E3 and SM Assessment Guide for Operational Testing

13 June 2001

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1.0 INTRODUCTION

This guide establishes Electromagnetic Environmental Effects (E3) and Spectrum Management (SM) assessment criteria for acquisition programs[1] to assist Director, Operational Test and Evaluation (DOT&E) assessors, Operational Test Agencies (OTAs), and acquisition Program Managers (PMs) in executing the DOT&E *"Policy on Operational Test and Evaluation of Electromagnetic Environmental Effects and Spectrum Management"* (See Appendix A). Through the use of this guide, adverse E3 and SM issues can be identified during the early life-cycle phases of the acquisition process.

E3 is defined as the impact of the electromagnetic environment upon the operational capability of military forces, equipment, systems, and platforms. It encompasses all electromagnetic disciplines, including electromagnetic compatibility (EMC)/electromagnetic interference (EMI); electromagnetic vulnerability (EMV); electromagnetic pulse (EMP); electronic protection (EP); hazards of electromagnetic radiation to personnel (HERP), ordnance (HERO), and volatile materials (HERF); and natural phenomenon effects of lightning and precipitation static (P-Static).

SM is defined as planning, coordinating, and managing the use of the electromagnetic spectrum through operational, engineering, and administrative procedures, with the objective of enabling electronic systems to perform their functions in the intended environment without causing or suffering unacceptable interference. The major components of SM are spectrum certification (SC) and frequency assignment. SC is the process (called the JF-12 Process) by which spectrum-dependent systems/equipment are certified to operate in a portion of the electromagnetic spectrum. Frequency assignment is the operational process that gives the users the authority to operate a fielded, spectrum-dependent system[2] at specific locations on assigned frequencies within the allocated frequency band.

In military operations, the control of E3 and the application of SM are concerned with promoting efficient, compatible use of the electromagnetic spectrum among military forces. The interrelationship between E3 and SM issues is depicted in Figure 1. The overlap occurs primarily with ensuring the EMC of spectrum-dependent equipment (e.g., antenna-connected transmitters and receivers).

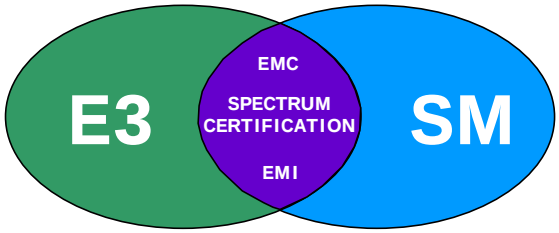


Figure 1. Interrelationship between E3 and SM Issues.

[1] These include upgrades to fielded systems.
[2] A spectrum-dependent system is a system that depends on the use of the electromagnetic spectrum for its operation (e.g., radio and radar).

The DOT&E policy was issued to reinforce emphasis on E3 and SM issues during Developmental Test and Evaluation (DT&E) and Operational Test and Evaluation (OT&E) events. This action became necessary because of recent incidents attributed to E3 and SM problems that have limited mission effectiveness and have resulted in fratricides. In recent operations in the Balkans, a jammer aircraft experienced an engine shutdown when it began to transmit jamming signals. An unmanned air vehicle (UAV) for which a payload of electronics was rapidly configured experienced interference problems that caused dropouts in the downlink. Our own jammer aircraft interfered with an artillery counter-battery radar. In Macedonia, electronic equipment experienced problems when hooked up to the local power grid. In a test flight over a range in the southwest United States, a Global Hawk UAV experienced interference from an adjacent test range that was testing auto-termination transmissions on the same frequency. The result was initiation of the self-destruct mechanism in the UAV; the aircraft was destroyed. During the Vietnam War, an explosion and resulting fire occurred aboard the aircraft carrier USS *Forrestal*, operating off Vietnam. Stray voltage was thought to have been a possible cause. A potential source was one of the ship's radars, which may have ignited a rocket on one of the aircraft waiting to be catapulted. A number of lives and aircraft were lost. Additionally, deployments of U.S. military Command, Control, Communications, Computers, and Intelligence (C4I) assets to foreign nations have resulted in the denial to operate these assets and even confiscation due to lack of SC (i.e., Host Nation Coordination).

Operational impact assessments of E3 and SM issues need to be accomplished during all life-cycle phases of the acquisition process and reviewed at each milestone decision. The Department of Defense (DoD) can reduce this negative impact to military operations by ensuring that system/equipment limitations and vulnerabilities are mitigated and/or sufficiently documented for the Warfighter.

Additional background information regarding E3 and SM is provided in Appendix B.

2.0 ASSESSMENT GUIDANCE

> *E3 and SM problems that affect operational capabilities must be minimized, and all limitations and vulnerabilities that remain, or the necessary workarounds to minimize the problems, must be documented for the Warfighter.*

DOT&E and the OTAs, with support from PMs, can accomplish this goal by performing assessments that identify potentially adverse E3 and SM issues during the acquisition life-cycle phases.

2.1 ASSESSMENT PROCESS FOR E3

To the extent possible, an E3 operational impact assessment must identify and quantify limitations and/or vulnerabilities that result from E3. While field operational testing (OT) would normally be used to accomplish this, DOT&E recognizes that field OT occurs late in the acquisition process and is expensive. It is DOT&E policy that "all credible and applicable test data, including those from non-OT sources, accrued prior to or during the completion of

independent OT&E, should be considered for use in operational evaluations." [3] Thus, field OT of E3 issues, if required, should be structured to resolve identified E3 issues that could have a significant adverse operational impact where such E3 issues cannot be measured or assessed by other means.

A decision regarding the need for field OT of E3 issues can be reached systematically in the acquisition process for many systems and equipment developed for the Warfighter. Figure 2 depicts the process for assessing E3 in an operational context. It shows the normal acquisition process with developmental test (DT) and OT events emphasized. Tester involvement early in the acquisition process is emphasized in the Design Reviews block, the Early DT/OT Assessment block, and the E3 OT decision points represented by the diamond decision symbols. To minimize the amount of E3 field OT required, three major decision points are shown where a decision can be made as to the need for further E3 assessments in OT.

The first E3 OT decision point occurs after the combat developer and/or Joint Staff defines the mission needs and operational requirements in the Mission Needs Statement (MNS) and Operational Requirements Document (ORD). At this time, the activities making the E3 OT assessment decision (typically, the PM in consultation with the requirements developer and the OTA) can review the MNS and ORD to determine whether the system to be developed to satisfy the requirements has E3 requirements that are applicable.

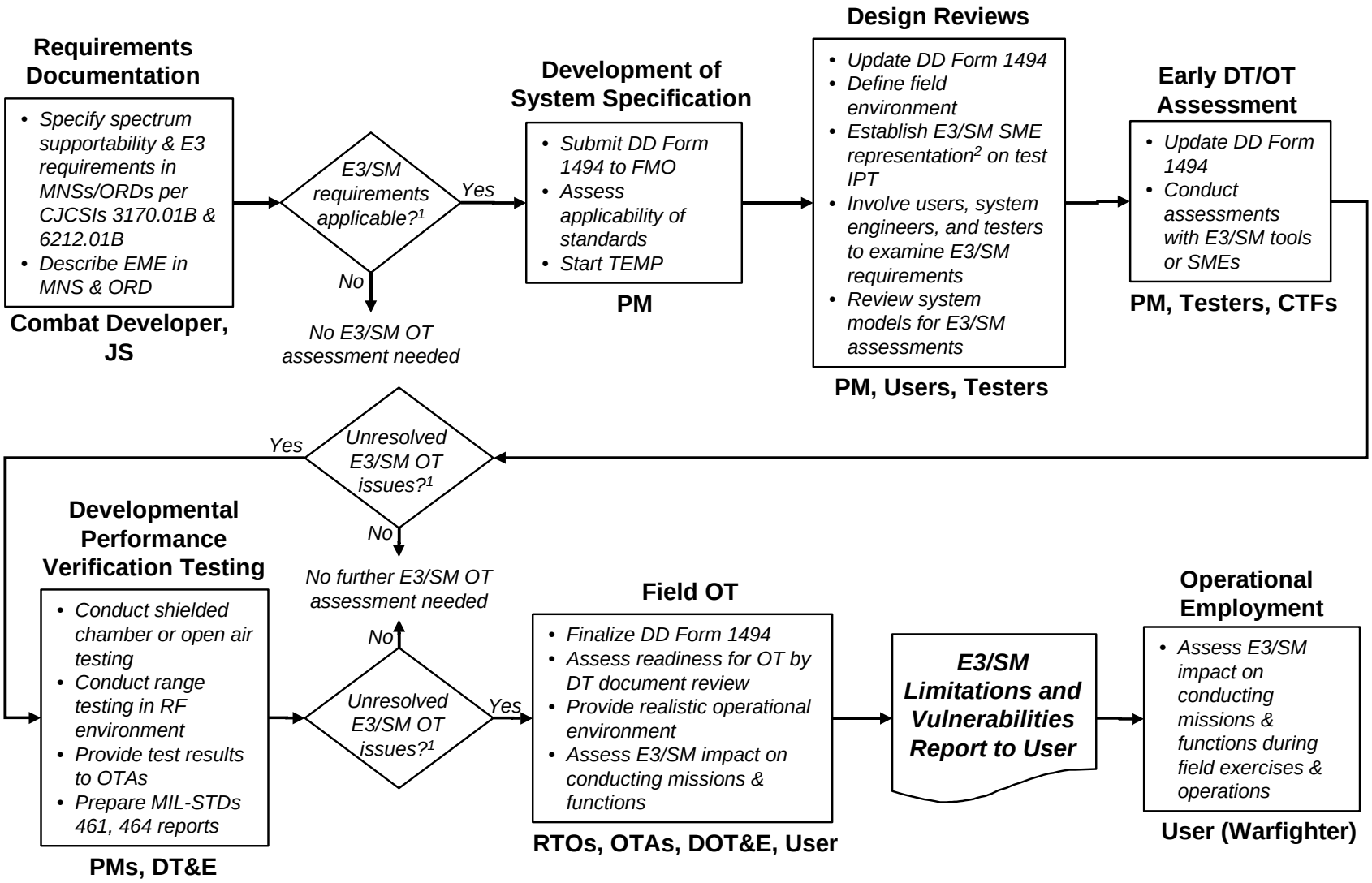
> *Generally, any system or equipment that contains (or will contain) electronic or electrical components will have E3 requirements, and an E3 assessment will be necessary.*

If an E3 assessment is necessary, the PM should initiate the completion of DD Form 1494 (Appendix C), ensure that the Test and Evaluation Master Plan (TEMP) outlines the approach to testing E3, and that recognized E3 subject matter experts (SMEs) are represented on the test and evaluation integrated product team (IPT). The SMEs would typically come from the Services or the Joint Spectrum Center (JSC). Users and testers should examine E3 requirements and review system models for E3 assessments. An E3 desktop assessment should be conducted in Early DT/OT to identify potential E3 problem areas.

The second E3 OT decision point is a decision as to whether any unresolved E3 issues remain. This decision occurs after the Early DT/OT Assessment and prior to Developmental Performance Verification Testing. Using updated DD Form 1494 data, E3 assessment tools (if necessary) (Appendix D), and recognized E3 SMEs, the assessor can determine whether all E3 concerns have been identified and that their operational impact is understood. If no unresolved issues remain, E3 field OT will not be required, and the identified E3 concerns can be documented in the E3 and SM Limitations and Vulnerability Report. For example, a decision not to require E3 field OT might be made for some systems because of their close similarity to other systems that have been assessed, simplicity of design, or extremely low risk of operational impact resulting from E3 issues.

Regardless of the second E3 OT assessment decision point, all systems/equipment being developed that have E3 requirements normally undergo Developmental Performance

[3] *Policy on the Use of Test Data in Operational Evaluations,* DOT&E Memorandum, 11 September 2000.



Notes: 1. Decision diamonds are OT decision points only. DT decision points may be different.
2. SMEs would typically come from the Services or from the Joint Spectrum Center.

Figure 2. E3 and SM Operational Assessment Processes

Verification Testing. However, in those cases where, at the second E3 OT decision point, the determination has been made that E3 field OT is not required, the PM and OTA assessor will still review the Developmental Performance Verification Testing data to ensure that nothing unexpected has been identified during this test. If unexpected anomalies have been identified, the second E3 OT decision needs to be revisited (or the PM and OTA assessor must reenter the E3 OT assessment process at the third decision point), and it may be necessary to require E3 assessments during field OT.

The third and last E3 OT assessment decision point follows the completion of Developmental Performance Verification Testing, using some ranges and resources (if necessary) (Appendix E), and analysis of the data. Again, with the help of recognized E3 SMEs, the assessor determines whether all E3 concerns have been identified and addressed. If all E3 concerns have been addressed, the E3 and SM Limitations and Vulnerabilities Report stating any anticipated operational issues can be prepared without E3 field OT. However, in those few cases where the E3 concerns have not been quantified and mitigated, it will be necessary to conduct E3 assessments as part of field OT prior to preparation of the final E3 and SM Limitations and Vulnerabilities Report.

2.2 ASSESSMENT PROCESS FOR SM

An SM operational assessment must determine whether adequate spectrum will be available to support system operation in the DoD, Allied, and Coalition force operational areas. To evaluate spectrum availability effectively, spectrum-related operational restrictions, frequency availability, host nation approvals, electromagnetic compatibility, and other such issues must be considered. Spectrum-dependent systems that transmit cannot legally be operated in the United States and Possessions (US&P) until they have been granted SC by National and DoD authorities. Additionally, for operation outside the US&P, spectrum-dependent systems that transmit must obtain host nation approval prior to operation in each foreign country where the system/equipment will be employed. Once SC and host nation approvals are granted, and the appropriate area or regional spectrum or frequency manager authorizes frequency assignments, then spectrum-dependent systems that transmit can legally operate. Furthermore, SC is required for receivers for purposes of registration and frequency planning. Receivers will not normally require host nation approval.

The SM OT assessment is essentially a review of the SC process for the system/equipment in question. The results will be documented in the E3 and SM Limitations and Vulnerabilities Report to the Warfighter for that system/equipment. Figure 2 is applicable to assessing SM in an operational context.

The first SM OT decision point is a decision as to whether the system/equipment requires the use of the electromagnetic spectrum.

> *All spectrum-dependent systems or equipment (both transmit and receive) will need SC; an SM operational assessment will be necessary.*

If the use of the electromagnetic spectrum is required, the OTA, with the help of SM SMEs, needs to ensure that, during the Development of System Specification, the completion of DD Form 1494 has been initiated, the data are technically correct, and the form has been submitted to

the proper U.S. spectrum management authorities [typically, through the Service Frequency Management Office (FMO)] for processing. The U.S. spectrum management authority will work with host nation spectrum management authorities to obtain necessary host nation approvals.

The second SM OT decision point is a decision as to whether any unresolved SM issues remain. This decision occurs after the Early DT/OT Assessment and prior to Developmental Performance Verification Testing. At the Early DT/OT Assessment, an updated DD Form 1494 must be submitted, compliance with the frequency allocation tables verified, and spectrum availability (the ability to obtain frequency assignments) in the system/equipment's intended operational area confirmed. The system must have DoD SC by this time, and the status of any host nation approvals must be noted. If all requested spectrum allocations, including host nation approvals, have been obtained, and no other unresolved spectrum issues remain, no further SM OT assessment is needed.

