage rates for the 1985 FOE were duplicated for the 1988 IPT and are such that an M9 ACE can be expected on average to require one new road wheel for each 12 hours of operation. Work continues to improve the road wheel life, but a quick solution is not likely. The burden associated with this failure rate is not as oppressive as it had been earlier; one of the 53 engineering changes made subsequent to the 1985 FOE was the development of a dogbone jack to raise the road wheel. This jack is simple to use and effective. Intermediate road wheels now can be changed routinely in 15 to 30 minutes. Another effective engineering change was the addition of a pressure gauge that permits diagnosis of the complex hydraulic system. Spare parts types and quantities continue to be updated based on experience gained, as do the technical manuals and repair procedures.

Human Factors. Human factors considerations were the direct incentive for 6 of the 53 engineering changes made following the 1985 FOE and were a contributing factor for 11 others in conjunction with safety, maintainability, and mission performance. All but one were found to be effective and suitable in easing operator or maintainer tasks. The exception was in ease of battery access, which is improved but still cumbersome. All changes based on human factors were undertaken with the expectation of improved performance in operations or maintenance, not simply comfort. The 1988 IPT showed no discernible degradation in the system's ability to dig, despite mechanical changes that were biased towards decreased effectiveness, accompanied by a major improvement in maintenance times.

Safety. Seven of the 53 engineering changes implemented following the 1985 FOE were based primarily on safety considerations, and 3 other changes were partially due to safety. No significant injuries occurred in the 1985 FOE; therefore it is only observation and judgement that leads to the conclusion that these were effective changes, and that the potential for injury has been reduced as a result of the changes. On the other hand, it seems inconceivable that any of the changes such as ejector lock, seat belt attachment, or nonskid surfaces would be eliminated because no quantifiable data shows their contribution. Operator and maintainer safety is better now than it was before, and the consequences of a lack of vigilance are less serious now because of the changes.

DOT&E Concerns. Following the 1985 FOE, DOT&E expressed five remaining concerns. They were the hatch, RAM, productivity, transition from the Technical Data Package to production, and the effectiveness of the implemented engineering changes. All have been discussed under the issues addressed above. In summary, DOT&E concerns have been satisfactorily addressed.

CONCLUSION

As tested the M9 ACE has been found to be operationally effective and suitable. However, additional engineering changes are planned, and the M9 ACE should not be fielded until a suitable test is performed to prove that these changes are adequate, and are applied to all produced vehicles.

The planned corrections address: drain valve durability; steer unit torque link durability; steer unit bolt durability; parking brake cable durability; brake chamber bracket durability; and hatch durability. All can be addressed adequately in the already planned and contractually required comparison test of M9 ACE vehicle performance versus contractual requirements. The test will accumulate 300 hours of operation on each of two vehicles; it is to be conducted from February to April 1989.

The comparison test is to be monitored by USAOTEA under their continuous and comprehensive evaluation (C2E) methodology, with results reported to DOT&E by means of a C2E Update Report. Produced M9 ACE vehicles may be allocated to and used by the Engineer Center and School for training purposes. All fixes must be certified effective by USAOTEA and be applied to all produced vehicles prior to fielding to line units, which is expected to begin in July 1989.

DEPARTMENT OF DEFENSE

OPERATIONAL TEST AND EVALUATION

REPORT ON THE

LOW ALTITUDE NAVIGATION AND TARGETING

INFRARED SYSTEM FOR NIGHT

(LANTIRN)

TARGETING POD

DECEMBER 19, 1988

OFFICE OF THE SECRETARY OF DEFENSE

WASHINGTON, D.C. 20301-1700

OPERATIONAL TEST
AND EVALUATION

19 December 1988

OPERATIONAL TEST AND EVALUATION

The Office of the Director, Operational Test and Evaluation, has completed its assessment of the testing of the Air Force Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) Targeting Pod. This testing included the Initial Operational Test and Evaluation (IOT&E), Follow-on Operational Test and Evaluation, Phase One (FOT&E(1)), and extensive flight testing since July 1987. This report is being submitted in fulfillment of the provisions of Title 10, U.S.C. 138.

Due to recent availability and testing of aircraft equipped with production avionics, the production LANTIRN targeting (TGT) pod has demonstrated effective interface and performance with both the F-16 Block 40 and the F-15E. Consequently, I now consider that LANTIRN TGT pod testing has been adequate to assess its operational effectiveness and suitability as satisfactory.

IOT&E, Phase 2, of the LANTIRN system was conducted from January to April 1986 with major deficiencies noted on the TGT pod. Based on test results of IOT&E, the navigation (NAV) pod component of the LANTIRN system was recommended for full-rate production. A DOT&E Beyond Low-rate Initial Production (B-LRIP) Report on the NAV pod was submitted to the Congress in November 1986. FOT&E(1) of the LANTIRN system was conducted from December 1986 to July 1987 for the purposes of: (1) evaluating corrections to deficiencies identified during the previous IOT&E, and (2) further evaluating and assessing operational effectiveness and suitability objectives that were not completed during IOT&E. FOT&E(1) test results did not support a full-rate production decision for the targeting pod. Subsequent to FOT&E(1), the Air Force conducted extensive developmental flight tests on LANTIRN and test/training flights for F-16C/D and F-15E pilots preparing to conduct IOT&E on those aircraft using LANTIRN.

The two formal phases of operational testing of the LANTIRN TGT pod, combined with extensive flight testing in the