Regardless of the second SM OT assessment decision point, all systems/equipment being developed that have spectrum requirements normally undergo Developmental Performance Verification Testing. However, in those cases where, at the second SM OT decision point, the determination has been made that SM field OT is not required, the prudent PM and OTA assessor, with the help of SM SME's, should review the Developmental Performance Verification Testing data to ensure that nothing unexpected has been identified during this test. If unexpected anomalies have been identified, the SM OT decision needs to be revisited (or the PM and OTA assessor must reenter the SM OT assessment process at the third decision point), and it may be necessary to require SM assessments during field OT.

At the third SM OT decision point, DT documentation is reviewed, measured data needed to finalize DD Form 1494 are obtained, and system spectrum requirements in a realistic operational context are analyzed to determine whether additional SM assessment in field OT is required. If SM issues have been identified, they should be addressed at the operational test readiness review (OTRR). At the end of field OT, the PM and OTA, with the help of SM SMEs, must assess the operational impact of any SM concerns/shortfalls so they can be published in the E3 and SM Limitations and Vulnerabilities report to the Warfighter for the system/equipment in question.

2.3 ASSESSMENT CHECKLIST

This section provides guidance on the aforementioned assessment processes. Table 1 presents the data requirements checklist to be used as a guide for the information needed by an E3 and SM assessor. All items except Items 9 and 10 should be provided by the PM.

The information in the checklist is based on material presented in the following references.

- DoD Interim Regulation 5000.2-R, "*Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information System (MAIS) Acquisition Programs,*" dated 30 December 2000.

[4] *Policy on the Use of Test Data in Operational Evaluations,* DOT&E Memorandum, 11 September 2000.

Table 1. OT Checklist for E3 and SM Assessments

Objective: To identify, to the best extent possible, the E3 and SM limitations and vulnerabilities of the subject system.	
Information as appropriate to program development	**Responsibility**
1. DD Form 1494 submitted to the Service Frequency Management Office (FMO)	PM
2. Status of Host Nation Frequency Supportability (HNFS)	PM
3. Description of operational electromagnetic environment (EME) (e.g., operational environment, theater, mission in the OPLAN)	PM
4. Latest program documentation (e.g., MNS, ORD, APB, C4ISP, Specification)	PM
5. TEMP which contains: a. E3 within the scope of a Critical Operational Issue (COI) b. List of tests and analyses used to determine the equipment effectiveness /suitability/survivability performance in the operational EME	PM
6. Copy of the following analyses and/or test and evaluation data: a. Intra-platform/system analyses: (1) Antenna coupling and blockage analyses and/or test data (2) Subsystem/equipment EMC analyses and/or test data (3) CI/NDI/GFE EMC analyses and/or test data b. Inter-platform/systems EMC analyses and/or test data for spectrum-dependent (JEET model) and non-spectrum-dependent equipment c. Special E3 analyses and/or test data (i.e., HERO, HERP, HERF, EMP, Lightning, and P-Static), if required by the ORD or TEMP	PM
7. E3 and SM impact assessments that identify and define operational limitations and vulnerabilities (i.e., lessons learned)	PM
8. DT&E Test Plans and results/reports	PM
9. OT&E Test Plan and results	OTA
10. User-initiated test results	OTA

- DoD Directive 3222.3, *"Department of Defense Electromagnetic Compatibility Program (EMCP),"* 20 August 1990.
- DoD Directive 4650.1, *"Management and Use of the Radio Frequency Spectrum,"* 24 June 1987.
- CJCSI 3170.01B, *"Requirements Generation System,"* 15 April 2001.
- CJCSI 6212.01B, *"Compatibility, Interoperability, Integration and C4 Supportability Certification of Command, Control, Communications, Computers and Weapon Systems,"* 8 May 2000.
- MIL-HDBK-237B, "*Electromagnetic Compatibility Management Guide for Platforms, Systems, and Equipment,"* 1 October 1997.
- MIL-STD-464, "*Electromagnetic Environmental Effects Requirements for Systems,*" 18 March 1997.

- MIL-STD-461E, "*Requirements for the Control of EMI Characteristics of Subsystems and Equipment,"* 20 August 1999.

Appendix D provides Model and Simulation resources that are available at the JSC,[5] Appendix E presents a partial list of available E3 resources within DoD, and Appendix F lists points of contact. Additional guidance, applicable documents, and points-of-contact information can be found in the Defense System Management College CD and Elective Course *"Electromagnetic Environmental Effects (E3)/Spectrum Certification (SC) for Program Managers."*

3.0 RESPONSIBILITIES

The DOT&E policy (see Appendix A) delineates specific areas that must be addressed by DOT&E assessors, the OTAs, and the PMs.

3.1 DIRECTOR, OPERATIONAL TEST AND EVALUATION

DOT&E assessors are tasked with the following responsibilities:

- Review Service TEMPs, System Threat Assessment Reports, Operational Requirements Documents, test plans, test concept briefings, and test reports to determine the adequacy of E3 testing.

- Ensure that E3 issues are satisfactorily reviewed by the PM or the program acquisition IPTs.

- Review Services' E3 evaluation approaches, including modeling and simulation, small-scale tests, and appropriate chamber and laboratory tests.

- Leverage the evaluation of E3 impacts during large-scale field training exercises.

- Review Services' early assessments to identify and understand those situations where E3 and spectrum limitations would likely affect mission accomplishment. The results and projected impacts should be reviewed in the appropriate IPT forum and be used in the design and scoping of full-scale operational tests.

- Review the status of the DD Form 1494 in the JF-12 process and share the data with the OTAs.

- Review E3 engineering assessments and qualification test plans and reports.

- Report the status of E3 issues for each program in the DOT&E Annual Report, and report specific program findings as part of Beyond Low-Rate Initial Production reports to the Secretary of Defense and the Congress.

[5] This appendix will be expanded in a subsequent edition of this document to include Service capabilities.

- As E3 issues related to fielded systems arise during OTs, or during large-scale training exercises used to complement OTs, report these issues to the appropriate agencies for resolution.

3.2 OPERATIONAL TEST AGENCIES

OTAs are advised to:

- Work in conjunction with the Joint Spectrum Center, the Defense Intelligence Agency, the system user, and others, as appropriate, to conduct early independent analyses of potential E3 issues, and review the PM's resolution of these issues.

- Conduct early operational assessments that consider the intended operational environment, including storage, training, transportation, staging, and conduct of the battle in single Service, joint, and international deployments. (Avoid relying solely on developer-planned E3 analyses or evaluations.)

- Include E3 and spectrum supportability assessment issues as a standard presentation at Operational Test Readiness Reviews. These assessments should include E3 limitations and vulnerabilities, the operational impact of any waivers, and results of analyses normally accomplished as part of the DD Form 1494 or JF-12 review process.

3.3 PROGRAM MANAGERS

PMs are advised to:

Ensure timely submission of DD Form 1494.

Ensure E3 and SM issues are addressed in appropriate program documentation.

Ensure that E3 test and evaluation and SM planning and analysis are adequately funded and sufficiently addressed in system TEMPs.

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APPENDIX A - POLICY ON OPERATIONAL TEST AND EVALUATION OF ELECTROMAGNETIC ENVIRONMENTAL EFFECTS AND SPECTRUM MANAGEMENT

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OFFICE OF THE SECRETARY OF DEFENSE
1700 DEFENSE PENTAGON
WASHINGTON, DC 20301-1700

OPERATIONAL TEST
AND EVALUATION

25 OCT 1999

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
ATTENTION: SERVICE ACQUISITION EXECUTIVES
ASSISTANT SECRETARY OF DEFENSE (COMMAND, CONTROL COMMUNICATIONS & INTELLIGENCE)
DIRECTOR, DEFENSE INFORMATION SYSTEMS AGENCY
DIRECTOR FOR FORCE STRUCTURE, RESOURCES & ASSESSMENT, JOINT STAFF (J-8)
DIRECTOR, TEST, SYSTEMS ENGINEERING & EVALUATION, OUSD (A&T)
DEPUTY UNDER SECRETARY OF THE ARMY (OPERATIONS RESEARCH)
DIRECTOR, NAVY TEST & EVALUATION & TECHNOLOGY REQUIREMENTS
DIRECTOR, AIR FORCE TEST & EVALUATION

SUBJECT: Policy on Operational Test and Evaluation of Electromagnetic Environmental Effects and Spectrum Management

References:
(a) Department of Defense (DoD) Regulation 5000.2-R, "Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information System (MAIS) Acquisition Programs," 1996
(b) DoD Directive 3222.3, "Department of Defense Electromagnetic Compatibility Program (EMCP)," 1990[1]
(c) DoD Directive 4650.1, "Management and Use of the Radio Frequency Spectrum," 1987
(d) DoD Inspector General Audit Report 99-009, "Coordination of Electromagnetic Frequency Spectrum and International Telecommunications Agreements," 1998

Background

Reference (a) states that all electric or electronic systems shall be designed to be mutually compatible with other electric or electronic equipment within their expected operational environment. Reference (b) describes the DoD electromagnetic compatibility program. Reference (c) specifies procedures for management and use of the radio frequency spectrum, including procedures for coordination with host nations where

[1] This directive is being updated as "DoD Joint Electromagnetic Environmental Effects (E3) Program and Joint Spectrum Center (JSC) Charter," (Draft).

deployment of equipment is planned. Reference (d) reports that DoD does not periodically evaluate the impact of international telecommunications agreements with allied nations on friendly electronic systems.

Electromagnetic Environmental Effects (E3) can adversely affect the operational effectiveness of military forces, equipment, systems, and platforms. Additionally, today's complex military operational environment is characterized by an increasingly congested electromagnetic spectrum coupled with a reduction of spectrum allocated for exclusive military use. The mix of DoD-developed, non-developmental, and commercial-off-the-shelf electronic equipment increases the importance of effectively managing E3 and spectrum usage in the battlespace. It is the responsibility of the Program Managers (PMs) to ensure, and the responsibility of the Operational Test Agencies (OTAs) to validate, the readiness of systems to be fielded into this environment.

Traditionally, operational evaluations of E3 have been limited to narrowly-scoped operational scenarios and limited electromagnetic environments. Specifically, evaluations have been limited to:

- Intra-platform/system environments rather than inter-platform/system environments
- Single Service participation in testing rather than multi-Service.
- Single mission areas rather than multiple mission areas.

A number of joint-Service operations have identified instances of E3 problems between operational forces. These instances have resulted in a restricted operational employment, diminished mission effectiveness, and fratricide. Furthermore, peacetime deployments to host nations are failing to consider the private and commercial use of spectrum in those nations.[2] Early operational assessments need to focus on these issues from the onset of the development cycle. The Department must reduce the impact of potential interference, avoid the cost of making mitigating modifications in the field, and ensure that the Warfighter is cognizant of his systems' vulnerabilities and limitations in these areas.

Scope

E3 encompasses a broad range of electromagnetic disciplines.[3] This policy encompasses all aspects of E3, but emphasizes electromagnetic compatibility/ electromagnetic interference and the hazards of electromagnetic radiation to ordnance. This policy also focuses on limitations to operational performance caused by restrictions on spectrum availability.

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[2] Allocations for use of the spectrum vary in different regions of the world. These allocations are set by international agreements, and nations control the use of the spectrum within their borders.

[3] Electromagnetic compatibility/electromagnetic interference (EMC/EMI); electromagnetic vulnerability (EMV); electromagnetic pulse (EMP); electronic protection (EP); hazards of electromagnetic radiation to personnel (HERP), ordnance (HERO), and volatile materials; and natural phenomena effects of lightning and p-static (Joint Pub 1-02, "Department of Defense Military and Associated Technical Terms," 23 March 1994 (as amended through 10 February 1999).

POLICY

This policy is intended to more clearly define the role of Operational Test and Evaluation in identifying potentially adverse E3 and spectrum availability situations. The policy is intended to make PMs and OTAs aware that the Director, Operational Test and Evaluation (DOT&E) plans to assess this area more systematically, as described below. It is not intended to replace or add to any existing DoD directives or regulations, but to ensure that current required practices are applied and leveraged to the fullest extent in the evaluations of system operational effectiveness.

DOT&E will:

- Review Service Test and Evaluation Master Plans (TEMPs), System Threat Assessment Reports, Operational Requirements Documents, test plans, test concept briefings, and test reports to determine the adequacy of E3 testing.
- Ensure that E3 issues are satisfactorily reviewed by program acquisition Integrated Product Teams (IPTs).
- Review Services' evaluation approaches, including modeling and simulation, small-scale tests, and appropriate chamber and laboratory tests.
- Leverage the evaluation of E3 impacts during large-scale field training exercises.
- Review Services' early assessments to identify and understand those situations where E3 and spectrum limitations would likely affect mission accomplishment. The results and projected impacts should be reviewed in the appropriate IPT forum and be used in the design and scoping of full-scale operational tests.
- Review the DD Form 1494[4] and JF-12[5] process and share the data with the OTAs.
- Review E3 engineering assessments and qualification test plans and reports.
- Report the status of E3 issues for each program in the DOT&E Annual Report, and report specific program findings as part of Beyond Low-Rate Initial Production reports to the Secretary of Defense and the Congress.
- As E3 issues related to fielded systems arise during operational tests (OTs) or during large scale training exercises used to complement OTs, report these issues to the appropriate agencies for resolution.

OTAs are advised to:

- Work in conjunction with the Joint Spectrum Center, the Defense Intelligence Agency, the system user, and others as appropriate to conduct early independent analyses of potential E3 issues, and review the PM's resolution of these issues.
- Conduct early operational assessments that consider the intended operational environment, including storage, training, transportation, staging, and conduct of the battle in single Service, joint, and international deployments. (Avoid relying solely on developer-planned E3 analyses or evaluations.)

[4] Application for Equipment Frequency Allocation.
[5] The process by which spectrum allocations and frequency assignments for systems are approved.

- Include E3 and spectrum availability assessment issues as a standard presentation at Operational Test Readiness Reviews. These assessments should include the operational impact of any waivers and results of analyses normally accomplished as part of the DD-1494 or JF-12 review process.

PMs should ensure that E3 test and evaluation receives adequate funding and is sufficiently addressed in system TEMPs. This area will receive close DOT&E scrutiny as part of the TEMP approval process.

This guidance is effective immediately and applies to all DOT&E oversight programs. It is applicable to programs at Milestone 0 at the time of approval. Programs between Milestone 0 and Milestone III will incorporate this approach during their next TEMP approval cycle.

Philip E. Coyle
Director

cc:

OPTEC
OPTEVFOR
AFOTEC
MCOTEA
JITC
JOINT STAFF J-6
JSC

APPENDIX B - BACKGROUND INFORMATION

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APPENDIX B - BACKGROUND INFORMATION

B.1.0 SCOPE

Historically, failure to verify platform/equipment EMC adequately in the item's operational EME has resulted in costly delays, mission aborts, and reduced operational effectiveness. To demonstrate that the engineering design and development process is complete, E3 and SM risks have been minimized, and item limitations and vulnerabilities have been identified and documented, it will be necessary for a series of evaluations to be planned and conducted. This appendix provides supplemental information for the following: definitions, the spectrum certification processes, requirements documents (such as the MNS, ORD, and TEMP) with the intra- and inter-platform/equipment and special E3 data requirements. To identify the item limitations and vulnerabilities, a series of evaluations will be conducted using models and simulations, factory, laboratory, chamber, and/or open area test sites (OATS). These evaluations can also be used to formulate operational procedures for the employment of the item. The final step in the process is certification that the item is ready for operational use. The DOT&E validation of E3 and SM will be based heavily on the information gained following this evaluation process.

B.2.0 DEFINITIONS

A more complete understanding E3 and SM can be obtained from formal definitions found in Joint Pub. 1-02[1] and other documents.

E3 is defined as:

> The impact of the electromagnetic environment upon the operational capability of military forces, equipment, systems, and platforms. It encompasses all electromagnetic disciplines, including electromagnetic compatibility/ electromagnetic interference (EMC/EMI); electromagnetic vulnerability (EMV); electromagnetic pulse (EMP); electronic protection (EP); hazards of electromagnetic radiation to personnel (HERP), ordnance (HERO), and volatile materials (HERF); and natural phenomena effects of lightning and p-static (precipitation static). (Joint Pub. 1-02)

SM is defined as:

> Planning, coordinating, and managing joint use of the electromagnetic spectrum through operational, engineering, and administrative procedures, with the objective of enabling electronic systems to perform their functions in the intended environment without causing or suffering unacceptable interference. (Joint Pub. 1-02)

E3 comprises a number of electromagnetic disciplines, as indicated in the definition. The definitions of these disciplines, found in Joint Pub. 1-02, are presented in Table B-1.

[1] Joint Publication 1-02, *Department of Defense Dictionary of Military and Associated Terms*, 23 March 1994 (as amended through 10 February 1999).

Table B-1. Definitions of the Electromagnetic Disciplines Covered by E3.

Discipline	Definition
EMC	The ability of systems, equipment, and devices that utilize the electromagnetic spectrum to operate in their intended operational environments without suffering unacceptable degradation or causing unintentional degradation because of electromagnetic radiation or response. It involves the application of sound electromagnetic spectrum management; system, equipment, and device design configurations that ensure interference-free operation; and clear concepts and doctrines that maximize operational effectiveness. (Joint Pub 1-02)
EMI	Any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics/electrical equipment. It can be induced intentionally, as in some forms of electronic warfare, or unintentionally, as a result of spurious emissions and responses, intermodulation products, and the like. (Joint Pub 1-02)
EMV	The characteristics of a system that cause it to suffer a definite degradation (incapability to perform the designated mission) as a result of having been subjected to a certain level of electromagnetic environmental effects. (Joint Pub 1-02)
EMP	The electromagnetic radiation from a nuclear explosion caused by Compton-recoil electrons and photoelectrons from photons scattered in the materials of the nuclear device or in a surrounding medium. The resulting electric and magnetic fields may couple with electrical/electronic systems to produce damaging current and voltage surges (pulses). May also be caused by non-nuclear means. (Joint Pub 1-02)
EP	That division of electronic warfare involving actions taken to protect personnel, facilities, and equipment from any effects of friendly or enemy employment of electronic warfare that degrade, neutralize, or destroy friendly combat capability. (Joint Pub 1-02)
HERO	The danger of accidental actuation of electro-explosive devices or otherwise electrically activating ordnance because of radio frequency (RF) electromagnetic fields. This unintended actuation could have safety (premature firing) or reliability (dudding) consequences. (Joint Pub 1-02)
HERP	Potential for electromagnetic radiation to produce harmful biological effects in humans. (ANSI C63.14-1998)
HERF	Potential for electromagnetic radiation to cause spark ignition of volatile combustibles, such as aircraft fuel. (ANSI C63.14-1998)
Lightning	Direct Effects - Any physical damage to the system structure and electrical/electronic equipment due to the direct attachment of the lightning channel. These effects include tearing, bending, burning, vaporization, or blasting of hardware. Indirect Effects - Electrical transients induced by lightning in electrical circuits due to coupling of electromagnetic fields. (MIL-STD 464)
P-Static	Electromagnetic interference effects primarily on antenna-connected receivers caused by corona discharge at sharp edges or points of a structure, arcing across non-conductive surfaces, and arching between conductive joints or panels which are not electrically bonded. (ANSI STD C63.14-1998)

B.3.0 SPECTRUM CERTIFICATION

Spectrum certification (SC) is defined as:

> The process by which development or procurement of spectrum dependent systems will be reviewed and approved for system compliance with spectrum management policy, allocations, regulations, and technical standards to ensure

that radio frequency spectrum is available. (Approved by ASD(C3I) for use in revised DOD Directive 3222.3 and DoD Directive 4650.1)

The spectrum certification process begins with the submittal of an "Application for Equipment Frequency Allocation," commonly referred to as "DD Form 1494." The DD Form 1494 is used to facilitate the SC review process and begin the coordination with host nations. Initially, the DD Form 1494 is reviewed to determine if the intended use of the equipment is in compliance with the statutory allocation tables. Then, the electromagnetic compatibility between the proposed equipment and other spectrum dependent equipment is assessed, and the possible need for an electromagnetic compatibility evaluation is determined. The entire review process is coordinated by the J-12 Permanent Working Group (J-12 PWG), an element of the Joint Frequency Panel of the Military Communications-Electronics Board (MCEB).

The certification process starts with the Program Office submitting the required DD Form 1494 through the chain of command to a Major Command (MAJCOM), or Systems Command (SYSCOM) or Headquarters (HQ) activity responsible for SM in their Service. The DD Form 1494 is reviewed for sufficient data and accuracy throughout, and once completed, is submitted to the Military Department (MILDEP) spectrum management office (SMO) for action. The MILDEP SMOs are the Communications-Electronics (C-E) Services Office for the Army, the Naval Electromagnetic Spectrum Center for the Navy and the Marine Corps, and the Air Force Frequency Management Agency (AFFMA) for the Air Force.

The MILDEP SMO also reviews the DD Form 1494 for sufficient data and data accuracy, and begins compliance checking with applicable standards, regulations, and guidelines. Coordination packages are prepared and the DD Form 1494 is then submitted to the J-12 PWG. The MILDEP SMOs, JSC, and NSA representatives of J-12 working group review the data for accuracy, sufficiency, and potential conflicts. Concurrent with this review and coordination, and as required, the following coordination can occur: (1) National level agencies (e.g., FAA, FCC) as required, (2) National Telecommunications and Information Administration/Spectrum Planning Subcommittee if required for National level certification of spectrum support, and (3) Commander in Chiefs (CINCs) for host nation coordination. After supportability comments are received on the application, the requesting MILDEP prepares the MCEB guidance and forwards the final package to the J-12 working group for final DoD coordination and approval. If approved, MCEB FP J-12 Steering Member signs the guidance package, which is then distributed through channels to the submitting MAJCOM, SYSCOM, or MILDEP SMO. The submitter may then initiate frequency assignment proposals based on MCEB guidance. A DD Form 1494 submittal is required at each milestone in the acquisition process. However, for mature systems, the normal schedule may be moved ahead depending on the maturity of the equipment/system.

Host Nation Coordination (HNC) is required for spectrum-dependent equipment (specifically, transmitters) prior to the introduction into the host nation. HNC is the process by which spectrum dependent equipment is approved for use in foreign countries. This coordination is normally part of the national frequency certification process. Upon submittal to the Spectrum Planning Subcommittee, a releasable copy of the DD Form 1494 is provided to the CINCs and Department of State for submittal to the nations designated in the application. In countries under

the purview of a CINC, the CINC J6 is responsible for the required coordination. In other countries, the Department of State is responsible for the required coordination activities. Action by the host nation is reported through frequency management channels to the system program office. **Strict compliance with all host nation restrictions is mandatory.**

B.4.0 REQUIREMENTS DOCUMENTS

The requirements generation system (CJCSI 3107.01A), along with the acquisition management system (DoDD 5000.1, DoDI 5000.2, and DoD Regulation 5000.2-R) and the Planning, Programming, and Budgeting System (DoDD 7045.14 and DoDI 7045.7), form DoD's three principal decision support systems. A close and effective interface among these systems is required to ensure that quality products are acquired for the Nation's Armed Forces. The requirements generation system produces information for the decision-makers on the projected mission needs and the operational requirements of the Warfighter. These mission needs are defined in broad operational terms in the MNS document. Subsequently, the needs expressed in the MNS are developed into requirements by the ORDs.

The Joint Staff reviews MNS based on the following criteria from CJCSI 3170.01:

> "Does the MNS address E3 in which the system will be operated?"
>
> "Does the MNS address supportability to include spectrum certification?"

The Joint Staff reviews ORDs based on the following criteria from CJCSI 6212.01:

> "Does the ORD address E3 and Spectrum Supportability for systems and equipment?"
>
> "Does the ORD address natural and manmade environmental factors (such as the electromagnetic compatibility and propagation constraints?)"
>
> "Does the ORD address safety issues regarding Hazards of Electromagnetic Radiation to Ordnance (HERO)?"

Typical ORD requirement statements that meet the above criteria include the following:

> The XXX shall be electromagnetically compatible within itself and with other systems in its operating environment. The operational performance should not be degraded by electromagnetic environmental effects (E3).
>
> > Rationale – Intra-and inter-platform/system electromagnetic compatibility issues could result in limitations being placed on the use of the installed equipment/sub-systems, which in turn could adversely impact the operational effectiveness of the total platform/system.
>
> HERO – All ordnance items shall be integrated into the XXX in such a manner to preclude all safety problems and performance degradation when exposed to its operational electromagnetic environment.

Rationale – HERO issues, if not fully defined, could result in a hazard to life, hazard to equipment, or overly restrictive emission control requirements being placed on XXX or its host platforms.

Spectrum Certification and Supportability – All installed communications/electronics equipment/subsystems including any commercial or non-developed item (NDI) subsystems shall comply with all DoD, national, and international spectrum management policies and regulations.

Rationale – Paragraph 4.c. of the mandatory format for the ORD in Appendix II of DoD Regulation 5000.2-R specifically requires that spectrum certification and supportability for systems and equipment be addressed. Commercial items must also be processed through the DoD spectrum certification process. The lack of specific equipment/subsystem spectrum certification would prevent the XXX from legally operating, thereby resulting in operational limitations. Additionally, the lack of spectrum certification documentation could result in interference with collocated systems, which could in turn result in XXX operational limitations.

B.5.0 TEST AND EVALUATION MASTER PLAN

DoD Regulation 5000.2-R states that

> The PM shall design all electric or electronic systems/equipment to be mutually compatible with other electric or electronic systems/equipment and the operational electromagnetic environment. All systems shall meet operational performance requirements. The PM shall design ordnance and associated systems to preclude inadvertent ignition, and to perform effectively, during or after exposure to the operational electromagnetic environment.

To meet this requirement the test and evaluation master plan (TEMP) shall focus on the overall structure, major elements, and objectives of the test and evaluation program that are consistent with the acquisition strategy. It shall include sufficient detail to ensure the timely availability of both existing and planned test resources required to support the test and evaluation program. The individual tests and/or analyses that may be addressed in the TEMP in order to meet the requirements of DOD Regulation 5000.2-R are described below. The TEMP format and procedures are provided in DOD Regulation 5000.2-R.

B.5.1 INTRA-PLATFORM/EQUIPMENT EMC

B.5.1.1 Antenna Coupling Analyses and/or Test Data

Antenna coupling analyses conducted during the acquisition process are critical for ensuring that potential interference problems between such systems/equipment are identified before the equipment is fielded. Analyses (modeling, simulation, or measurement) are normally performed at increasing levels of detail during each stage of the acquisition process and provide essential information regarding siting and frequency assignment limitations. Both system designers and the spectrum management community use this information during the production and deployment phases of the program. The analyses produce a documented profile of limitations and the methods by which interference problems may be mitigated to produce an acceptable level of performance. The results of the analyses that are not conclusive provide the goals for the test phase. The individual services and the Joint Spectrum Center have a wide range of analytical models that are used to perform these analyses.

B.5.1.2 Subsystems/Equipment Analyses and/or Test Data

Subsystems/equipment should not be susceptible to conducted and radiated electromagnetic emissions that could degrade or render them ineffective. Likewise, they should not be sources of EMI to other equipment within the platform/system. Developmental EMI requirements for subsystems/equipment [i.e., conducted and radiated emission and susceptibility (immunity) requirements] are defined in MIL-STD-461E. Many of the requirements contained in the standard are universally applicable to all subsystems/equipment, regardless of their end use, whereas a limited number of requirements are structured to address specific concerns associated with the end platform/system. Tables in the standard define the applicability of the requirements. The requirements contained therein are not to be applied to subassemblies of equipment such as modules or circuit cards. The requirements in the standard are to be used as a baseline and must be tailored to the specific item being procured. Verification of the EMI requirements is demonstrated by tests that are based on those also in MIL-STD-461E. The appendix of the standard provides rationale and guidance for implementing and tailoring the requirements contained therein. In addition, the appendix should be consulted for detailed guidance on tailoring and performing the required tests.

B.5.1.3 CI/NDI and GFE Analyses and/or Test Data

The use of CI/NDI or GFE presents a dilemma between the need for imposing E3 controls and the desire to take advantage of existing designs, which may have unknown or undesirable EMI characteristics. Blindly using CI/NDI or GFE carries a risk of E3 problems within the platform/ system or subsystem/equipment. CI/NDI/GFE should meet the operational performance requirements for that equipment in the proposed installation. However, this may be difficult because CI is not normally designed to operate in the harsh military EME. Also, NDI and GFE may be designed for one environment but selected for use in another. Each potential use of CI/NDI and GFE must be reviewed for the actual intended usage, and a determination needs to be made of appropriate requirements for that application.

To mitigate any risk, an assessment should be performed to evaluate the planned EME and the equipment's EMI characteristics. This can be accomplished by reviewing existing test data, by reviewing the equipment design, or by performing limited EMI testing. If the item was designed

to a commercial standard, or to one from another Government agency, there may be existing EMI test data. Those data, if available, should be reviewed to determine if the item is suitable for the particular application or intended installation. If data are nonexistent or do not allow comparison with the applicable MIL-STD-461E requirements, limited laboratory EMI testing should be performed to provide the data necessary to do the comparison. If, after evaluation of the EMI data, it is determined that the equipment would not satisfactorily operate in its operational EME, it is the responsibility of the developing activity to implement modifications to the equipment or to select another item of equipment with adequate characteristics. There is no commercial or civilian standard equivalent to MIL-STD-461E.

The use of CI/NDI equipment presents a dilemma in that it does not always conform to the DoD spectrum management policy and, therefore, could make it difficult to obtain spectrum certification and supportability. The DoD purchasers of the CI/NDI equipment are required to submit a Stage 4 DD Form 1494 containing measured characteristics of the equipment. However, the use of the spectrum could still be denied because the use of civil and non-DoD spectrum by the DoD community is normally limited and sometimes forbidden. The problem is only compounded when the military attempts to use the new CI/NDI equipment overseas because of the differences in spectrum allocation tables among countries.

B.5.2 INTER-PLATFORMS/EQUIPMENT EMC

Operational problems resulting from the adverse effects of electromagnetic energy from one platform/equipment to another are well documented. These problems underscore the importance of providing the Warfighter with platforms/equipment that are compatible with their operational EME. Joint-Service operations further increase the potential for safety and reliability problems, particularly if the platforms/equipment are exposed to an operational EME different from those for which they were designed and tested. For example, Army platforms/systems designed to operate in a land EME may be adversely affected by exposure to a Navy shipboard environment that may be encountered in a joint operation.