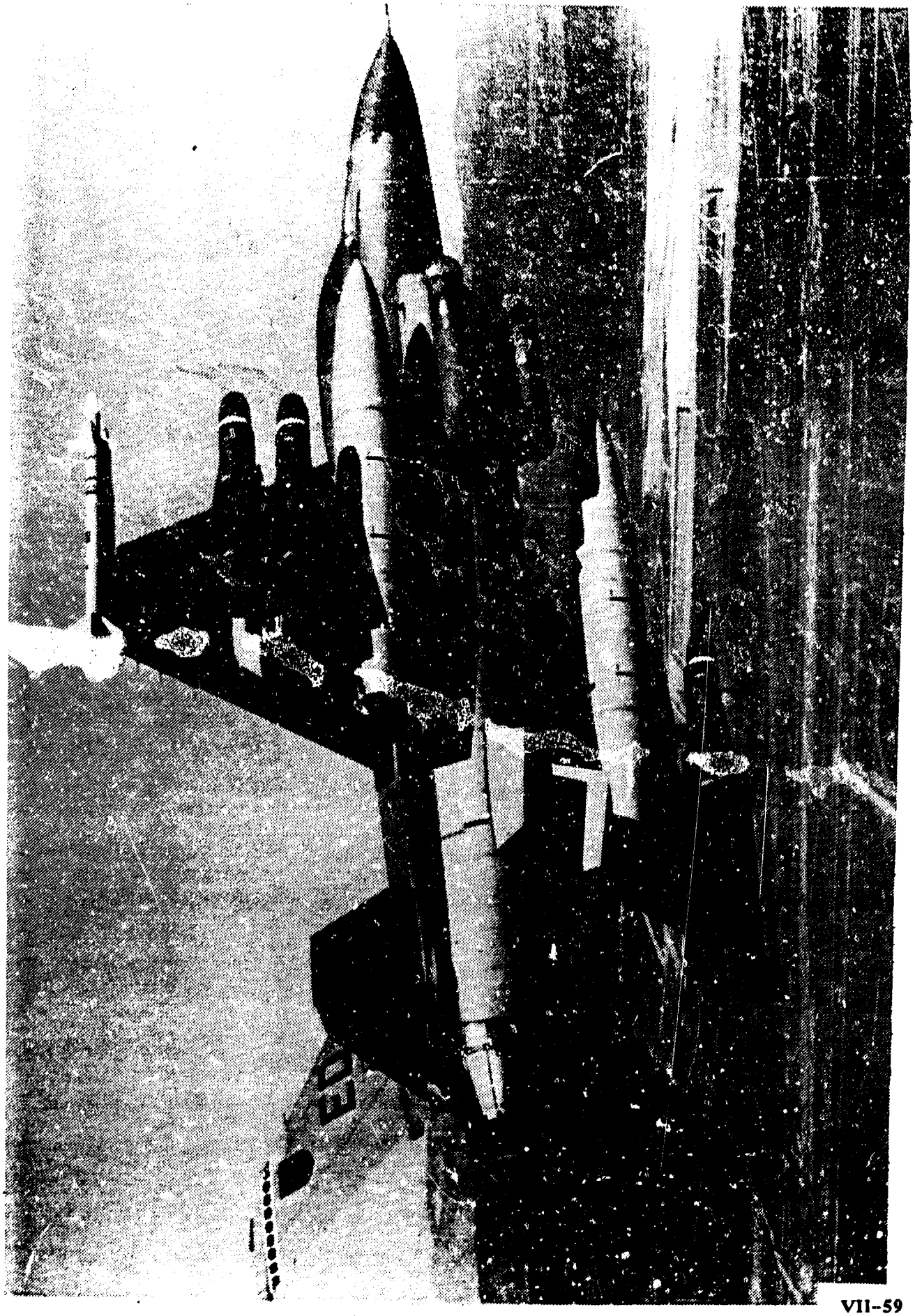
past 18 months, have resulted in adequate testing being done to determine the functional performance and operational effectiveness of the LANTIRN targeting pod. There was, however, a major test limitation. End-to-end operational testing of the production targeting pod as a component of the production F-16C/D Block 40/LANTIRN weapon system or the production F-15E/LANTIRN weapon system is incomplete because of late delivery of the production aircraft. This test limitation will be overcome in the near future as production models of both aircraft become available for operational tests. Formal, DOT&E-approved IOT&E of the F-15E has already begun, and F-16 Block 40 IOT&E will begin during the summer of 1989. Results of LANTIRN operational effectiveness with these production aircraft will be assessed and reported to the Congress by DOT&E. The first production LANTIRN TGT pod was delivered in August 1988 and, in developmental tests, has demonstrated that it can perform its primary functions of target acquisition and aiding in weapon delivery. Consequently, the results of previous operational effectiveness testing in FOT&E(1) of the FSD TGT pod on testbed aircraft with early versions of production aircraft software remain valid and can be considered a minimum baseline for production TGT pod performance. At the end of FOT&E(1), Maverick missile weapon delivery capability was considered satisfactory. Laser guided bomb (LGB) delivery was considered marginal on the F-16, but with demonstrated improvements in the TGT pod, it is now considered by DOT&E to be at least satisfactory against a limited target set. Conventional weapon delivery with LANTIRN, which was previously largely untested in operational scenarios, has demonstrated functional integration in recent testing and will be extensively demonstrated in the upcoming F-15E and F-16 Block 40 IOT&Es.

IOT&E, FOT&E(1) and additional flight test data during the past 18 months were adequate to make an evaluation of the LANTIRN system's operational suitability. It is important to know that this statement is made with the understanding that the Air Force intends to support LANTIRN using contractor support at Luke AFB until 1990. The first operational unit at Seymour-Johnson AFB will have a full Air Force organic maintenance capability for the NAV pod starting in May 1989. Contractor support and lack of integrated logistics support (ILS) equipment are major limitations to LANTIRN testing which affect suitability assessments. For example, the Air Force's capability to maintain the targeting pod (and entire LANTIRN system) has been estimated from observations of the contractor-performed maintenance and limited "blue suit" hands-on experience. After FOT&E(1), TGT pod operational

suitability was evaluated to be marginal using contractor maintenance and support. Design improvements to the TGT pod, flight tested over the past year, and recent support equipment evaluations demonstrated that the TGT pod's operational suitability clearly has the potential to be satisfactory using organic (Air Force) maintenance. The Air Force intends for the contractor to support LANTIRN until ILS elements and fully trained Air Force maintenance personnel are available. The Air Force's capability to maintain LANTIRN will be assessed in a 1989 supportability evaluation and a 1990 maintainability demonstration. The results of both will be evaluated and reported to the Congress by DOT&E.

A description and assessment of the LANTIRN TGT pod and the operational tests conducted, together with amplifying information on operational effectiveness and operational suitability follows.

John E. Krings
Director



F-16 with LANTIRN Navigation and Targeting Pods

SYSTEM DESCRIPTION AND BACKGROUND

The Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) is designed to provide a night attack capability for use on the F-16C/D Block 40 and F-15E aircraft. The LANTIRN system consists of a wide field of view (WFOV) head-up display (HUD), a navigation (NAV) pod and a targeting (TGT) pod. The head-up display is an electro-optical device which displays flight, navigation and weapon delivery information in the pilot's line-of-sight. The NAV pod contains a forward-looking infrared receiver (FLIR), a terrain-avoidance radar and subsystems for servo-control. The TGT pod functions include FLIR imaging, laser designation, precision pointing and tracking, and missile boresight correlation for AGM-65D Maverick missile handoff and lock-on.

The F-16 WFOV HUD received production approval in October 1984. The LANTIRN development program was restructured in 1984 because development of the TGT pod was lagging the NAV Pod and the WFOV HUD. Program restructuring resulted in the NAV pod reaching a full production decision point in October 1986, more than a year before the same planned decision point for the TGT pod. The LANTIRN NAV pod was approved for full production by the Air Force and was the subject of a Director, Operational Test and Evaluation (DOT&E) Beyond Low-rate Initial Production (B-LRIP) Report dated 14 November 1986. The Air Force also decided in October 1986, and again in October 1987, to continue the TGT pod in low-rate production pending correction of deficiencies observed in operational testing. In January 1988, the Director, Operational Test and Evaluation, and the Air Force agreed to eighteen criteria which could be used to measure LANTIRN test progress and TGT pod deficiency corrections in the absence of a formal operational test program before the next planned decision milestone in October 1988. In November 1988, the Air Force assessed the test results and decided to continue with low-rate production for the LANTIRN TGT pod pending full resolution of a laser designator problem.. After a correction to the production pod laser problem was demonstrated, the Air Force made a full-rate production decision in December 1988 causing the Director to submit this report in fulfillment of Title 10 U.S.C. 139.

Operational testing of the TGT pod component of the LANTIRN system was begun in the second phase of LANTIRN Initial Operational Test and Evaluation (IOT&E) from January to April 1986 and continued in Follow-on Test and Evaluation, Phase 1 (FOT&E(1)) which was completed in July 1987. Testing since

July 1987 of LANTIRN TGT pod improvements, as well as improved aircraft integration and weapon delivery using LANTIRN production pods, has occurred in development testing and in LANTIRN test/training flights. These latter flights are designed to prepare pilots for IOT&E missions on the F-16C/D and F-15E aircraft which will utilize the LANTIRN system and included missions specifically designed to assess overall production LANTIRN system integration. This B-LRIP report uses data derived from all these phases of LANTIRN testing, as well as the personal observations of the Director and a member of his staff who have both flown LANTIRN missions in the F-16D and F-15E aircraft.