In addition, the worldwide threat presented by RF emitters is becoming increasingly more serious. Increased multinational military operations, proliferation of both friendly and hostile weapons, and the worldwide expanded use of the spectrum have resulted in operational EMEs not previously encountered. It is therefore essential that these EMEs be defined and used to evaluate inter-platform/equipment performance. The EME in which military platforms/ equipment and associated subsystems must operate is created by a multitude of sources. The contribution of each emitter may be described in terms of its individual characteristics, such as power level, modulation, frequency, bandwidth, antenna gain (main beam and side lobe), antenna scanning, and so forth. These characteristics are important in determining the potential impact on performance. Many threats may be seen infrequently. For example, a high-powered emitter may illuminate a platform/equipment for only a very short time because of its search pattern. Also, it may operate at a frequency where effects are minimized. There are many different EMEs that can be encountered during an item's life cycle. The Joint Spectrum Center has models that can be used to determine the EMI interactions of spectrum-dependent platform equipment. MIL-STD-464 describes various land-based, ship-based, airborne, and battle-space EMEs and provides the non-spectrum-dependent EMI requirements for inter-platform/systems.

Some inter-platform/system EMI testing may be performed under laboratory conditions where the items under test and the simulated EME are controlled. However, undesired responses observed during routine EMI testing might require further analysis to determine the operational impact (or EMV) of the laboratory-observed susceptibility. The results of the EMV analysis and testing guide the possible need for modifications, additional analyses, or testing. The inter-platform/system environment is evaluated to determine which frequencies are of interest from the possible emitters to be encountered when deployed, optimum coupling frequencies, susceptibility of the subsystem/equipment, available simulators, and authorized test frequencies that can be radiated. These evaluations require descriptions of the EM energy, both friendly and hostile, that the item may encounter during its life cycle. Based on these considerations and other unique factors, a finite list of test emitters is derived. For each test emitter, the item is illuminated and evaluated for susceptibilities. These tests are usually carried out in specialized test chambers (e.g., mode-stirred chambers, anechoic chambers, OATS) depending on the size of the item being tested.

B.5.3 SPECIAL E3 EVALUATIONS

The following special E3 evaluations are described in MIL-STD-464 and are to be applied on a case-by-case basis, as noted in the ORD and TEMP.

B.5.3.1 Electromagnetic Radiation Hazards

It has been firmly established that sufficiently high electromagnetic fields create electromagnetic radiation hazards (EMR), or RADHAZ, that can cause uncommanded activation of Electrically Initiated Devices (EIDs), cause harm to personnel, and ignite fuel. Precautions must be exercised to ensure that unsafe conditions do not develop. EMR is more precisely defined as follows:

> Hazards caused by a transmitter/antenna installation that generates electromagnetic radiation in the vicinity of ordnance, personnel, or fueling operations in excess of established safe levels or increases the existing levels to a hazardous level; or a personnel, fueling, or ordnance installation located in an area that is illuminated by electromagnetic radiation at a level that is hazardous to the planned operations or occupancy. These hazards will exist when an electromagnetic field of sufficient intensity is generated to: a. Induce or otherwise couple currents and/or voltages of magnitudes large enough to initiate electroexplosive devices or other sensitive explosive components of weapon systems, ordnance, or explosive devices. b. Cause harmful or injurious effects to humans and wildlife. c. Create sparks having sufficient magnitude to ignite flammable mixtures of materials that must be handled in the affected area. **(**Joint Pub. 1-02)

B.5.3.1.1 HERO

Ordnance includes weapons, rockets, explosives, EIDs, squibs, flares, igniters, explosive bolts, electric primed cartridges, destructive devices, and jet-assisted take-off bottles. Adequate measures must be taken to protect these devices from EM energy, and the effectiveness of these measures must be verified to ensure safety and effective operational performance.

HERO testing should, first, include exposure of the ordnance to the test EME in all life-cycle configurations, including packaging, handling, storage, transportation, checkout, loading and unloading, and launch from the host platform/system to determine its susceptibility characteristics. The ordnance should be exposed to the test EME while being exercised with operating procedures associated with the aforementioned configurations. Verification methods must show that the ordnance device will not inadvertently operate, initiate, or be dudded. Methods used to determine HERO susceptibility characteristics require instrumenting the device using any number of possible techniques, such as thermocouple and fiber-optic temperature sensors, RF voltage or current detectors, temperature-sensitive waxes, or substitution of more sensitive elements. Such instrumentation must not alter the overall sensitivity or response characteristics of the ordnance. The test EME should simulate the operational EME to the maximum extent possible. This requires appropriate representation of the EME with respect to frequency, field strength or power density, field polarization, and illumination angle. For radar EMEs, representative pulse widths, pulse repetition frequencies, and beam dwell periods should be chosen to maximize response by the ordnance. In the HF range, transmitting antennas should be the same type used to produce the fields in operation. Determination of resonances is a fundamental aspect of HERO testing. Where possible, swept-frequency testing is the preferred means of determining resonance frequencies. Mode-stirred (reverberation) chambers can be used effectively for low-level swept-frequency evaluations. Follow-on testing at discrete, high-level EMEs is recommended to determine actual susceptibility thresholds.

After the susceptibility characteristics of the ordnance are ascertained, the platform/system operational EME must be determined to ensure that potentially hazardous EM levels are not present in areas where ordnance may be stored, handled, or used. Appendix A to MIL-STD-464 should be consulted for detailed rationale, guidance, and procedures to conduct HERO evaluations. Final HERO reports should be submitted to JSC for inclusion of the data into the JSC Ordnance E3 Risk Assessment Database (JOERAD), which is used by the Warfighter to make HERO risk assessments.

B.5.3.1.2 HERP

Radar and other high-power RF transmitters usually present the greatest potential personnel hazard because of their high output powers and their operating frequencies, antenna characteristics, and possible exposure of servicing personnel. Personnel assigned to repair, maintenance, and test facilities have a higher potential for being overexposed because of the variety of tasks, the proximity to radiating elements, and the pressures for rapid maintenance response. A HERP evaluation should be performed to determine safe distances for personnel from RF emitters. Safe distances can be determined from calculations based on RF emitter characteristics or through measurement. Once a distance has been determined, an inspection is required of areas where personnel have access, together with the antenna's pointing characteristics. If personnel have access to hazardous areas, appropriate measures must be taken, such as warning signs and precautions in servicing publications, guidance manuals, operating manuals, and the like. The safety tolerance levels for electromagnetic radiation to personnel are defined in DoDD 6055.11.

Before a measurement survey is performed, calculations should be made to determine distances for starting measurements to avoid hazardous exposures to survey personnel and to prevent

damage to instruments. Safe distance calculations are often based on the assumption that far-field conditions exist for the antenna. The applicable Service publication should be consulted for techniques to calculate the safe distances and for calculating the gain of certain types of antennas. Since hazard criteria are based primarily on average power density and field strength levels, caution needs to be exercised with the probes used for measurements because they have peak power limits above which burnout of probe-sensing elements may occur. When multiple emitters are present and the emitters are not phase coherent, as is usually the case, the resultant power density is additive. This effect needs to be considered for both calculation and measurement approaches. In addition to the main beam hazard, localized hot spots may be produced by reflections of the transmitted energy off of any metal structure.

B.5.3.1.3 HERF

Fuel (and other volatile) vapors can be ignited from an arc induced by a strong RF field. The existence and extent of a fuel hazard are determined by comparing the actual power density to an established safety standard. The volatility and flash points of particular fuels influence whether there is a hazard under varying EME conditions. The amount of current, and thus the strength of a spark across a gap between two conductors, depends on both the field intensity of the energy and how well the conductors act as a receiving antenna. Many parts of a platform/system, a refueling vehicle, and static grounding conductors can act as receiving antennas. RF energy can induce currents into any metal object. The induced current depends, mainly, on the conductor length in relation to the wavelength of the energy and the orientation in the radiated field. It is neither feasible to predict, nor control, these factors. The hazard criteria are, therefore, based on the assumption that an ideal receiving antenna could be inadvertently created with the required spark gap. Safety regarding RF hazards to fuels must be verified. Verification by inspection and analysis is usually done, with testing limited to special circumstances. T.O. 31Z-10-4 and OP 3565 provide procedures for determining safe operating distances. An important issue is that fuel hazard criteria are based on peak power, while personnel hazard criteria are based, primarily, on average power. Any area on a platform/system where fuel vapors may be present needs to be evaluated. Restrictions on the use of some transmitters may be necessary to ensure safety under certain operational conditions, such as refueling operations.

B.5.3.2 Lightning

Lightning is hazardous to platforms/systems and provisions for lightning protection have been incorporated in the design of the platform/system and its subsystem/equipment. Lightning effects can be direct (physical) or indirect (electromagnetic). Direct effects such as burning and eroding, blasting, and structural damage are visible. Indirect effects result from the interaction of the EM fields with subsystems/equipment within the platform/system.

Verification of lightning requirements is essential to demonstrate that the design protects the platform/system from the lightning threat environment. During development, numerous development tests and analyses are normally conducted to sort out the optimum design. These tests and analyses can be considered part of the verification process and must be properly documented. Many documents are available that describe analysis and test approaches for lightning. These include MIL-STD-464, MIL-STD-1542, MIL-E-4158, FAA Advisory Circular AC 20-136, and the Society of Automotive Engineers SAE AE-4L Committee Report AE4L-87-3.

Flight testing of aircraft may occur prior to verification of lightning protection control. Under this circumstance, the flight test program should include restrictions to prohibit flights within a specified distance from thunderstorms, usually 25 miles. Lightning flashes sometimes occur at great distances from thunderstorm clouds and can occur up to an hour after the storm appears to have left the area.

B.5.3.3 EMP

For most platforms and systems, the operational performance requirements for the platform/system must be met "after" exposure to the EMP field. At the instant of the EMP event, the electrical transients may cause some disruption of performance. However, immediately after the event or within some specified time frame, driven by the platform/system operational performance requirements, the item must function properly. EMP poses a threat only to electrical and electronic subsystems/equipment. There are no structural damage mechanisms; however, EMP-induced arcing of insulators on antenna systems can permanently damage the insulator, disabling the antenna. MIL-STD-188-125 prescribes the minimum performance requirements for systems/facilities, such as ground-based C4I facilities, that must operate through an EMP event with no operational impact to the system/facility. The requirements for the limited number of systems that must operate through the EMP event with no operational impact are contained in MIL-STD-188-125.

For platforms/systems with an EMP requirement, verification is necessary to demonstrate that the control measures implemented provide the required protection. Verification that the platform/system meets EMP requirements in MIL-STD-464 is accomplished by demonstrating that the transient levels at the subsystem/equipment interfaces of mission-critical subsystems/ equipment do not exceed the hardness levels for the individual subsystems/ equipment and that the required design margins have been met. Mission-critical items are those where proper operation is critical or essential to the operation of the platform/system.

Both analysis and test are usually required to verify platform/system performance after being subjected to an EMP level described in MIL-STD-464. Analyses or models are necessary to determine the EMP field that can be coupled into the platform/system. Existing coupling data on similar platforms/systems may be used to estimate the voltages and currents generated by the EMP at each interface of each mission-critical subsystem/equipment. However, the complex geometry of a final platform/system design may be so different from that which was modeled that the electromagnetic behavior can be substantially altered. There are a number of ways to obtain platform/system excitation for purposes such as quality control or hardening evaluation. Testing for EMP may be done using an injection method whereby a pulse current is injected into the penetrating conductors at points outside the platform/system EM shielding barrier. Residual responses are measured and the operation of the mission-critical subsystems/equipment is monitored for upset or damage. For example, in the case of an aircraft, single-point excitation (i.e., electrical connection of a signal source to a physical point on the external structure of the aircraft) can be done in a hangar and can reveal any obvious problems in the airframe shielding. As an alternative, a platform/system-level test can be performed on a functioning platform/ system using a high-level EMP simulator in a controlled test site. The DoD has a number of such sites available for EMP testing.

B.5.3.4 P-Static

As an aircraft in motion encounters dust, rain, snow, and ice, an electrostatic charge is built up on the structure due to P-Static charging. This charge can cause significant voltages to be present that can result in EMI to onboard subsystems/equipment and a shock hazard to personnel either during flight or after landing. The control of static charge accumulation is accomplished during the design and construction of the aircraft and its associated subsystems/equipment. The aircraft must be verified to pose no hazard when exposed to P-Static charging. Conductive coating resistance must be verified to fall within the required range to prevent excessive accumulation of charge. In addition, the metallic and composite structural members should be inspected to verify that they are adequately bonded and that electrically conductive hardware and finishes are used.

APPENDIX C - DD FORM 1494

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APPLICATION FOR EQUIPMENT FREQUENCY ALLOCATION	CLASSIFICATION	DATE	*Form Approved OMB No. 0704-0188*
			PAGE 1 OF PAGES

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS. RETURN COMPLETED FORM TO THE USING AGENCY OR CONTRACTING AGENCY, AS APPROPRIATE.

DOD GENERAL INFORMATION

TO	FROM

1. APPLICATION TITLE

2. SYSTEM NOMENCLATURE

3. STAGE OF ALLOCATION *(X one)*

☐ a. STAGE 1 - CONCEPTUAL ☐ b. STAGE 2 - EXPERIMENTAL ☐ c. STAGE 3 - DEVELOPMENTAL ☐ d. STAGE 4 - OPERATIONAL

4. FREQUENCY REQUIREMENTS

a. FREQUENCY(IES)

b. EMISSION DESIGNATOR(S)

5. TARGET STARTING DATE FOR SUBSEQUENT STAGES

a. STAGE 2	b. STAGE 3	c. STAGE 4

6. EXTENT OF USE

7. GEOGRAPHICAL AREA FOR

a. STAGE 2

b. STAGE 3

c. STAGE 4

8. NUMBER OF UNITS

a. STAGE 2	b. STAGE 3	c. STAGE 4

9. NUMBER OF UNITS OPERATING SIMULTANEOUSLY IN THE SAME ENVIRONMENT

10. OTHER J/F 12 APPLICATION NUMBER(S) TO BE	11. IS THERE ANY OPERATIONAL REQUIREMENT AS DESCRIBED IN THE INSTRUCTIONS FOR PARAGRAPH 11?
☐ a. SUPERSEDED J/F 12/	☐ a. YES ☐ b. NO ☐ c. NAvail
☐ b. RELATED J/F 12/	

12. NAMES AND TELEPHONE NUMBERS

a. PROGRAM MANAGER	(1) COMMERCIAL	(2) AUTOVON
b. PROJECT ENGINEER	(1) COMMERCIAL	(2) AUTOVON

13. REMARKS

DOWNGRADING INSTRUCTIONS	CLASSIFICATION	

DD FORM 1494, AUG 96 (EG) PREVIOUS EDITION MAY BE USED. Designed using Perform Pro, WHS/DIOR, Aug 96

INSTRUCTIONS FOR COMPLETING DD FORM 1494, "APPLICATION FOR EQUIPMENT FREQUENCY ALLOCATION"

GENERAL INFORMATION

CLASSIFICATION: This form must be classified in accordance with appropriate agency security directions. Downgrading instructions must be indicated. The highest classification for each item or sub- item as required must be indicated by a (U), (C), or (S) alongside the item or sub-item title, for classified applications.

APPLICATION PURPOSE: This is an application for development or procurement of equipment with RF emitters. It is not a frequency assignment request for operation of RF emitters. Funds must not be obligated prior to the approval of an application for frequency allocation.

DATA REQUIREMENT: All applicable data items shall be submitted for all stages. Estimated values or ranges of values may be submitted for Stage 1 and 2 in the absence of calculated or measured values and shall be annotated (EST). Values for Stages 3 and 4 should be measured.

STANDARDS: Technical parameters of the application will be evaluated against the appropriate DoD, National and International EMC standards.

REMARKS ITEMS: Use the remarks item located at the bottom of each page of the form to amplify or clarify the entries. Add continuation pages as required.