Throughout this report, it is very important to understand the differences between the components of the complete LANTIRN system. The NAV pod component is primarily used for low altitude navigation. As previously stated, the NAV pod's effectiveness, suitability, and test adequacy were the subject of an earlier DOT&E B-LRIP report. The TGT pod, which is the subject of this report, is used primarily in the attack segment of a typical mission profile.

TESTING ADEQUACY

The Air Force Operational Test and Evaluation Center (AFOTEC) conducted the first phase of LANTIRN IOT&E on F-16 aircraft from October 1984 to January 1985, using only the WFOV HUD and NAV pod to evaluate the operational effectiveness and suitability of the LANTIRN system in support of a low-rate initial production decision scheduled in February 1985. The test team participated in 319 test sorties during combined development test and evaluation (DT&E)/IOT&E at Edwards AFB. Thirteen dedicated IOT&E missions were flown at Edwards AFB and an additional 52 were flown during a 3-month deployment to Loring AFB, Maine. The latter missions were flown over New Brunswick, Canada, in weather conditions representative of the European environment. An IOT&E of the complete LANTIRN system could not be done at that time because the TGT pod was not available.

The second phase of LANTIRN IOT&E (with a complete LANTIRN system) was conducted from January to April 1986. The WFOV HUD and NAV Pod equipment demonstrated improved performance over that observed in prior testing. During this phase, testing was conducted at five locations (McChord AFB, Washington; Ft Hunter-Liggett, California; Eglin AFB, Florida; Nellis AFB, Nevada; NWC China Lake, California). Operations from deployed locations allowed pilots to fly test profiles developed for various types of missions in representative flight conditions over unfamiliar (first look) routes and terrain. Sixty-three effective test sorties were flown.

The critical operational issues which were examined for both phases of the LANTIRN system IOT&E on the F-16 were:

a. Single-seat effectiveness. The pilot of single-seat LANTIRN-equipped aircraft should be able to operate safely and effectively at low altitude during day/night under-the-weather conditions.

b. Effective aid to navigation. The LANTIRN system should provide an effective aid to navigation at low altitude during day/night under-the-weather conditions.

c. Transition to attack. The LANTIRN system should provide an effective aid in the transition from navigation to attack during day/night under-the-weather conditions.

d. Attack capability. The LANTIRN-equipped F-16 should have the capability to acquire and attack targets using current ordnance and delivery tactics compatible with the night, under-the-weather environment.

e. Survivability. The LANTIRN system should improve survivability during ingress, attack, and egress.

f. LANTIRN reliability and maintainability. LANTIRN reliability and maintainability characteristics should assure adequate availability and sortie generation capability.

g. Supportability. Air Force personnel must be able to support the LANTIRN system within the framework of the Air Force support system.

The major test limitations in the first phase of IOT&E (Oct 84-Jan 85) were:

a. The TGT pod was not available. (TGT pod was available in later phases of testing.)

b. The employment of the NAV Pod in an attack role was not evaluated because the LANTIRN system was designed to accomplish target attack using the TGT pod in conjunction with the NAV Pod. (NAV pod attack capability was evaluated in later FOT&E(1) when the TGT pod was available.)

c. Active threat simulators were not available on Canadian ranges. (Active simulators were used on U.S. ranges in the second phase of IOT&E and FOT&E(1).)

d. NAV pod maintenance was done solely by contractors.

e. Evaluations of logistics and software supportability were incomplete because development of most integrated logistics support (ILS) elements was deferred until the production phase, and software support resources plans were not available for evaluation.

The major test limitations in the second phase of LANTIRN IOT&E (Jan-Apr 86) were:

a. The tested NAV and TGT pods were not production equipment. Production nose section heater and slip ring assemblies for the TGT pod were not available. (Production TGT pod with heater and slip ring assemblies was flown in 1988.)

b. Laser designation during LGB deliveries and laser ranging was used infrequently because of environmental and safety constraints. (A dual-frequency, "eye-safe" laser entered developmental test in 1988.)

c. The pilots' choices of turn-points for low-level routes were limited to existing instrument/visual (IR/VR) route structure and by range constraints. Because turn-points could not be chosen for optimum thermal signature, the navigation task was more demanding than necessary in some cases.

d. The choice of initial points (IP) and target run-in headings was also limited by range constraints. Therefore, some attacks were executed under higher than necessary workloads.

e. The TGT pod WFOV was out of focus on most test sorties because of a pod temperature compensation algorithm error. Transition to attack was difficult or unsuccessful because WFOV acquisition of targets or target areas was not possible. (The problem was corrected for FOT&E(1).)

f. The TGT pod laser offset track was available but not mechanized properly, so precise positioning of the laser spot utilizing this mode was not evaluated. (Improved area tracking capability corrected this problem for FOT&E(1).)

g. The offset aim point in the aircraft air-to-ground mode was not mechanized properly, which hampered transition to attack and target acquisition. (The problem was considered minor and worked around in FOT&E(1).)

h. The LANTIRN system was integrated with the most advanced F-16 software (Block 25B++) available at the time. The F-16 Block 40 software and hardware planned for production use with LANTIRN and other systems, such as Global Positioning System (GPS) and Automatic Terrain Avoidance, were not available. Pilot workload increased because of not having the increased navigational accuracy which will be available with GPS. (F-16s with Block 40 avionics were flown with LANTIRN in 1988.)

i. No F-16 onboard electronic countermeasures (ECM) capability or EF-111 jamming support was available for survivability testing. (Onboard ECM was used in FOT&E(1))

j. The threat arrays were the most realistic available, but were limited in both types and numbers of threats.

k. Evaluation of logistics supportability was incomplete because development of most ILS elements was

deferred until production. Contractors provided maintenance for both pods and technical orders were not available. Consequently, Air Force hands-on maintenance was limited, and training requirements could not be identified.

FOT&E(1) of the LANTIRN system was conducted by AFOTEC from December 1986 through July 1987. The purpose of the test was threefold: first, to evaluate corrections to deficiencies identified during the initial operational test and evaluation (IOT&E) of the LANTIRN system; second, to further evaluate and assess operational effectiveness and suitability objectives that were incomplete from previous testing; and third, at the request of Tactical Air Command (TAC), to provide an assessment of pilot experience and training levels required for a LANTIRN NAV pod-equipped F-16.

AFOTEC flew 63 effective test sorties during FOT&E(1) as shown below:

Location	# of Sorties	Purpose of Test
Eglin AFB, FL	29	LANTIRN Assessment
	9	EOCM (Note 2)
	8	Maverick (Note 3)
	12	LGB (Note 4, 5)
Nellis AFB, NV (Note 1)	6	LGB (Note 5)
Edwards AFB, CA	12	
	6	LGB (Note 5)
	6	Conventional Toss
Edwards AFB, CA	16	TAC Syllabus Assessment
Total	63	

NOTES:
1. Missions launched and recovered at Edwards AFB.
2. Electro-optical countermeasures.
3. Imaging Infrared Maverick missile (AGM-65D).
4. Laser guided bomb.
5. 38% of total LGB missions flown with safety pilot (75% of live LGB missions had a safety pilot)

The critical operational issues examined in FOT&E(1) were the same as those tested earlier for IOT&E with the exception of LANTIRN as an aid to navigation and its impact on survivability. Previous IOT&E adequately addressed these two

issues by determining the LANTIRN NAV pod's capability to aid navigation and increase survivability. FOT&E(1) testing emphasized evaluation of the attack capability provided by the LANTIRN TGT pod.

LANTIRN FOT&E(1) test missions were flown using the planned operational mission profiles and configurations using both single and two-seat F-16 aircraft. Weapon delivery test objectives were designed to evaluate the LGB, Maverick, and conventional toss capability provided by LANTIRN-equipped F-16s. The test missions were flown in the desert environment at or near Edwards AFB, CA, and in significantly higher absolute humidity conditions during a deployment to Eglin AFB, FL. Some missions flown during the Eglin deployment were flown in the presence of target area defense simulators while using active onboard ECM to maximize test realism. Weapon delivery test missions were flown against target arrays representative of the types of targets LANTIRN-equipped aircraft will be tasked to attack in wartime. All effectiveness objectives were designed to assess, insofar as the limitation of the FSD equipment allowed, the issue of single-seat effectiveness, with primary emphasis on TGT pod improvements since IOT&E and the impact of those improvements on LANTIRN-equipped F-16 attack capability.

Effects of integration into the Tactical Air Force (TAF) mission and pilot training requirements were addressed through an assessment of a NAV pod training syllabus provided by TAC. Two relatively inexperienced pilots from operational squadrons flew the syllabus, with instruction provided by experienced members of the LANTIRN test team.

FOT&E(1) included completion of an EOCM susceptibility analysis conducted by the Office of the Test Director (OTD), Electro-Optical Guided Weapons Countermeasure/Counter-Countermeasures Joint Test and Evaluation Directorate. This analysis was planned and scheduled for completion as part of the overall EOCM investigation during LANTIRN IOT&E, but was not performed in its entirety due to scheduling conflicts during IOT&E.

System reliability and maintainability were evaluated against TAC requirements using the same objectives developed for IOT&E. As in IOT&E, LANTIRN supportability was not fully evaluated due to the lack of major ILS elements. However, AFOTEC did assess LANTIRN support planning and identify potential supportability problems.

The major test limitations to FOT&E(1) included:

a. Differences between the FSD targeting pods and production equipment. The tested FSD pods, however, were considered reasonably representative of the production pod and allowed evaluation of key pod capabilities. (Production TGT pod was delivered to flight test in August 1988.)

b. The tested FSD TGT pods did not incorporate many reliability and maintainability improvements planned for production as a result of previous testing. (Production TGT pod incorporating improvements was flown in August 1988.)

c. The FSD TGT pods were contractor maintained during the test and AFOTEC was limited in its ability to fully assess the maintainability of the LANTIRN system. Limited hands-on work by test team maintenance evaluators was assessed, and all contractor actions were evaluated over-the-shoulder.

d. The production Built-in-test (BIT) capability was not available; therefore, preventive maintenance was performed using data from unique flight-test instrumentation. (BIT capability has shown steady improvement through successive software updates since FOT&E(1).)

e. Major ILS elements (support equipment, technical documentation, and maintenance training) were not available for assessment. Plans for supporting LANTIRN equipment in the field were reviewed.

f. Differences between the testbed F-16 aircraft compared to production aircraft. Lack of a full-up F-16 C/D Block 40 aircraft meant the tested F-16/LANTIRN combination did not have several items essential to a complete end-to-end evaluation of the entire pilot/aircraft/LANTIRN system. (F-16s with Block 40 avonics were flown with a production LANTIRN TGT pod in late 1988.)

g. Full implementation of the planned production F-16C/D Block 40 hardware and software was not possible because it was still under development at the time of testing. Partial Block 40 software and avionics were used for test and did not include software enhancements for unguided weapon dive delivery modes. (Full Block 40 software and avionics were flown with LANTIRN in late 1988.)

h. Planned improvements to eliminate deficiencies in conventional (unguided) bombing accuracy using the TGT pod

laser ranging were only partially developed. (Improvements were demonstrated on Block 40 F-16 in late 1988.)

i. Global Positioning System (GPS) equipment was not available.

j. The planned F-16 Automatic Terrain Following (ATF) system was not available.

k. The APG-66 radar used on the testbed aircraft lacked the F-16C/D APG-68 radar's moving target and improved resolution ground map capabilities.

l. Range restrictions, the inability to fire the laser off-range, and other peacetime safety constraints affected the operational realism of the testing. For example, range and safety restrictions required Maverick missile firing to be displaced to a less than operationally desired distance from the target because of the missile's safety footprint and the physical boundaries of the range.

m. Range safety considerations did not permit manned threat simulators/emitters to be used on a range where live/inert ordnance delivery was planned.

The specific test limitations in IOT&E and FOT&E(1) which critically affected determination of the TGT pod's operational effectiveness and suitability are discussed later in this report.

After consideration of the results of FOT&E(1) in October 1987, the Air Force decided to continue low-rate production of the TGT pod and agreed with the Director, Operational Test and Evaluation, upon eighteen criteria which had to be addressed prior to making a full-rate production decision on the TGT pod. The criteria included considerations for pod reliability and maintainability, aircraft integration, and weapon delivery capability using LANTIRN. The 1988 availability and flight test of production navigation and targeting pods and F-16 test aircraft with production Block 40 software, as well as production F-15E aircraft, have overcome most of the critical operational effectiveness test limitations listed above. An extensive LANTIRN flight test program involving both developmental test flights and test/training missions for F-16 and F-15E pilots preparing for operational testing of those aircraft has provided additional test data since formal

FOT&E(1) ended in July 1987. Specifically, this flight test program has included 943 sorties and 1544 hours on LANTIRN equipment, including 610 hours on the TGT pod, since July 1987.

Limitations to test which affect determination of suitability (contractor maintenance, lack of ILS equipment, etc.) have not been overcome. It is important to note, however, that the Air Force intends to utilize interim contractor support (ICS) as part of its LANTIRN support concept in the field until it completes an AFOTEC-directed maintenance evaluation (i.e., blue suit maintenance capability) in 1990. The results of this evaluation will be reported to the Congress when it is completed.

The results of IOT&E, FOT&E(1), and additional flight test data obtained since July 1987 provide a great deal of information on which to base an effectiveness and suitability assessment of the LANTIRN system and, specifically, the targeting pod. The limitations to test regarding the absence of production pods and aircraft noted above in IOT&E and FOT&E(1) were of concern to DOT&E in 1987--so much so that the Director stated to the Air Force that the results of testing at that time warranted increased production but not full-rate production of the TGT pod. The fact that most of the critical test limitations have been overcome in the past year of testing, combined with previous and recent successful test results, lead to the conclusion that LANTIRN testing has been adequate to support a full-rate production decision for the TGT pod. Ongoing F-15E operational tests and the beginning of F-16 C/D Block 40 operational testing in the near future with LANTIRN will further add to the LANTIRN test data base. The results of this future testing of the production aircraft with LANTIRN and the Air Force LANTIRN maintenance evaluation will be reported to the Congress in the DOT&E Annual Report.