ABBREVIATIONS:

Hertz	Hz	microseconds	usec
kilohertz	kHz	decibel	dB
megahertz	MHz	dB isotropic	dBi
gigahertz	GHz	pulses per second	pps
milliwatt	mW	parts per million	ppm
watt	W	peak envelope power	PEP
nanoseconds	nsec	not applicable	NA
National Telecommunications & Information Administration	NTIA	not available	NAvail
		occupied bandwidth	OC-BW

HOW TO ASSEMBLE THE FORM:

FOR US COORDINATION:

1. DoD General Information Page
2. Transmitter Page(s)
3. Receiver Page(s)
4. Antenna Page(s)
5. Line Diagram(s)
6. Space Systems Data, if applicable
7. Continuation Page(s) (cross reference pages)
8. NTIA General Information Page

FOR FOREIGN COORDINATION: If this form is used to obtain foreign national frequency supportability comments, see the instructions on the back of the Foreign Coordination General Information Page.

DOD GENERAL INFORMATION PAGE

ITEM 1 - Application Title. Enter the Government nomenclature of the equipment, or the manufacturer's name and model number, and a short descriptive title.

ITEM 2 - System Nomenclature. Enter the nomenclature of the system for which this equipment is a subsystem, e.g., PATRIOT or Global Positioning System.

ITEM 3 - Stage of Allocation. Mark the appropriate block using the following NTIA definitions.

Stage 1 - Conceptual. The initial planning effort has been completed, including proposed frequency bands and other available characteristics.

Stage 2 - Experimental. The preliminary design has been completed, and radiation, using test equipment or preliminary models, may be required.

Stage 3 - Developmental. The major design has been completed, and radiation may be required during testing.

Stage 4 - Operational. Development has been essentially completed, and final operating constraints or restrictions required to assure compatibility need to be identified.

ITEM 4 - Frequency Requirements.

a. Enter the required frequency band(s). For equipment designed to operate only at a single frequency, enter this frequency. Indicate units, e.g., kHz, MHz, or GHz.

b. Enter the emission designator(s) including the necessary bandwidth for each designator, as described in Chapter 9 of the NTIA Manual e.g., 40M0PON. Identify each mode as hopping or non-hopping, e.g. 64M0F3E (Hopping).

Enter in Item 13, "Remarks," any other information pertinent to frequency requirements, such as minimum frequency separation or special relationships involving multiple discrete frequencies.

ITEM 5 - Target Starting Date for Subsequent Stages. Enter proposed date of application submission for each subsequent stage.

ITEM 6 - Extent of Use. Describe extent of use that will apply to Stage 4, e.g., continuous or intermittent. If intermittent, provide information including the expected number of hours of operation per day or other appropriate time period; scheduling capability; and any conditions governing the times of intermittent use, e.g., used only during terminal guidance phase, used only as required for calibration of test range equipment.

ITEM 7 - Geographical Area. Enter geographical location(s) or area(s) of use for this and subsequent stage(s), e.g., Gillilan Plant, Los Angeles, California, and White Sands Missile Range, New Mexico (Stage 2); US&P (Stage 3); US&P, NATO Countries and Korea (Stage 4). Provide geographical coordinates (degrees, minutes, seconds) if available.

ITEM 8 - Number of Units. Enter total number of units planned for the stage review requested and the subsequent stages.

ITEM 9 - Number of Units Operating Simultaneously in the Same Environment. Enter maximum number of these units planned to be operating simultaneously in the same environment during Stage 4 use.

ITEM 10 - Other J/F 12 Application Number(s). Mark appropriate block(s) and enter J/F 12 number(s) for superseded and/or related application(s).

ITEM 11 - Operational Requirement. If this equipment will operate with the same or similar equipment used by other US Military Services, DoD Components, US Government Agencies or Allied Nations, mark "Yes," and specify in Item 13, "Remarks," the Services, Agencies or countries (to include the country's services).

ITEMS 12 and 13 - Self-explanatory.

CLASSIFICATION	PAGE

TRANSMITTER EQUIPMENT CHARACTERISTICS

1. NOMENCLATURE, MANUFACTURER'S MODEL NO.	2. MANUFACTURER'S NAME
3. TRANSMITTER INSTALLATION	4. TRANSMITTER TYPE
5. TUNING RANGE	6. METHOD OF TUNING
7. RF CHANNELING CAPABILITY	8. EMISSION DESIGNATOR(S)
9. FREQUENCY TOLERANCE	
10. FILTER EMPLOYED *(X one)* ☐ a. YES ☐ b. NO	
11. SPREAD SPECTRUM *(X one)* ☐ a. YES ☐ b. NO	12. EMISSION BANDWIDTH *(X and complete as applicable)* ☐ CALCULATED ☐ MEASURED
13. MAXIMUM BIT RATE	a. -3 dB
	b. -20 dB
14. MODULATION TECHNIQUES AND CODING	c. -40 dB
	d. -60 dB
	e. OC-BW
	15. MAXIMUM MODULATION FREQUENCY
16. PRE-EMPHASIS *(X one)* ☐ a. YES ☐ b. NO	17. DEVIATION RATIO
	18. PULSE CHARACTERISTICS
19. POWER	a. RATE
a. MEAN	b. WIDTH
b. PEP	c. RISE TIME
20. OUTPUT DEVICE	d. FALL TIME
	e. COMP RATIO
	21. HARMONIC LEVEL
22. SPURIOUS LEVEL	a. 2ND
	b. 3RD
23. FCC TYPE ACCEPTANCE NO.	c. OTHER
24. REMARKS	

CLASSIFICATION	

DD FORM 1494, AUG 96

INSTRUCTIONS FOR COMPLETING DD FORM 1494, "APPLICATION FOR EQUIPMENT FREQUENCY ALLOCATION" TRANSMITTER EQUIPMENT CHARACTERISTICS PAGE

ITEM 1 - Nomenclature, Manufacturer's Model No. Enter the Government assigned alphanumeric equipment designation. If above is not available, enter the manufacturer's model number, e.g., MT 502, and complete item 2. If above is not available, enter a short descriptive title, e.g., ATS-6 telemetry transmitter.

ITEM 2 - Manufacturer's Name. Enter the manufacturer's name if available. If a manufacturer's model number is listed in item 1, this item must be completed.

ITEM 3 - Transmitter Installation. List specific type(s) of vehicle(s), ship(s), plane(s) or building(s), etc., where the transmitter(s) will be installed.

ITEM 4 - Transmitter Type. Enter the generic class of the trans- mitter, e.g., Frequency Scan, Scan While Track Radar, Monopulse Tracker, AM or FM Communications.

ITEM 5 - Tuning Range. Enter the frequency range through which the transmitter is capable of being tuned, e.g., 225-400 MHz. For equipment designed to operate only at a single frequency, enter this frequency. Indicate units, e.g., kHz, MHz or GHz.

ITEM 6 - Method of Tuning. Enter the method of tuning, e.g., crystal, synthesizer or cavity. If the equipment is not readily tunable in the field, indicate in item 24, "Remarks," the complexity of tuning. Include complexity factors such as skill levels involved, major assemblies involved, time required, and location (factory or depot) where equipment is to be tuned.

ITEM 7 - RF Channeling Capability. Describe the RF channeling capability. For uniformly spaced channels, enter the center frequency of the first channel and channel spacing e.g., first channel 406 MHz, 100 kHz increments; for continuous tuning, enter the lowest frequency and the word "continuous;" for others, such as SSB or cases where a channel selection is under software control, enter a detailed description in item 24, "Remarks." Any constraints on using any of these channels must be described in item 24, "Remarks," e.g., degraded channels, internal hardwiring limitations or lockout capability for frequency hopping systems.

ITEM 8 - Emission Designator(s). Enter the emission designator(s) including the necessary bandwidth for each designator as described in Chapter 9 of the NTIA Manual, e.g., 16K0F3E. For systems with a frequency hopping mode as well as a non-hopping mode enter the emission designators for each mode. Identify each mode as hopping or non-hopping.

ITEM 9 - Frequency Tolerance. Enter the frequency tolerance, i.e., the maximum departure of a transmitter from its assigned frequency after normal warm-up time has been allowed. Indicate the units in parts per million (ppm) for all emission types except single sideband which shall be indicated in Hertz (Hz).

ITEM 10 - Filter Employed. Mark the appropriate block. Provide the characteristics of any filter used in item 24, "Remarks."

ITEM 11 - Spread Spectrum. Mark the appropriate block. If "Yes," see instructions for item 14.

ITEM 12 - Emission Bandwidth. Enter the emission bandwidths for which the transmitter is designed at the -3, -20, and -60 dB levels and the occupied bandwidth. The bandwidth at -40 dB shall also be entered for pulse radar transmitters. The emission bandwidth is defined as that appearing at the antenna terminals and includes any significant attenuation contributed by filtering in the output circuit or transmission lines. Values of emission bandwidth specified should be indicated as calculated or measured by marking the appropriate block. Indicate units used, e.g., Hz, kHz or MHz. Note that the Occupied Bandwidth (Item 12.e.) is defined as the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5% of the total mean power radiated.

ITEM 13 - Maximum Bit Rate. Enter the maximum information bit rate for digital equipment, in bits per second. If spread spectrum is used, enter the bit rate after encoding.

ITEM 14 - Modulation Techniques and Coding. Describe in detail the modulation and/or coding techniques employed. For complex modulation schemes such as direct sequence spread spectrum, frequency hopping, frequency agile, etc., enter full details in Item 24, "Remarks."

ITEM 15 - Maximum Modulation Frequency. For frequency or phase modulated transmitter enter the maximum modulation or baseband frequency. This frequency is assumed to be the frequency at -3 dB point on the high frequency side of the modulator response curve. Indicate the units, e.g., Hz, kHz or MHz.

ITEM 16 - Pre-emphasis. For frequency or phase modulated transmitters mark the appropriate block to indicate whether pre-emphasis is available.

ITEM 17 - Deviation Ratio. For frequency or phase modulated transmitter enter the deviation ratio computed with the formula:

$$\text{Deviation Ratio} = \frac{\text{Maximum Frequency Deviation}}{\text{Maximum Modulation Frequency}}$$

ITEM 18 - Pulse Characteristics. For pulse modulated transmitters:

a. Enter the pulse repetition rate in pulses per second (pps).

b. Enter the pulse width at the half voltage levels in microseconds (usec).

c. Enter the pulse rise time in microseconds (usec). This is the time duration for the leading edge of the voltage pulse to rise from 10% to 90% of its peak amplitude.

d. Enter the pulse fall time in microseconds (usec). This is the time duration for the trailing edge of the voltage pulse to fall from 90% to 10% of its peak amplitude.

e. Enter the maximum pulse compression ratio, if applicable.

ITEM 19 - Power. Enter the mean power delivered to the antenna terminals for all AM and FM emissions, or the peak envelope power (PEP) for all other classes of emissions. If there are any unique situations such as interrupted CW, provide details in Item 24, "Remarks." Indicate the units, e.g., W or kW.

ITEM 20 - Output Device. Enter a description of the device used in the transmitter output stage, e.g., ceramic diode, reflex klystron, transistor or TWT.

ITEM 21 - Harmonic Level. Enter the harmonic level in dB relative to the fundamental of the 2nd and 3rd harmonics. Enter in item c. the relative level in dB of the highest powered harmonic above the 3rd.

ITEM 22 - Spurious Level. Enter the maximum value of spurious emission in dB relative to the fundamental which occurs outside the -60 dB point on the transmitter fundamental emission spectrum (Item 12) and does not occur on a harmonic of the fundamental frequency.

ITEM 23 - FCC Type Acceptance No. Enter the FCC type acceptance number if applicable.

CLASSIFICATION	PAGE

RECEIVER EQUIPMENT CHARACTERISTICS

1. NOMENCLATURE, MANUFACTURER'S MODEL NO.	2. MANUFACTURER'S NAME
3. RECEIVER INSTALLATION	4. RECEIVER TYPE
5. TUNING RANGE	6. METHOD OF TUNING
7. RF CHANNELING CAPABILITY	8. EMISSION DESIGNATOR(S)
9. FREQUENCY TOLERANCE	

10. IF SELECTIVITY	1ST	2ND	3RD
a. -3 dB			
b. -20 dB			
c. -60 dB			

11. RF SELECTIVITY *(X and complete as applicable)*

☐ CALCULATED ☐ MEASURED

a. -3 dB
b. -20 dB
c. -60 dB
d. PRESELECTION TYPE

12. IF FREQUENCY	13. MAXIMUM POST DETECTION FREQUENCY
a. 1ST	
b. 2ND	14. MINIMUM POST DETECTION FREQUENCY
c. 3RD	

15. OSCILLATOR TUNED	1ST	2ND	3RD
a. ABOVE TUNED FREQUENCY			
b. BELOW TUNED FREQUENCY			
c. EITHER ABOVE OR BELOW TUNED FREQUENCY			

16. MAXIMUM BIT RATE

17. SENSITIVITY

a. SENSITIVITY dBm
b. CRITERIA
c. NOISE FIG dB
d. NOISE TEMP Kelvin

18. DE-EMPHASIS *(X one)*

☐ a. YES ☐ b. NO

19. IMAGE REJECTION	20. SPURIOUS REJECTION

21. REMARKS

CLASSIFICATION	

DD FORM 1494, AUG 96

INSTRUCTIONS FOR COMPLETING DD FORM 1494, "APPLICATION FOR EQUIPMENT FREQUENCY ALLOCATION" RECEIVER EQUIPMENT CHARACTERISTICS PAGE

ITEM 1 - Nomenclature, Manufacturer's Model No. Enter the Government assigned alphanumeric equipment designation. If above is not available, enter the manufacturer's model number, e.g., MIT 502, and complete Item 2. If above is not available, enter a short descriptive title, e.g., GPS Receiver, Director Station RX.

ITEM 2 - Manufacturer's Name. Enter the manufacturer's name if available. If a manufacturer's model number is listed in Item 1, this item must be completed.

ITEM 3 - Receiver Installation. List specific type(s) of vehicle(s), ship(s), plane(s) or building(s), etc., where the receiver(s) will be installed.

ITEM 4 - Receiver Type. Enter the generic class, e.g., Dual Conversion Superheterodyne or Homodyne.

ITEM 5 - Tuning Range. Enter the frequency range through which the receiver is capable of being tuned, e.g., 225-400 MHz. For equipment designed to operate only at a single frequency, enter this frequency. Indicate units, e.g., kHz, MHz or GHz.

ITEM 6 - Method of Tuning. Enter the method of tuning, e.g., crystal, synthesizer or cavity. If the equipment is not readily tunable in the field, indicate in Item 21, "Remarks," the complexity of tuning. Include complexity factors such as skill levels involved, major assemblies involved, time required, and location (factory or depot) where equipment is to be tuned.

ITEM 7 - RF Channeling Capability. Describe the RF channeling capability. For uniformly spaced channels, enter the center frequency of the first channel and channel spacing e.g., first channel 406 MHz, 100 kHz increments; for continuous tuning, enter the lowest frequency and the word "continuous;" for others, including cases where channel selection is under software control, enter a detailed description in Item 21, "Remarks."

ITEM 8 - Emission Designator(s). Enter the emission designator(s) including the necessary bandwidth(s) for each designator, e.g., 16K0F3E. For systems with a frequency hopping mode as well as a non-hopping mode enter the emission designators for each mode.

ITEM 9 - Frequency Tolerance. Enter the frequency tolerance, i.e., the maximum departure of a receiver from its assigned frequency after normal warm-up time has been allowed. Indicate the units in parts per million (ppm) for all emission types except single sideband which shall be indicated in Hertz (Hz).

ITEM 10 - IF Selectivity. Enter the bandwidth for each IF stage at the -3, -20 and -60 dB levels. Indicate units, e.g., kHz or MHz.

ITEM 11 - RF Selectivity. Enter the bandwidth at the -3, -20 and -60 dB levels. The RF bandwidth includes any significant attenuation contributed by filtering in the input circuit or transmission line. Values of RF bandwidths specified should be indicated as calculated or measured by marking the appropriate block. Indicate units, e.g., kHz or MHz. Enter the preselection type, e.g., tunable cavity.

ITEM 12 - IF Frequency. Enter the tuned frequency of the first, second and third IF stages. Indicate units, e.g., kHz or MHz.

ITEM 13 - Maximum Post Detection Frequency. Enter the maximum post detection frequency. This is the nominal frequency at the -3 dB point on the high frequency side of the receiver base band. Indicate units, e.g., kHz or MHz.

ITEM 14 - Minimum Post Detection Frequency. For multichannel FM systems enter the minimum post detection frequency. This is the nominal frequency at the -3 dB point on the low frequency side of the receiver base band. Indicate units, e.g., kHz or MHz.

ITEM 15 - Oscillator Tuned. Mark the appropriate block to indicate the location of the 1st, 2nd and 3rd oscillator frequencies with respect to the associated mixer input signal.

ITEM 16 - Maximum Bit Rate. Where applicable, enter the maximum bit rate (bps) that can be used. If spread spectrum is used, enter the bit rate after encoding. Describe any error detecting/correcting codes in Item 21, "Remarks."

ITEM 17 - Sensitivity.

a. Enter the sensitivity in dBm.

b. Specify criteria used, e.g., 12 dB SINAD (Signal to Interference plus Noise and Distortion).

c. If the receiver is used with terrestrial systems, enter the receiver noise figure in dB.

d. If the receiver is used with space or satellite earth stations, enter the receiver noise temperature in Kelvin.

ITEM 18 - De-emphasis. For frequency or phase modulated receivers mark the appropriate block to indicate whether de-emphasis is available.

ITEM 19 - Image Rejection. Enter the image rejection in dB. Image rejection is the ratio of the image frequency signal level required to produce a specified output, to the desired signal level required to produce the same output.

ITEM 20 - Spurious Rejection. Enter the spurious rejection in dB. Enter the single level of spurious rejection that the receiver meets or exceeds at all frequencies outside the -60 dB IF bandwidth. Spurious rejection is the ratio of a particular out-of-band frequency signal level required to produce a specified output, to the desired signal level required to produce the same output.

CLASSIFICATION	PAGE

ANTENNA EQUIPMENT CHARACTERISTICS

1. ☐ a. TRANSMITTING ☐ b. RECEIVING ☐ c. TRANSMITTING AND RECEIVING

2. NOMENCLATURE, MANUFACTURER'S MODEL NO.	3. MANUFACTURER'S NAME
4. FREQUENCY RANGE	5. TYPE
6. POLARIZATION	7. SCAN CHARACTERISTICS
	a. TYPE
8. GAIN	b. VERTICAL SCAN
a. MAIN BEAM	(1) MAX ELEV
	(2) MIN ELEV
b. 1ST MAJOR SIDE LOBE	(3) SCAN RATE
9. BEAMWIDTH	c. HORIZONTAL SCAN
a. HORIZONTAL	(1) SECTOR SCANNED
	(2) SCAN RATE
b. VERTICAL	d. SECTOR BLANKING *(X one)* ☐ (1) YES ☐ (2) NO

10. REMARKS

CLASSIFICATION	

DD FORM 1494, AUG 96

INSTRUCTIONS FOR COMPLETING DD FORM 1494, "APPLICATION FOR EQUIPMENT FREQUENCY ALLOCATION" ANTENNA EQUIPMENT CHARACTERISTICS PAGE

ITEM 1 - Function. Mark the appropriate block to indicate the type of function the antenna performs. For multi-antenna system, use one page for each antenna.

ITEM 2 - Nomenclature, Manufacturer's Model No. Enter the Government assigned alphanumeric equipment designation. If above is not available, enter the manufacturer's model number, e.g., DS6558, and complete Item 3. If above is not available, enter a short descriptive title, e.g., ATS-6 telemetry antenna.

ITEM 3 - Manufacturer's Name. Enter the manufacturer's name if available. If a manufacturer's model number is listed in Item 2, this item must be completed.

ITEM 4 - Frequency Range. Enter the range of frequencies for which the antenna is designed. Indicate units, e.g., kHz or MHz.

ITEM 5 - Type. Enter the generic name or describe general technical features, e.g., Horizontal Log Periodic, Cassegrain with Polarization Twisting, Whip, Phased Array or Conformal Array.

ITEM 6 - Polarization. Enter the polarization; if circular, indicate whether it is right or left hand.

ITEM 7 - Scan Characteristics.

a. If this antenna scans, enter the type of scanning, e.g., vertical, horizontal, vertical and horizontal.

b. (1) Enter the maximum elevation angle in degrees (positive or negative referenced to the horizontal) that the antenna can scan.

(2) Enter the minimum elevation angle in degrees (positive or negative referenced to the horizontal) that the antenna can scan.

(3) Enter the vertical scan rate in scans per minute.

c. (1) Enter the angular scanning range in scans per minute.

(2) Enter the horizontal scanning rate in scans per minute.

d. Indicate if antenna is capable of sector blanking. If yes, enter details in item 10, "Remarks."

ITEM 8 - Gain.

a. Enter the maximum gain in dBi.

b. Enter the nominal gain of the first major side lobe of the main beam in dBi and the angular displacement from the main beam in degrees.

ITEM 9 - Beamwidth. Enter the 3 dB beamwidth in degrees.

ITEM 10 - Remarks. Use this item to describe any unusual characteristics of the antenna, particularly as they relate to the assessment of electromagnetic compatibility. Use this item to amplify or clarify any of the information provided above.

APPLICATION FOR SPECTRUM REVIEW	CLASSIFICATION	PAGE

NTIA GENERAL INFORMATION

1. APPLICATION TITLE

2. SYSTEM NOMENCLATURE

3. STAGE OF ALLOCATION *(X one)*

☐ a. STAGE 1 - CONCEPTUAL ☐ b. STAGE 2 - EXPERIMENTAL ☐ c. STAGE 3 - DEVELOPMENTAL ☐ d. STAGE 4 - OPERATIONAL

4. FREQUENCY REQUIREMENTS

a. FREQUENCY(IES)

b. EMISSION DESIGNATOR(S)

5. PURPOSE OF SYSTEM, OPERATIONAL AND SYSTEM CONCEPTS (WARTIME USE) *(X one)* ☐ a. YES ☐ b. NO

6. INFORMATION TRANSFER REQUIREMENTS

7. ESTIMATED INITIAL COST OF THE SYSTEM

8. TARGET DATE FOR

a. APPLICATION APPROVAL	b. SYSTEM ACTIVATION	c. SYSTEM TERMINATION

9. SYSTEM RELATIONSHIP AND ESSENTIALITY

10. REPLACEMENT INFORMATION

11. RELATED ANALYSIS AND TEST DATA

12. NUMBER OF MOBILE UNITS

13. GEOGRAPHICAL AREA FOR

a. STAGE 2

b. STAGE 3

c. STAGE 4

14. LINE DIAGRAM *(See Page(s))*	15. SPACE SYSTEMS *(See Page(s))*
16. TYPE OF SERVICE(S) FOR STAGE 4	17. STATION CLASS(ES) FOR STAGE 4

18. REMARKS

DOWNGRADING INSTRUCTIONS	CLASSIFICATION	

DD FORM 1494, AUG 96

INSTRUCTIONS FOR COMPLETING DD FORM 1494, "APPLICATION FOR EQUIPMENT FREQUENCY ALLOCATION" NTIA GENERAL INFORMATION PAGE

ITEM 1 - Application Title. Enter the Government nomenclature of the equipment, or the manufacturer's name and model number, and a short descriptive title.

ITEM 2 - System Nomenclature. Enter the nomenclature of the system for which this equipment is a subsystem, e.g., PATRIOT or Global Positioning System.

ITEM 3 - Stage of Allocation. Mark appropriate block.

ITEM 4 - Frequency Requirements.

a. Enter the required frequency bands. For equipment designed to operate only at a single frequency, enter this frequency. Indicate units, e.g., kHz, MHz, or GHz.

b. Enter the emission designators including the necessary bandwidth for each designator, as described in Chapter 9 of the NTIA Manual e.g., 40M0PON.

Enter in Item 18, "Remarks," any other information pertinent to frequency requirements, such as minimum frequency separation for full duplex links or repeaters; or special relationships involving multiple discrete frequencies.

ITEM 5 - Purpose of System, Operational and System Concepts. Enter a summary description of the function of the system or subsystem, e.g., collect and disseminate meteorological data using satellite techniques; transmission of radar data for air traffic control; a remote control of ATC radars; provide for the transmission and reception of digital voice and data by means of LOS or tropo modes of propagation; provide navigational signal from which a broad spectrum of users are able to derive navigation data. Also include information on operational and system concepts. Mark whether the system has a wartime function.

ITEM 6 - Information Transfer Requirements. Enter the required character rate, data rates, circuit quality, reliability, etc.

ITEM 7 - Estimated Initial Cost of the System. This item is for information to show the general size and complexity of the system. It is not intended to be a determining factor in system review. For Stage 2 enter research cost, for Stage 3 enter development cost, for Stage 4 enter unit cost of equipment and expected number of equipments/systems to be procured.

ITEM 8 - Target Date. For the stage review requested, enter the appropriate dates. Funds must not be obligated prior to the approval of this application. If foreign coordination is not required, then approximately one year must be allowed for application approval. If foreign coordination is required, approximately two years must be allowed for application approval.

ITEM 9 - System Relationship and Essentiality. Enter the essentiality and a statement of the relationship between the proposed system and the operational function it is intended to support.

ITEM 10 - Replacement Information. Identify existing system(s) which may be replaced by the proposed system. State any known additional frequency requirements.

ITEM 11 - Related Analysis and/or Test Data. Identify reports that can be made available documenting previous EMC studies, predictions, analyses, or prototype EMC testing that are relevant to the assessment of the system under review.

ITEM 12 - Number of Units. (For mobile systems) - Self explanatory.

ITEM 13 - Geographical Area. Enter geographical location(s) or area(s) of use for this and subsequent stage(s), e.g., Gilfillan Plant, Los Angeles, California, and White Sands Missile Range, New Mexico (Stage 2); US&P (Stage 3); US&P, NATO Countries and Korea (Stage 4). Provide geographical coordinates (degrees, minutes, seconds) if available.

ITEM 14 - Line Diagram. Enter the page number of the line diagram(s). Attach as another page the line diagram showing the links, direction of transmis- sions, frequency band(s), and associated equipment with J/F 12 numbers.

ITEM 15 - Space Systems. Enter the page number of the space system data. Attach as another page the space system data as described in the NTIA Manual, Paragraph 8.3.7. Data Requirement.

ITEM 16 - Type of Service(s) for Stage 4. Enter the appropriate type of service(s) that applies or will apply to the equipment in the operational stage (Stage 4), as described in Chapter 6, Table of Services, Station Classes, and Stations of the NTIA Manual. If the service is not in accordance with the allocation tables full justification must be entered.

ITEM 17 - Station Class(es) for Stage 4. Enter the appropriate station class(es) as described in Chapter 6 of the NTIA Manual.

DD FORM 1494, AUG 96 — NTIA General Information Page (Back)

APPLICATION FOR FOREIGN SPECTRUM SUPPORT	CLASSIFICATION	PAGE

FOREIGN COORDINATION GENERAL INFORMATION

1. APPLICATION TITLE

2. SYSTEM NOMENCLATURE

3. STAGE OF ALLOCATION *(X one)*

☐ a. STAGE 1 - CONCEPTUAL ☐ b. STAGE 2 - EXPERIMENTAL ☐ c. STAGE 3 - DEVELOPMENTAL ☐ d. STAGE 4 - OPERATIONAL

4. FREQUENCY REQUIREMENTS

a. FREQUENCY(IES)

b. EMISSION DESIGNATOR(S)

5. PROPOSED OPERATING LOCATIONS OUTSIDE US&P

6. PURPOSE OF SYSTEM, OPERATIONAL AND SYSTEM CONCEPTS

7. INFORMATION TRANSFER REQUIREMENTS

8. NUMBER OF UNITS OPERATING SIMULTANEOUSLY IN THE SAME ENVIRONMENT

9. REPLACEMENT INFORMATION

10. LINE DIAGRAM *(See Page(s))*	11. SPACE SYSTEMS *(See Page(s))*

12. PROJECTED OPERATIONAL DEPLOYMENT DATE

13. REMARKS

DOWNGRADING INSTRUCTIONS	CLASSIFICATION	

DD FORM 1494, AUG 96

INSTRUCTIONS FOR COMPLETING DD FORM 1494, "APPLICATION FOR EQUIPMENT FREQUENCY ALLOCATION" FOREIGN COORDINATION GENERAL INFORMATION PAGE

NOTES

1. For equipment intended to be operated outside the US&P foreign disclosure authority is required to coordinate and obtain radio frequency spectrum support from those countries where this equipment may operate. Action must be initiated to obtain foreign disclosure authority in accordance with Military Department regulations and policies for the release of appropriate data to the proposed host nations.

2. Do not complete this page unless you are preparing a foreign coordination version of the DD Form 1494. A foreign coordination version of this form is treated as a completely separate document from a US coordination version, and in general the information content will be different.

3. Frequency allocation processing for US coordination can be initiated without submitting a foreign coordination version of the DD Form 1494. In any case, submission of the US coordination version should not be delayed simply because a foreign coordination version has not been completed.

HOW TO ASSEMBLE THE APPLICATION FOR FOREIGN SPECTRUM SUPPORT:

1. Foreign Coordination General Information Page(s).
2. Transmitter Equipment Characteristics Page(s).
3. Receiver Equipment Characteristics Page(s).
4. Antenna Equipment Characteristics Page(s).
5. Continuation Page(s).

FOREIGN COORDINATION GENERAL INFORMATION PAGE

ITEM 1 - Application Title. Enter the Government nomenclature of the equipment, or the manufacturer's name and model number, and a short descriptive title.

ITEM 2 - System Nomenclature. Enter the nomenclature of the system for which this equipment is a subsystem, e.g., PATRIOT or Global Positioning System.

ITEM 3 - Stage of Allocation. Mark the appropriate block.

ITEM 4 - Frequency Requirements.

a. Enter the required frequency band(s). For equipment designed to operate only at a single frequency, enter this frequency. Indicate units, e.g., kHz, MHz, or GHz.

b. Enter the emission designator(s) including the necessary bandwidth for each designator, as described in Chapter 9 of the NTIA Manual e.g., 40M0PON.

Enter in Item 13, "Remarks," any other information pertinent to frequency requirements, such as minimum frequency separation or special relationships involving multiple discrete frequencies.

ITEM 5 - Proposed Operating Locations Outside US&P. Enter host nations, locations or areas of use. Provide geographical coordinates (degrees, minutes, seconds) if available.

ITEM 6 - Purpose of System, Operational and System Concepts. Enter a summary description of the function of the system or subsystem, e.g., collect and disseminate meteorological data using satellite techniques; transmission of radar data for air traffic control; a remote control of ATC radars; provide for the transmission and reception of digital voice and data by means of LOS or tropo modes of propagation; provide navigational signal from which a broad spectrum of users are able to derive navigation data. Also include information on operational and system concepts.