OPERATIONAL EFFECTIVENESS

Operational effectiveness of the LANTIRN system was determined through evaluation of test objectives derived from and associated with the critical operational issues listed in the Test Adequacy section of this report. Where applicable, objective criteria were provided by the user throughout all phases of test. Criteria were added or changed as LANTIRN capabilities became apparent and matured during five years of testing. The original requirement for LANTIRN was not specific, since the Air Force's goal at the beginning of its development was to provide increased night attack capabilities using emerging and improved infrared technology. Operational effectiveness of the LANTIRN targeting pod, which is used primarily for transition to attack and attack, was evaluated as the capability of a LANTIRN-equipped F-16 to deliver laser-guided bombs (LGBs), Imaging Infrared (IIR) Maverick missiles, and conventional weapons in a toss delivery mode. Additionally, the adequacy of LANTIRN controls and displays, navigation capability, survivability, LANTIRN integration into the Tactical Air Forces (TAF), and the susceptibility of LANTIRN to EOCM were assessed during testing.

IOT&E was accomplished in two separate phases. The TGT pod was not available for test in October 1984 when the Air Force conducted a limited evaluation of the WFOV HUD and the NAV pod. A full system (with TGT pod) IOT&E was conducted from January 1986 to April 1986 using the most current software available on F-16s at that time. NAV pod operational performance was satisfactory, while the TGT pod exhibited deficiencies which needed improvement and further testing.

FOT&E(1) was accomplished using improved FSD TGT pods and upgraded F-16 aircraft with avionics and software more closely representative of the F-16 Block 40 aircraft planned for deployment with LANTIRN. Primary emphasis during FOT&E(1) was on TGT pod technical improvements since IOT&E, and the impact of those improvements on LANTIRN-equipped F-16 attack capability. TGT pod deficiencies identified in previous IOT&E testing were FOV size and performance, inadequate tracking system tenacity, inadequate FLIR recognition range, and Maverick handoff problems. FOT&E(1) evaluated corrections to all these deficiencies as well as improvements to LANTIRN software and hands-on sensor controls. Subsequent to FOT&E(1), LANTIRN testing has been conducted with F-16 aircraft using production Block 40 avionics and software with a production TGT pod and FSD TGT pods with greater numbers of production components.

All LANTIRN weapon delivery missions with the FSD targeting pod in FOT&E(1) were flown using TAC's planned operational mission profiles and configurations. The test sorties were flown in the desert environment at or near Edwards AFB, and in high absolute humidity conditions during a two-month deployment to Eglin AFB. During the Eglin deployment, seven sorties were flown in the presence of target area defense simulators to enhance test realism. ALQ-131 electronic countermeasures (ECM) pods were carried on 17 sorties. Simulated LGB attack missions against real-world targets and live LGB delivery missions against an array of buildings representative of targets LANTIRN-equipped aircraft will be tasked to attack in wartime were flown. Similar live and simulated missions were flown using Maverick and conventional weapons.

The F-16/LANTIRN LGB capability in FOT&E(1) was evaluated by flying mission profiles which consisted of a low-level route to an initial point (IP), followed by a first-look, simulated or actual toss/loft attack against a realistic target. TAC mission planning personnel supported all LGB missions and assisted in route planning and target selection. Due to the lack of an Automatic Terrain Following flight control system on the testbed F-16 aircraft and other safety considerations, some (38%) of the total LGB missions were flown in a two-seat aircraft with a pilot safety observer in the rear cockpit. The safety observer did not participate in the navigation or attack segments of the test missions. To increase test realism, F-16 aircraft carried operable ECM pods and surface-to-air threat simulators were used during actual LGB delivery missions on the Eglin AFB ranges. The use of chaff/flares in the target area was simulated because the aircraft did not have a functional ALE-40 system. Pilots did note simulated use of chaff/flares on voice tapes of the missions.

The test team based their evaluation of LGB attack capability solely upon first-pass attacks during those missions where (1) navigation to the IP was successful, and (2) weather, target/background heat contrast, and IR visibility conditions were within the demonstrated operating envelope of the LANTIRN system. The operational test pilots judged the usability of LANTIRN for F-16 LGB delivery capability and measured the percentage of correctly identified targets, successful lock-on attempts, successful target tracks, successful laser designations, and successful attacks.

The operational test team pilots qualitatively evaluated LANTIRN's usability for single-seat LGB delivery as

marginally acceptable. Pilot workload was normally very high during the LGB delivery phase, and was unacceptably high on those missions where unfavorable target characteristics were combined with low IR visibility and/or post-release tracker slewing problems. The pilots considered that a correction to the tracker slewing problem was mandatory, and, even with this correction, safe, reliable, effective F-16 LGB employment will require highly qualified pilots and careful target selection. A fix to the tracker slewing problem was evaluated by AFOTEC pilots in October 1988 and considered satisfactory.

Improvements to the identified deficiency in FLIR target recognition range were demonstrated with a 44% better recognition range in narrow FOV than that previously achieved in IOT&E. The FOT&E(1) observed TGT pod range performance was much better than required for the planned wartime weapon delivery profiles used during test.

The thrust available from the F-16A/B test aircraft used in FOT&E(1) for some LGB toss/loft deliveries raised operational problems. Production F-16 C/D Block 40 aircraft will be powered by either the F-110-GE-100 engine or the F-100-PW-220 engine, which are expected to provide an increase in thrust.

LGB conclusions from FOT&E(1) were that the testbed LANTIRN-equipped F-16s demonstrated a limited LGB attack capability. High pilot workload during critical phases of the attack, unpredictable TGT pod tracker performance, and post-release tracker slewing problems made LGB attacks difficult. However, system performance was significantly improved under favorable IR visibility conditions against thermally significant targets with low background clutter. The slew problem has been solved and the tracker has shown improved performance in 1988.

Maverick missile/LANTIRN capability was primarily evaluated by flying mission profiles which consisted of a low-level route to an IP and a single-pass, live or simulated attack against a stationary array of M-47 tanks on the Eglin AFB range complex. Both single and dual Maverick launches were evaluated. The test team evaluated only first-look attacks where navigation to the target area was successful and where IR visibility and target temperature differences were within the LANTIRN system operating envelope.

The LANTIRN system was well integrated with the testbed F-16C/D avionics and with the IIR Maverick. Improvements in

the missile boresight correlation process increased the pilots' ability to monitor the Maverick video and assisted his situation awareness. Hands-on control mechanization made it possible for the pilot to take control of the missile and lock on manually if necessary. Handoffs from the TGT pod to live AGM-65D Mavericks were very rapid. F-16 test team pilots qualitatively evaluated LANTIRN/Maverick usability by measuring the percentage of successful simulated or actual Maverick single and two-shot attacks using the TGT pod.

Despite the high absolute humidity conditions which caused very poor IR visibility conditions in the Eglin AFB environment, target recognition ranges and Maverick handoff and lock-on performance were satisfactory. In these conditions, the TGT pod improved target detection ranges over those which would have been possible with the unassisted IIR Maverick. In addition, the F-16/TGT pod lock-on and missile handoff mechanization allowed two-shot deliveries with minimum tracking time. The system provided an effective single and dual launch capability against armored vehicles.

Maverick conclusions were that the testbed LANTIRN-equipped F-16s demonstrated a much-improved IIR Maverick delivery capability over that of aircraft without the TGT pod.

Conventional unguided toss capability using LANTIRN on the F-16 was evaluated using the same sorties as for the LGB evaluation. The criteria were less stringent, because LANTIRN TGT pod tracking and laser designation were not required after weapon release for this evaluation. In addition, the test team flew controlled sorties over Edwards AFB ranges to determine the impact the TGT pod had on tossed-weapon delivery accuracy.