ITEM 7 - Information Transfer Requirements. Enter the required character rate, data rates, circuit quality, reliability, etc.

ITEM 8 - Number of Units Operating Simultaneously in the Same Environment. Enter maximum number of these units which will be operating simultaneously in the same environment, during Stage 4 use.

ITEM 9 - Replacement Information. Identify the existing equipment/system(s) and associated frequency assignments to be replaced by the proposed equipment system(s) where applicable.

ITEM 10 - Line Diagram. Enter the page number of the line diagram(s). Attach as another page the line diagram showing the links, direction of transmissions, frequency band(s), and associated equipment.

ITEM 11 - Space System. Enter the page number of the space system data. Attach as another page the space system data as described in the NTIA Manual, Paragraph 8.3.7. Data Requirements.

ITEM 12 - Projected Operational Deployment Date. Self explanatory.

APPENDIX D - JSC MODELING AND SIMULATION TOOLS

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APPENDIX D - JSC MODELING AND SIMULATION TOOLS [1]

D.1.0 INTRODUCTION

The JSC mission is "to ensure the effective use of the electromagnetic spectrum in support of national security and military objectives." There are three objectives associated with this mission for which modeling and simulation (M&S) and database resources are required: spectrum planning, systems acquisition support, and operational support.

- Spectrum planning services and capabilities support the Warfighter's spectrum requirements by assisting in spectrum policy planning, spectrum certification, and frequency assignment planning.
- Acquisition support services and capabilities optimize the performance of systems in their intended operational electromagnetic environments while minimizing system acquisition cost and schedule.
- Direct operational support to the Warfighter provides spectrum management and interference resolution support to the warfighting commander in chiefs and Military Departments.

Analyses in support of these objectives have as their goal an evaluation of the impact of E3 on Command, Control, Computer, Communications, Intelligence, Surveillance, and Reconnaissance (C4ISR) systems, personnel, ordnance, or fuel. The application of E3 analyses may be to identify optimum spectrum use, operational constraints, or system design alternatives for C4ISR systems. For personnel, ordnance, and fuel, predictions of radiation hazard distances are often required. E3 analyses must identify not only impacts to system performance alone, but also the impact of system performance degradation in military missions (i.e., mission effectiveness). These analysis requirements define the M&S tools the JSC needs.

A taxonomy of JSC M&S resource requirements to support the analysis requirements stated above is depicted in Figure D-1.

D.2.0 MODELS

The tools represented in this taxonomy have various levels of detail, fidelity, and scope. Underneath the top two levels, the models are within the "electromagnetic engineering sciences," which is the JSC's area of subject matter expertise (SME). Analyses performed at the JSC utilize models at any or all levels of this hierarchy, depending on the specific requirements of the analysis. For example, a typical analysis approach may be to use cosite and intersite models to identify those interference issues that require more detailed study, using higher fidelity models. After the results of this detailed study are developed, warfare simulations can identify the impact of potential system performance degradation to mission effectiveness.

[1] The Services have many modeling and simulation tools that are not presented herein. Service data will be added in the next edition of this document.

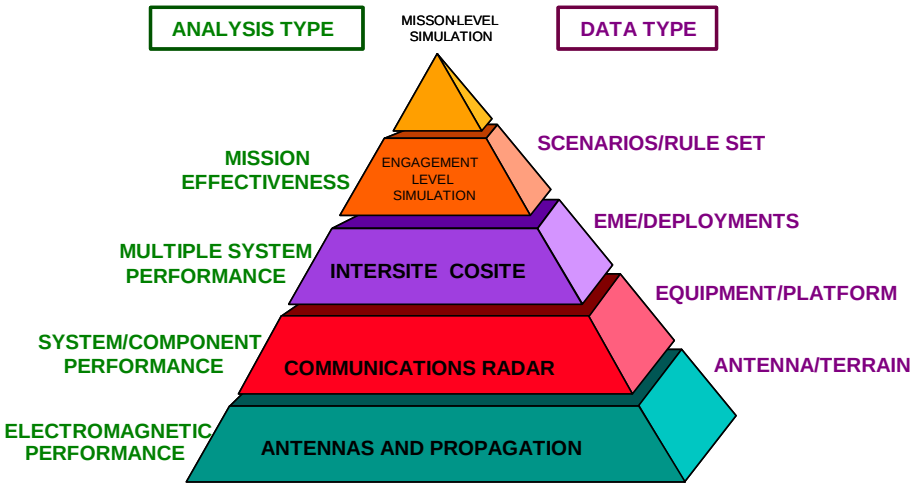

Figure D-1. M&S TAXONOMY

D.2.1 ANTENNA AND PROPAGATION

Antenna and propagation models are required to provide a multi-fidelity capability to predict path loss, antenna characteristics, and electromagnetic coupling. The models in this category include terrain-dependent, smooth-earth, ionospheric, and millimeter wave propagation prediction; linear, reflector, and array antenna near- and far-field gain patterns; and electromagnetic coupling where obstructions come into play using techniques such as method of moments, geometrical theory of diffraction, and finite element time domain methods. The results of these models are integrated into higher level models to predict system-level effects.

D.2.2 SYSTEM AND COMPONENT

System and component models are organized according to the type of system: radar, communications, intelligence, and electronic warfare. These models provide the capability to analyze individual systems and components to a high level of detail. For example, the receiver models predict susceptibility levels based on the waveform of the desired and undesired signals and their power levels. The tools are used to develop data required by higher level models and to evaluate issues identified in these higher level models in more detail.

D.2.3 COSITE AND INTERSITE

The tools used to predict interference between systems are divided into two areas: cosite and intersite. Intersite models are used when the receiver antenna is not in the near-field of the transmitter antenna and when sufficient separation distance exists so that nonlinear and other out-of-band interactions do not occur. In cosite situations (e.g., collocated on the same platform or on closely spaced platforms), additional receiver and transmitter issues must be addressed, and a more detailed model is required.

D.3.0 SIMULATIONS

Warfare simulations are normally used to predict the outcome of an engagement or battle in terms of mission effectiveness. These tools incorporate battlefield effects (e.g., weapons, platform movement, attrition) sufficient to predict the results of the engagement or battle. These tools are used at the JSC to relate system-level performance degradation resulting from interference or jamming to mission effectiveness.

D.4.0 M&S TOOLS

The JSC has developed and acquired M&S tools since the Center's inception. Over this time, hundreds of models have been used to support the many analyses performed by the JSC. These models have been refined or replaced to continually meet the needs of the JSC. A list of some of the models, which maybe of interest to the testing community, are summarized in Table D-1.

Table D-1. JSC Model Descriptions by Acronym

ACRONYM	FUNCTION
AAPG 2000	AAPG 2000 is a new antenna-to-antenna coupling analysis model that uses a computer-aided design (CAD) representation of a platform. AAPG 2000 provides the capability to model complex shaped airframes such as the B-2 or F-117. By including the detailed structure of the platform in its analysis, AAPG 2000 has improved accuracy over previous versions. Additionally the path finding algorithms in AAPG 2000 will work on any platform such as a ship or tank. Current plans call for the development and testing of additional loss algorithms in FY00 and FY01 to make AAPG 2000 fully applicable to other platforms. AAPG 2000 operates on an SGI workstation and includes a Windows-type environment with pull down menus, icons, and windows for entering data and displaying the results.
COSAM 5	COSAM is used to predict the performance of communications and radar receivers operating in a cosite environment of conventional, frequency-hopping, direct-sequence, and radar transmitters. It incorporates the analysis capabilities of COSAM 4 and the Design Algorithm (DEAL) program, a VAX-based program for cosite analysis of radar systems. COSAM provides the user with the ability to analyze the effects of intermodulation, adjacent-signal, spurious-emission, spurious-response, desensitization, cross-modulation, and noise interactions. The GUI provides an easy way for the user to graphically set up and perform a cosite analysis, and view the results. There are three analysis modes: Full Site, Parameter Stepping, or Frequency Separation. The Full Site mode provides the capability to analyze all of the systems in a cosite, and presents the predicted degradation for each receiver and detailed information regarding the cosite interference mechanisms. The Parameter Stepping mode allows the user to vary one input parameter and depicts the predicted degradation as a function of the varied parameter. The Frequency Separation mode provides the capability to specify up to five tuned frequencies per receiver, and to specify the transmitter/receiver frequency separations.

ACRONYM	FUNCTION
EADSIM	EADSIM is a workstation-hosted, systems-level simulation used by materiel developers, battle planners, and operational commanders to assess the effectiveness of Theater Missile Defense (TMD) and Air Defense systems against the full spectrum of extended air defense threats. EADSIM provides a many-on-many theater-level simulation of air and missile warfare, an integrated analysis tool to support joint and combined force operations, and a tool to augment maneuver force exercises at all echelons with realistic air defense training. EADSIM models fixed and rotary-wing aircraft, tactical ballistic missiles, cruise missiles, infrared and radar sensors, satellites, command and control structures, sensor and communications jammers, communications networks and devices, and fire support in a dynamic environment which includes the effects of terrain and attrition on the outcome of the battle.
GATE	GATE is a model that was developed as a cull pre-processor tool for SEER. It is designed to analyze the effect of introducing a new transmitter(s) and/or receiver(s) into an existing environment of RF equipment. It considers the effects of terrain-dependent propagation (TIREM) for fixed equipment, and smooth-earth propagation (SEM) for mobile equipment, combined with off-axis antenna coupling, frequency-dependent rejection (FDR), cross-polarization, and harmonic effects. Interference thresholds can be based on receiver noise (I/N) or on desired signal (S/I). GATE is also capable of generating line-of-sight (LOS) and elevation contours. Output consists of both a graphical and tabular display of the environmental equipment that will cause interference to an introduced receiver or that will experience interference from an introduced transmitter. Results can be displayed for individually introduced equipment or combined to model an entire introduced network. Data pertaining to a particular transmitter, receiver, or an interference interaction can be obtained via point and click.
JEET	JEET examines potential E3 interactions between equipment scheduled for operational testing and existing equipment in the DoD inventory. It identifies the systems in the DoD inventory with the potential to interfere with the subject equipment under test in a joint E3 environment. JEET uses a pre-built database consisting of operational mode records downloaded from the EC/S database. One database will consist of data solely from the EC/S. A second database will use the same original data augmented to fill in any missing data required for analysis. No user intervention will be required to fill in missing data. Options will be provided to filter the database for the purpose of identifying a subset of records to be considered in the analysis. JEET calculates I/N and power density, employing many of the same engineering models used in GATE.
PDP	PDP, otherwise known as POWDEN-NEDWOP, contains two power density programs: POWDEN, which calculates near-field power density and field strength, and NEDWOP, which calculates the farthest distance from a transmitter for a given field strength and power density. PDP is designed for rectangular and circular aperture antennas having only certain illumination types.

ACRONYM	FUNCTION
SCSAT	SCSAT was previously referred to as ASMART. Distribution is authorized to U.S. Government Agencies Only (Export Control). SCSAT is a PC-based software program that enhances and automates the ability to 1) review the frequency allocation guidance (both frequency dependent and nonfrequency dependent) published by (a) the National Telecommunications and Information Administration (NTIA), (b) the Inter-range Instrumentation Group (IRIG), (c) the MCEB, and (d) the Interdepartment Radio Advisory Committee (IRAC); 2) determine whether C-E equipment characteristics adhere to the standards established by NTIA, IRIG, the Military (MIL-STD), and the International Telecommunications Union (ITU); 3) verify the consistency of the C-E equipment technical characteristics; 4) perform engineering calculations to approximate the transmitter emission bandwidth envelope for (a) FM, (b) radar, and (c) binary FSK (BFSK) equipment.
SEER	SEER combines the Space Environmental Compatibility (SPEC), Environmental Analysis System (EASY), Emitter Environment Definition System (EEDS), and Satellite Antenna Footprint (SAF) models into one integrated set of functions. SEER is an analysis tool for analyzing electromagnetic interactions in a dynamic environment composed of spaceborne and terrestrial equipment. The model is used to determine incident power density, received signal power, signal to interference ratios, desired to undesired signal ratios, and interference to noise ratios, where appropriate. Full-color graphics illustrate orbital position and environmental ground sites and provide easy identification of incident interactions when user-specified thresholds have been exceeded.
SPECTRUM XXI	SPECTRUM XXI is a distributed Windows NT based application providing spectrum management services and functionality to the spectrum management community. SPECTRUM XXI is composed of multiple clients interconnected through servers hierarchically organized for the maximum amount of automated data transfer. Additionally, clients may directly exchange data among themselves (through non-automated means such as floppy disks). SPECTRUM XXI at the client level provides spectrum managers with the following functionality: maintain background frequency assignment data; manage frequency assignment transactions; nominate frequencies; validate proposals; view/maintain spectrum management coordination procedures; generate allotments; manage frequency resources; engineer networks and links; display Communications Electronics Operating Instructions (CEOI) data; maintain Joint Restricted Frequency List (JRFL) data; perform Electronic Warfare (EW) deconfliction; analyze terrain and propagation; prepare and process interference reports; analyze interference; manage spectrum certification data; maintain spectrum management reference information; access and maintain geophysical data; and, access exercise and operations data. SPECTRUM XXI supports its functionality using the following data sets: frequency proposals and assignments with status tracking; allotment plans; JRFL; CEOI; interference reports; spectrum certification requests and spectrum certifications; geographic data; frequency allocation data for the ITU Regions 1, 2, and 3 and the U.S. allocation data for government and non-government; geosynchronous satellite data; and HF sunspot data. SPECTRUM XXI at the Oracle server level supports the transfer of “frequency proposals and assignments with status tracking“ data among clients. The clients connect to the Oracle server through either the Secure Internet Protocol Router Network (SIPRNET) or a Secure Telephone Unit (STU-III) using the Transmit Control Protocol/Internet Protocol (TCP/IP), exchange frequency proposals and assignments, and disconnect. The clients remain connected only during periods of active data exchange.