Team pilots made qualitative evaluations of LANTIRN's usability for F-16 unguided toss weapons delivery while the percentage of targets correctly identified, successful lock-on attempts, successful target tracks, miss distances, and target recognition ranges were measured.

Conventional weapon unguided toss capability conclusions were that the TGT pod provided an additional sensor which increased the F-16 toss attack capability against IR-significant targets. However, the TGT pod did not provide an increase in toss-bombing accuracy over radar direct-aim bombing because of an unresolved toss-bombing algorithm problem. (This aircraft-related problem was resolved in 1988.)

LANTIRN controls and displays were qualitatively evaluated by mission pilots as to adequacy and effectiveness and ease of use and effectiveness of LANTIRN operator-machine interface software.

Control and display conclusions were that the tested aircraft hardware and software incorporated a large number of features planned for the production Block 40 F-16, and were significantly improved over previously evaluated versions that had been unsatisfactory in IOT&E. Control and display problems were found in the TGT pod WFOV and tracker slew control mechanization. (These problems were resolved in 1988.) The pilots judged the adequacy and effectiveness of the controls/displays and the operator-machine interface software to be acceptable and no absent or improperly displayed symbols were found.

Navigation capability of a LANTIRN-equipped F-16 was assessed by determining pilot ability to navigate successfully to an IP on course, with accurate steering into a target area, using only the testbed F-16/LANTIRN system. This objective was primarily concerned with navigation accuracy at the IP, which directly affected the pilot's ability to successfully transition to an attack. The percentage of missions in which the IP appeared in the HUD or TGT pod FOV, successful identification of the IP was made, and successful inertial navigation system updates were accomplished were measured.

Navigation conclusions were that pilots were able to successfully transition to attack 95 percent of the time. With the testbed F-16/LANTIRN system, successful navigation and transition to attack required a high level of pilot training/proficiency and mission planning support. As seen in previous testing, turn-point selection, extremely accurate turn-point and target coordinates, and the rate of INS drift continued to be important factors bearing on navigation success.

The integration of LANTIRN into the TAF was assessed using TAC's proposed F-16 NAV pod pilot-training syllabus and by determining additional impacts that LANTIRN will have on individual pilots and LANTIRN units. The TGT pod syllabus had not been developed in time for assessment in FOT&E(1).

Two young, qualified and current F-16C pilots from operational units completed the NAV pod syllabus as students. The proposed Tactical Air Command syllabus for the NAV pod pilot training on the F-16 was found to be adequate. The test

team recommended that greater emphasis be placed on single-ship/flight-lead skills during F-16C training prior to LANTIRN upgrade. Increased mission planning, intelligence, and weather forecasting support will be required for LANTIRN mission employment.

EOCM susceptibility of the LANTIRN system was determined in flight testing which completed EOCM and susceptibility testing begun in previous DT&E/IOT&E.

The Office of the Test Director, Electro-Optical Guided Weapons, Countermeasure/Counter-Countermeasures Joint Test and Evaluation Directorate designed and executed an EOCM susceptibility test of the LANTIRN system with AFOTEC support. Night and day sorties employing operationally representative, simulated LGB and Maverick delivery profiles were flown to determine LANTIRN's susceptibility to various EOCM devices. The test was conducted under controlled conditions in a DT&E-like environment. The purpose of the EOCM testing was:

(1) to determine the capabilities and limitations of the LANTIRN system in an EOCM environment,

(2) assess the effect of EOCM on operational performance of the LANTIRN system, and

(3) provide information to the developer and the TAF concerning possible counter-countermeasures improvements and tactics.

The effects of fog oil smoke, IR absorbing aerosols, white phosphorous flares, high-intensity thermal source (HITS) pyrotechnics, pulsed and continuous-wave lasers, 105 mm tank rounds, and flamethrowers on the LANTIRN NAV and TGT pods were investigated for each countermeasure effect on target acquisition and tracker performance.

During acquisition denial testing, the LANTIRN system was flown into a target area in which an EOCM was already initiated, or initiated during the target acquisition (target identification and lock-on) phase of the attack. During tracker interference testing, the pilot was allowed to acquire and establish track of the target before the EOCM was initiated.

EOCM susceptibility conclusions were that the LANTIRN system was susceptible to the EOCM used in this test to varying degrees according to the countermeasure (CM) used. The NAV pod

and TGT pod FLIRs were affected in the same manner, however, the CM effects on the NAV pod FLIR were minimal, did not deny target area acquisition, and were insufficient to preclude using the NAV pod. The TGT pod was more vulnerable to EOCM, but usually only if the CMs were within or slightly outside its FOV. The LANTIRN system demonstrated significant resistance to the EOCM tested. Although system performance was degraded and pilot workload was increased because of the CMs, the LANTIRN system attack capability was not totally denied.

Test limitations in the testbed aircraft during FOT&E(1) which critically effected evaluation of the LANTIRN targeting pod's operational effectiveness included:

a. A full implementation of the planned production F-16C/D block 40 hardware and software with LANTIRN was not possible because a full-up Block 40 F-16 was not available. Lack of new F-16 software enhancements to unguided weapon dive delivery modes did not allow new data on those delivery methods to be gathered during FOT&E(1). This limitation precluded evaluation of the primary F-16 conventional weapon delivery modes using LANTIRN with a variety of common munitions. Most important, it precluded demonstration of the functionality of the TGT pod with the production aircraft avionics. (This major limitation was overcome when an F-16 aircraft with production Block 40 avionics became available and was tested with a production LANTIRN TGT pod in late 1988.)

b. Planned improvements to eliminate deficiencies in conventional (unguided) bombing accuracy using TGT pod laser ranging were only partially developed. This limitation precluded determination of the weapon accuracies available with an integrated F-16/LANTIRN system. (Recent tests have demonstrated a satisfactory solution to this problem.)

c. The planned Global Positioning System (GPS) equipment (or GPS level of navigation accuracy) was not available. This limitation caused increased pilot workload during low level navigation and transition to attack. (GPS entered developmental testing on the F-16 in 1988.)

d. The Automatic Terrain Following (ATF)system planned for the F-16 was not available. This limitation increased pilot workload. (F-16 ATF developmental test is on-going.)

e. The FOT&E(1) testbed F-16 aircraft used an APG-66 radar. This radar does not have the moving target track and improved ground map resolution capabilities which will be available with the F-16 Block 40 APG-68 radar. (F-16 aircraft with APG-68 radar were flown with LANTIRN in 1988.)

Additionally, operational realism in LANTIRN testing was constrained by range restrictions, inability to fire the laser off-range, and other peacetime safety constraints. For example, range and safety restrictions required IIR Maverick firings to be displaced to less than operationally desired distances from the target because of the missile's safety footprint and the physical boundaries of the range airspace. Range safety considerations did not permit manned threat simulators/emitters to be used on a range where live/inert ordnance delivery was planned. Restricting laser firings to test ranges also precludes its use for inertial updates during low level navigation, while FAA restrictions on night low level routes limit the airspace, altitude, and airspeeds otherwise available in an "operational" environment.

As stated above, many of the noted limitations to test have been overcome in the past 18 months of LANTIRN testing since formal operational testing of LANTIRN ended in July 1987. Most important is the testing of a production TGT pod on an F-16 using production Block 40 software and avionics. Additionally, LANTIRN has demonstrated functional integration on the production F-15E with production TGT and NAV pods. The results of this testing have shown the functional integration of LANTIRN using production equipment, as well as performance improvements in TGT pod tracker tenacity, tracker slew control, and integrated weapon delivery. Based on the results of LANTIRN testing since FOT&E(1), DOT&E assesses F-16 LGB delivery capability to be better than the marginal rating assigned after FOT&E(1) and satisfactory against a limited target set. LANTIRN/Maverick delivery capability is considered satisfactory, as is limited conventional weapon delivery capability using the LANTIRN pods to deliver MK-82 bombs. Much testing of the LANTIRN/F-16 weapon system remains to be done after delivery of the production aircraft and completion of F-16 Seek Eagle testing with the entire range of conventional weapons. Dedicated operational testing of LANTIRN on the F-16 Block 40 aircraft will be done in F-16 Block 40 IOT&E beginning in 1989. This test phase will demonstrate further the functional integration of the production LANTIRN equipment and expand the limited LANTIRN/F-16 conventional weapon delivery testing to include operational profiles and more types of

weapons. A similar IOT&E for the F-15E/LANTIRN has begun and will be completed in 1989. LANTIRN controls and displays on the F-16 and navigation capability are satisfactory. LANTIRN NAV pod integration into the tactical air forces is assessed as satisfactory for F-16 pilot workload in navigation and terrain following. LANTIRN TGT pod integration has not been adequately addressed due to pod/aircraft limitations mentioned. The complete LANTIRN system will require high levels of F-16 pilot proficiency and training. F-15E integration will be easier due to a two-man crew. LANTIRN-equipped fighter squadrons will require increased support in weather and intelligence.

OPERATIONAL SUITABILITY

FOT&E(1) rated the operational suitability of the entire LANTIRN system (all three components). Specific ratings were provided for individual components where the data were available. Four aspects of operational suitability, which included logistics reliability, mission reliability, system maintainability, and system availability, were evaluated and potential supportability problems were identified. The data base which reports current results and projects estimates for future reliability, maintainability and availability, is cumulative and updated constantly with results of all LANTIRN experience in both developmental and operational test missions. This report reflects results for FOT&E(1), which ended in July 1987, and the cumulative current projections which include data from 1897 hours of LANTIRN operating time and 1557 hours of LANTIRN flight time since July 1987.

Logistics reliability is measured using mean time between maintenance for inherent failures (MTBMI). MTBMI is the average number of operating hours (OH) between inherent, on-equipment maintenance actions. At the time of FOT&E(1), reliability data were collected throughout the DT&E, IOT&E and FOT&E tests. MTBMI was projected to maturity (10,000 operating hours) using techniques from Military Handbook (MIL-HDBK) 189, Reliability Growth Management. A range of values (optimistic and conservative) was projected. The lower bound (conservative projection assumed the reliability growth demonstrated in test continued to maturity. The upper bound (optimistic) projection used the same growth rate, but also included an assessment of the impact of pending system improvements, which should provide additional reliability enhancements. FOT&E(1) test results, FOT&E(1) mature MTBMI projections, and mature evaluation criteria are shown below. In addition, a current (as of December 1988) mature projection is shown which reflects the equipment improvements demonstrated in flight test since July 1987.

Logistics Reliability Criteria and Results

Mean Time Between Maintenance, Inherent (hours)

	FOT&E(1) Results	FOT&E Mature Projection	Current Mature Projection	Mature Criteria
System	18	27-36	34.0-44.8	27
WFOV HUD	127	127	127	125
NAV Pod	38	60-89	77-118.4	50
TGT Pod	47	77-112	115.5-167.1	108

FOT&E(1) conclusions were that the logistics reliability of the LANTIRN system was projected to meet the user's requirements at maturity, primarily due to the high reliability of the WFOV HUD and Nav Pod. At that time, the logistics reliability of the TGT pod was rated marginal because of the high failure rate of the central electronics unit (CEU) and components within the nose/roll section. The specific nose/roll section components which failed several times were the slip rings, cooler/detector, and laser transmitter/ receiver. Since July 1987, these TGT pod components have been redesigned. Flight test results have demonstrated significant improvement which is reflected in the current mature projection above.

System reliability of the LANTIRN system (and targeting pod) as it affects mission performance was measured using weapon system reliability (WSR). WSR is the probability that the system or subsystem can complete a mission without a critical failure. Mean time between critical failure (MTBCF) was the parameter used for the calculation of WSR. Appropriate hardware failures were classified as critical, and a range of expected MTBCF was projected to maturity (10,000 hours) using the method and techniques described for logistics reliability. These projections were used to calculate a mature WSR. Because of known and previously reported deficiencies in FSD fault reporting software, many erroneous BIT failure indications which could have resulted in needless mission aborts were not included in the WSR calculations in FOT&E. If they had been, reliability would have been lower. LANTIRN system fault-reporting software was and is being redesigned for production to eliminate erroneous fault indications. FOT&E(1) test results, mature evaluation criteria, and FOT&E(1) mature WSR projections are shown below. In addition, a current (as of December 88) mature projection is shown which reflects equipment improvements demonstrated in flight test since July 1987.

Mission Reliability Criteria and Results

Weapon System Reliability

	FOT&E(1) Results	FOT&E Mature Projection	Current Mature Projection	Mature Criteria
System	.85	.90-.92	.927-.944	.92
WFOV HUD	.98	.98	.98	.98
NAV Pod	.93	.95-.97	.97-.98	.96
TGT Pod	.93	.96-.97	.977-.984	.98

FOT&E(1) conclusions were that the LANTIRN system mission reliability was projected to meet the user's requirements at maturity, primarily because of NAV pod and WFOV HUD reliability. The TGT pod reliability was rated marginal (one percent short of the requirement in the optimistic projection). Current projection is that the TGT pod will meet the requirement.

Maintainability of the LANTIRN system (not the targeting pod) in FOT&E(1) was estimated by observing contractor-performed maintenance and then estimating component removal and replacement times for a representative USAF field environment. These estimated "blue suit" values were used to compute maintenance man-hour per operating hour (MMH/OH). Because the computations included spares and manpower planned for the maintenance of all LANTIRN components, only an overall system MMH/OH was reported. Test results, mature evaluation criteria, and mature MMH/OH estimates are shown below:

LANTIRN System Maintainability Criteria and Results

	FOT&E(1) Result Estimate	FOT&E(1) Mature Estimate	Current Mature Estimate	Mature Criteria
MMH/OH(hour)	.77	.58-.54	.51-.46	.60

FOT&E(1) MMH/OH met the requirement in FOT&E(1). Mean down time (as calculated in a computer simulation model) did not satisfy the criterion in FOT&E(1). As during IOT&E, the FOT&E(1) test team qualitatively rated the FSD TGT pod ease of maintenance as inadequate. In addition, BIT mechanization in the FSD LANTIRN equipment was not capable of supporting fault isolation and troubleshooting. The BIT mechanization and the TGT pod center section were redesigned and have been flight tested on a production TGT pod.

Availability of the LANTIRN system (not individual components) was measured using many of the same estimated values discussed above to determine a fully mission capable (FMC) rate. LANTIRN system availability was projected using computer estimates of "blue suit" maintenance capabilities to meet the user's requirement of 80% FMC at maturity (10,000 hours) within a range of 87% to 92%.

Logistics supportability could not be tested as no integrated logistics support (ILS) elements were available for testing.

Limitations to test which critically affected the conduct and results of FOT&E(1) with regard to operational suitability included:

a. The tested LANTIRN NAV and TGT full scale development pods did not incorporate many reliability and maintainability improvements planned for production as a result of previous testing. This limitation precluded assessment of planned design changes and their subsequent affect on RAM. (Production NAV and TGT pods were flown in 1988.)

b. The FSD pods were contractor-maintained during the test, and, therefore, AFOTEC was limited in its ability to fully assess the maintainability of the LANTIRN system. However, limited hands-on-work by test team maintenance evaluators was assessed, and all contractor actions were evaluated over-the-shoulder. This limitation caused the Air Force to estimate LANTIRN blue suit capability after observing contractor maintenance actions.

c. The production built-in test (BIT) capability was not available; therefore, preventive maintenance was performed using data from unique flight-test instrumentation. (BIT capability has shown steady improvement since FOT&E(1).)

d. Major ILS elements (support equipment, technical documentation, and maintenance training) were not available for AFOTEC to assess. As a result, AFOTEC reviewed the plans for supporting the equipment in the field. This limitation caused the Air Force to estimate LANTIRN blue suit capability after observing contractor maintenance action.

Since the conclusion of FOT&E(1) in July 1987, an intensive LANTIRN flight test program has demonstrated the improved design of key TGT pod components on both FSD pods and a production pod. The data derived from flight test shows significant improvement has been made since FOT&E(1). Current mature projections for reliability, availability, and maintainability are that the mature criteria will be achieved.

(U) In addition, progress has continued on plans for the Air Force to assume full responsibility for LANTIRN maintenance. In 1989, TAC will participate in a supportability

evaluation using both production navigation and targeting pods, which will be monitored by AFOTEC. In 1990, a maintainability demonstration will be conducted on one set of LANTIRN production pods and production LANTIRN Intermediate Automatic Test Set (LIATS) equipment selected by the Air Force. The LANTIRN pods will be selected from units delivered in CY90 and the intermediate support equipment assets will be selected from serial numbers eight through thirteen. During the demonstration the LIATS will be operated a minimum of 540 hours and the contractor will determine the instantaneous MTBF for the LIATS equipment. The contractor will document procedures for collecting and evaluating reliability data. Air Force technicians, trained under Type I training, will conduct the demonstration, assisted by contractors responsible for inserting equipment faults and developing corrective procedures for any mistakes observed.

Development of production support equipment is on track and continuous support equipment validation will ensure that this equipment meets specifications. In November and December 1987, a demonstration of the Targeting Pod Support Equipment, using an FSD pod, was conducted at the contractor's facility. TAC and AFOTEC maintenance personnel participated in the demonstration which successfully isolated ten out of ten inserted faults (contractual requirement is eight out of ten).

Because of the successful progress on all suitability issues of concern to DOT&E in November 1987, this office now considers the LANTIRN TGT pod as being able to meet suitability criteria at maturity using Air Force maintenance. DOT&E assessments of future LANTIRN suitability progress and results will be made available to the Congress in the DOT&E Annual Report sections on on F-15E/LANTIRN IOT&E, F-16C/D/LANTIRN IOT&E, LANTIRN Supportability Evaluation, and LANTIRN maintainability demonstration.

GLOSSARY

GLOSSARY OF ACRONYMS

A	
ADATS	Air Defense Anti-Tank System
AEWTS	Advanced Electronic Warfare Test Set
AFB	Air Force Base
AFEWES	Air Force Electronic Warfare Evaluation Simulator
AFOTEC	Air Force Operational Test and Evaluation Center
AGM	Air-to-Ground Missile
AIM	Air Intercept Missile
ASD	Assistant Secretary of Defense
ATF	Advanced Tactical Fighter
B	
BES	Budget Estimate Submission
BIT	Built-In-Test
B-LRIP	Beyond Low-Rate Initial Production Report
C	
COI	Critical Operational Issues
COMOPTEVFOR	Commander Operational Test and Evaluation Force (Navy)
CW	Chemical Warfare
CY	Calendar Year
C^3	Command, Control, Communications
D	
DAB	Defense Acquisition Board
DDDR&E(T&E)	Deputy Director, Defense Research and Engineering (Test and Evaluation)
DoD	Department of Defense
DoDI	Department of Defense Instruction
DOT&E	Director, Operational Test and Evaluation
DRB	Defense Resources Board
DT	Development Test
DT&E	Developmental Test and Evaluation
E	
ECCM	Electronic Counter-Countermeasures
ECP	Engineering Change Proposal
ECM	Electronic CounterMeasures
EDM	Engineering Development Models
EOA	Early Operational Assessment
EOCM	Electro-Optical Counter-measures
EUT&E	Early User Test and Experimentation
EW	Electronic Warfare
EXCOM	Executive Committee on Air Defense Threat Simulators
F	
F/A	Fighter/Attack
FDT&E	Force Development Test and Experimentation
FOE	Follow-on Evaluation
FOT&E	Follow-on Operational Test and Evaluation
FWE	Foreign Weapons Evaluation Program
FY	Fiscal Year
FYDP	Five Year Defense Plan
G	
GAO	General Accounting Office
I	
ICBM	Intercontinental Ballistic Missile
IOC	Initial Operational Capability
IOT&E	Initial Operational Test and Evaluation
IPT	Initial Production Test
IR	Infrared
ITEA	International Test and Evaluation Association
J	
JCHEM	Joint Chemical Warfare
JCS	Joint Chiefs of Staff
JOG	Joint Oversight Group
JTF	Joint Test Force
JTFPMO	Joint Tactical Fusion Program Management Office
L	
LOI	Letter of Instruction
LOT	Limited Operational Test

LRIP	Low-Rate Initial Production
M	
MAISRC	Major Automated Information System Review Council
MCOTEA	Marine Corps Operational Test and Evaluation Activity
MEF	Mission Effectiveness Factor
MOT	Maturity Operational Test
MOTF	Mobile Operational Test Force
MOU	Memorandum of Understanding
MRTFB	Major Range and Test Facility Base
MS	Missile Seeker Radar
N	
NATO	North Atlantic Treaty Organization
NBC	Nuclear, Bilogical, and Chemical
NDI	Non-Developmental Item
NTCB	National Test Capability Base
O	
OA	Operational Assessment
OPEVAL	Operational Evaluation
OSD	Office of the Secretary of Defense
OT	Operational Test
OTA	Operational Test Agency
OT&E	Operational Test and Evaluation
OT&E CIP	Operational Test and Evaluation Capability Improvement Program
OTEA	Operational Test and Evaluation Agency (Army)
OTO	Operational Test Organization (SDS)
OUE	Operational Utility Evaluation
P	
PDM	Program Decision Memorandum
PE	Program Element
PMO	Program Management Office
POM	Program Objective Memorandum
P3I	Pre-Planned Product Improvement
R	
RAM	Reliability, Availability, and Maintainability
RDT&E	Research, Development Test and Evaluation
ROC	Required Operational Capability
S	
SAC	Strategic Air Command
SAR	Selected Acquisition Report
SOF	Special Operations Forces
SSTC	Space Systems Test Capability
T	
T&E	Test and Evaluation
TDP	Test Design Plan
TEC	Test and Evaluation Committee
TEMI	Test and Evaluation Management and Investment Initiative
TEMP	Test and Evaluation Master Plan
U	
UHF	Ultra-High Frequency
V	
VHF	Very-High Frequency