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APPENDIX E - RANGES AND RESOURCES

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APPENDIX E - RANGES AND RESOURCES

Ranges and Points of Contact

U.S. Army

Kwajalein Missile Range
Commander, Kwajalein Missile Range
P.O. Box 26
APO AP 96555

Telephone: (805) 355-1415
DSN: 254-1415
Facsimile: 254-1181

U.S. Army Dugway Proving Ground
Commander
U.S. Army Dugway Proving Ground
Dugway, UT 84022

Telephone: (435) 831-5187
Facsimile (435) 831-5711
E-mail: stedptd@dugway-emh9.army.mil

U.S. Army Electronic Proving Ground
U.S. Army Electronic Proving Ground
Attn: STEEP-TD
Bldg. 56301, Arizona Street
Fort Huachuca, AZ 95613-7110

Telephone: (520) 538-6891
DSN: 879-6891
Facsimile: (520) 538-6361
Facsimile DSN: 879-6361

White Sands Missile Range
National Range Operations
CSTE-DTC-WS-NRO
MR. GLENN A. HERMAN
White Sands Missile Range, NM 88002-5158

Telephone: (505) 678-0800
DSN 258-0800

Yuma Proving Ground
U.S. Army Yuma Proving Ground
Material Test Directorate
ATTN: STEYP-MT
Yuma Proving Ground, AZ 85365-9110

TOLL FREE: 1-800-TEST-YPG
Telephone: 520-328-6225/6044
DSN: 899-6225/6044
Facsimile: 520-328-6700
Facsimile DSN: 899-6700

U.S. Navy

Atlantic Undersea Test and Evaluation Center
Naval Undersea Warfare Center Division, Newport
ATTN: AUTEC Program Manager (Code 7005)
1176 Howell Street
Newport, RI 02841-1708

Telephone: (401) 832-3452
DSN: 920-3452

Naval Air Warfare Center, Aircraft Division
Business Development Team
Bldg 305, Unit 10
22541 Millstone Road
Patuxent River, MD 20670-5304

Telephone: 301-342-1133
DSN: 342-1133
Facsimile: 301-342-1134
E-mail: busdevteam@navair.navy.mil

Naval Air Warfare Center, Weapons Division
Naval Air Warfare Center Weapons Division
1 Administration Circle
China Lake, CA 93555-6001
Attn: Pacific Range and Facilities (520000D)
Telephone: (619) 939-6033
DSN: 437-6033
Facsimile: (619) 939-6071

U.S. Air Force

30th Space Wing
30th Space Wing/Program Requirements
747 Nebraska Avenue, Suite 34
Vandenberg Air Force Base, CA 93437-6294
Telephone: (805) 734-8232, Ext. 6-7363
DSN Telephone: 276-7363
Facsimile: Ext. 6-8608

45th Space Wing
Donald G. Cook
Brigadier General, USAF
Commander, 45th Space Wing
Director, Eastern Range
Patrick Air Force Base, FL 32925
Telephone: (407) 494-4500
DSN: (407) 854-4500
Facsimile: (407) 494-2801

46th Test Group
846 Test Squadron
1521 Test Track Road
Holloman Air Force Base, NM 88330-7847
Telephone: (505) 679-2766
DSN: 349-2766
Facsimile: (505) 679 2906

Air Force Development Test Center
46th Test Wing/XPX
101 West D Avenue, Suite 222
Eglin Air Force Base, FL 32542-5492
Tel: (904) 882-5307
DSN: 872-5307
Facsimile: (904) 882-3176
Send E-mail to: bevan@eglin.af.mil

Air Force Flight Test Center
AFFTC/PA
15 E. Yeager Blvd.
Edwards Air Force Base, CA 93524
Telephone: (661) 277-3510
DSN: 527-3510
Facsimile: (661) 277-2732

Air Warfare Center
Commander
99th Range Squadron
ATTN: Project Management
(99 RANS/DOJ)
3770 Duffer Drive
Nellis Air Force Base, NV 89191-7001
Telephone Commercial: (702) 652-3620
DSN: 682-3620
Facsimile Commercial: (702) 652-3808
Facsimile DSN: 682-3620
E-mail: projmgt@rang99.nellis.af.mil

Arnold Engineering Development Center
Arnold Engineering Development Center
(AEDC)
Director of Operations
100 Kindel Drive
Arnold Air Force Base, TN 37389-2213
Tel: (615) 454-7622
DSN: 340-7622
Facsimile: (615) 454-3559

Joint

Joint Interoperability Test Command 1-800 LET-JITC
2001 Brainard Road
Building 57305
Fort Huachucha, AZ 85613-7020

E3 Test Facility Addresses and Points of Contact

U.S. Army

Army Research Laboratory (ARL)
Survivability/Lethality Analysis Directorate
ATTN: AMSRL-SL-EA
Aberdeen Proving Ground, MD 21005-5068
(410) 278-6197

Communication-Electronics Command (CECOM)
Communications-Electronics RDE Center
ATTN: AMSEL-RD-ST-WL-AA, (Mr. P. Major)
Fort Monmouth, NJ 07703
(732) 427-2415

Test and Evaluation Command (ATEC)
Aberdeen Test Center
Electromagnetic Interference Test Facility
ATTN: CSTE-DTC-R-SL-EI (Mr. M. Geiger)
Aberdeen Proving Ground, MD 21005-5059
(410) 278-2598

Test and Evaluation Command (ATEC)
Electronic Proving Ground (EPG)
Test Support Branch
ATTN: CSTE-DTC-WS-EP-TT (Mr. D. Searls)
Fort Huachuca, AZ 85613-7110
(520) 538-4860

Test and Evaluation Command (ATEC)
Redstone Technical Test Center (RTTC)
E3 Test Branch
ATTN: CSTE-DTC-RT-E-EM (Mr. J. Zimmerman)
Redstone Arsenal, AL 35898-8052
(256) 876-6386

Tank-Automotive Command (TACOM)
Armaments RDE Center
ATTN: AMSTA-AR-CCF-D (Mr. D. Gutierrez)
Picatinny Arsenal, NJ 07806-5000
(973) 724-4667

Test and Evaluation Command (ATEC)
White Sands Missile Range,
Electromagnetic Radiation Effects Facility (EMRE)
ATTN: CSTE-DTC-WS-DT (Mr. J. O'Kuma)
WSMR, NM 88002-5158
(505) 678-1165

U.S. Navy

Naval Air Systems Command
Code: 4.1.7 (ATTN: Mr. M. Dabulskis)
22347 Cedar Point Road, Bldg 2185, Suite 2160-B1
Patuxent River, MD 20670-1161
(301) 342-7967

Naval Sea Systems Command
Code: 53H3 (ATTN: Mr. R. Bradley)
2531 Jefferson Davis Hwy
Arlington, VA 22242-5160
(703) 602-2549 X226

Naval Air Warfare Center Aircraft Division
Code 5.1.7 (ATTN: Mr. J. Dawson)
14438 Stanley Road, Hangar 144
Patuxent River, MD 20670-5304
(301) 826-4797

Naval Air Warfare Center Weapons Division
Code: 417000D (ATTN: Mr. S. Tanner)
1 Administrative Circle
China Lake, CA 93555
(760) 939-4669

Naval Surface Warfare Center, Dahlgren Division
EM Effects Division, Code J50 (Mr. W. Lucado)
17320 Dahlgren Road
Dahlgren, VA 22448-5100
(540) 653-3422

Naval Undersea Warfare Center
Code 343 (Mr. Craig Dereweny)
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Newport, RI 02841-1708
(401) 832-5543

Space and Naval Warfare Systems Command
Code: 051-1E (ATTN: Mr. Mike Stewart)
4301 Pacific Highway, Room 2251
San Diego, CA 92110-3127
(619) 524-7896

SPAWAR Systems Center Charleston
Code 323 (ATTN: Ms. Kathy Kahlil)
P.O. Box 190022
North Charleston, SC 29419-9022
(843) 974-5372

U.S. Air Force

46th Test Wing
205 West D Avenue, Suite 348
Eglin Air Force Base, FL 32542-6865
(850) 882-9551

738th Engineering Installation Squadron
738 EIS/EEEM (Mr. Hugh Hanna)
801 Vandenberg Ave
Keesler Air Force Base, MS 39534-2633
(228) 377-3920

AFFTC
15 E. Yeager Blvd.
412TW/TSR
Edwards Air Force Base, CA 93524
DSN: 527-3050

Air Force Aeronautical Systems Center
Code: ASC/ENAE (Mr. J. Welch)
2530 Loop Road West
Wright-Patterson Air Force Base, OH 45433-7101
(937) 255-8928

Rome Laboratory
RL/ERPE
(ATTN: Mr. R. Tucker)
Griffiss Air Force Base, NY 13441-4505
DSN: 587-3282

E3 Test Facility Capabilities

	EMI	EMC	EMV	EMP	HERF	HERO	HERP	Lightning	P-static	EP-RE
Army										
Army Research Laboratory (ARL), Aberdeen Proving Ground	✓	✓								✓
Communication-Electronics Command (CECOM), Fort Monmouth	✓	✓								✓
Test and Evaluation Command (ATEC), Aberdeen Proving Ground	✓	✓								✓
Test and Evaluation Command (ATEC), Fort Huachuca	✓	✓								✓
Test and Evaluation Command (ATEC), Redstone Arsenal	✓	✓	✓	✓		✓	✓	✓		✓
Tank-Automotive Command (TACOM), Picatinny Arsenal	✓	✓				✓				✓
Test and Evaluation Command (ATEC), White Sands Missile Range	✓	✓	✓	✓		✓	✓	✓		✓
Navy and Marine Corps										
Naval Air Systems Command, Patuxent River	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Naval Sea Systems Command, Arlington	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Naval Air Warfare Center Aircraft Division, Patuxent River	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Naval Air Warfare Center Weapons Division, China Lake	✓	✓	✓	✓		✓				✓
Naval Surface Warfare Center, Dahlgren Division	✓	✓	✓	✓	✓	✓	✓			✓
Naval Undersea Warfare Center, Newport	✓	✓								✓
Space and Naval Warfare Systems Command, San Diego	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SPAWAR Systems Center Charleston	✓	✓			✓	✓	✓			✓
Air Force										
46th Test Wing, Eglin AFB	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
738th Engineering Installation Squadron, Keesler AFB	✓	✓			✓	✓	✓			✓
AFFTC, Edwards AFB	✓	✓	✓							✓
Air Force Aeronautical Systems Center, Wright-Patterson AFB	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Rome Laboratory, Griffiss AFB	✓	✓	✓							✓

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APPENDIX F - FMO POINTS OF CONTACT

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APPENDIX F - FMO POINTS OF CONTACT

Army

Army C-E Services Office
Attn: SFIS-FAC-P (Mr. Radice)
2461 Eisenhower Ave.
Hoffman 1, Suite 1200
Alexandria, VA 22332
(703) 325-8226
arthur.radice@hqda.army.mil

Navy

Naval Electromagnetic Spectrum Center (NAVEMSCEN)
Code 113 (Mr. Quan Vu)
2461 Eisenhower Ave.
Hoffman 1, Suite 1202
Alexandria, VA 22332-0200
(703) 325-2865
vuq@navemscen.navy.mil

Air Force

Air Force Frequency Management Agency (AFFMA)
SC Issues (Ms. S. Holiday)
2461 Eisenhower Ave.
Hoffman 1, Suite 1203
Alexandria, VA 22332-1500
(703) 428-1509
susan.holiday@pentagon.af.mil

Note: Additional points-of-contact information can be found in the Defense System Management College CD and Elective Course *"Electromagnetic Environmental Effects (E3)/Spectrum Certification (SC) for Program Managers."*

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APPENDIX G - DOT&E, JSC, AND OTA POINTS OF CONTACT

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APPENDIX G - DOT&E, JSC, AND OTA POINTS OF CONTACT

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Navy

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Marine Corps

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Air Force

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Note: Additional points-of-contact information can be found in the Defense System Management College CD and Elective Course *"Electromagnetic Environmental Effects (E3)/Spectrum Certification (SC) for Program Managers."*

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APPENDIX H - BIBLIOGRAPHY

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APPENDIX H - BIBLIOGRAPHY

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AR-70-1	Army Acquisition Policy
AR-70-75	Survivability of Army Materiel and Equipment
AR-71-9	Material Objectives and Requirements
AR-73-1	Test and Evaluation Policy
DA PAM 70-3	Army Acquisition Procedures
DA PAM 73-2	Test and Evaluation Master Plan, Procedures and Guidelines
DA PAM 73-3	Critical Operational Issues and Criteria (COIC) Procedures and Guidelines
ADS-37A-PRF	Aeronautical Design Standard, Electromagnetic Environmental Effects Performance and Verification Requirements (Aviation and Missile Command Report)
TR-RD-TE-97-01	Electromagnetic Effects Criteria and Guidelines for EMRH, EMRO, Lightning Effects, ESD, EMP and EMI Testing of US Army Missile Systems, (Redstone Technical Test Center Report)
FM-11-490-30	Electromagnetic Radiation Management

NAVY REGULATIONS AND DOCUMENTS

SECNAVINST 2410.1	Electromagnetic Compatibility Program within the Department of the Navy
SECNAVINST 5000.2	Implementation of Mandatory Procedures for Major and Non-Major Defense Acquisition Programs and Major and Non-Major Information Technology Acquisition Programs
OPNAVINST 2410.11	Procedures for the Processing of Radio Frequency Applications for the Development and Procurement of Electronic Equipment
OPNAVINST 2450.2	Electromagnetic Compatibility Program within the Department of the Navy

OPNAVINST 2400.20	Navy Management of the Radio Frequency Spectrum
OPNAVINST 3960.10	Test and Evaluation
OPNAVINST 5000.42	Research, Development, and Acquisition Procedures
NAVSEA OP 3565/NAVAIR 16-1-529/SPAWAR 0967-LP-624-6010	Technical Manual, Electromagnetic Radiation Hazards, Volumes I & II
NAVSEAINST 8020.7B	Hazards of Electromagnetic Radiation to Ordnance (HERO) Safety Program
OD 30393	Design Principles and Practices for Controlling Hazards of Electromagnetic Radiation to Ordnance (HERO Design Guide)
S9407-AB-HDBK-010	Handbook of Shipboard Electromagnetic Shielding Practices

AIR FORCE REGULATIONS AND DOCUMENTS

AFR 80-23	The U.S. Air Force Electromagnetic Compatibility Program
AFR 800-2	Acquisition Program Management
AFMAN 33-120	Radio Frequency Spectrum Management
TO 31Z-10-4	Electromagnetic Radiation Management
AFSC DH 1-4	Design Handbook, Electromagnetic Compatibility
Air Force Occupational Safety and Health (AFOSH) STANDARD 161-9	Exposure to Radio Frequency Radiation

MARINE CORPS REGULATIONS AND DOCUMENTS

MCO 2400.2	Marine Corps Management of the Radio Frequency Spectrum
MCO 2410.2	Electromagnetic Environmental Effects Control Program
MCO 5104.2	Marine Corps Radio Frequency Electromagnetic Field Personnel Protection Program

MILITARY STANDARDS AND HANDBOOKS

MIL-HDBK-235	Electromagnetic (Radiated) Environment Considerations for Design and Procurement of Electrical and Electronic Equipment, Subsystems and Systems
MIL-HDBK-237	Electromagnetic Environmental Effects (E3) and Spectrum Certification Guidance for Program Managers
MIL-HDBK-274	Electrical Grounding for Aircraft Safety
MIL-HDBK-419	Grounding, Bonding, and Shielding for Electronic Equipment and Facilities
MIL-HDBK-423	HEMP Protection for Fixed and Transportable Ground-Based Facilities
MIL-STD-449	Test Method Standard: Radio-Frequency Spectrum Characteristics, Measurement of
MIL-STD-461E	Interface Standard, Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment (Consolidates MIL-STD-461D and 462D)
MIL-STD-464	Interface Standard, Electromagnetic Environmental Effects Requirements for Systems
MIL-STD-469	Interface Standard: Radar Engineering Design Requirements, Electromagnetic Compatibility
MIL-STD-1310	Standard Practice Document, Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility and Safety
MIL-STD-1542	Electromagnetic Compatibility and Grounding Requirements for Space Systems
MIL-STD-2169	High Altitude EMP Environment

DOD DIRECTIVES, INSTRUCTIONS, REGULATIONS, AND OTHER DOCUMENTS

CJCSI 3170.01B	Requirements Generation System
CJCSI 3220.01	Electromagnetic Spectrum Use in Joint Military Operations
CJSCI 6212.01B	Interoperability and Supportability of National Security Systems (NSS) and Information Technology Systems (ITS)

Defense FAR Supplement (DFARS) 252.235-7003	Frequency Authorization (Oct 1966)
DODD 3222.3	Department of Defense (DOD) Joint Electromagnetic Environmental Effects (E3) Program and JSC Charter
DODD 4630.5	Interoperability and Supportability of Information Technology (IT) And National Security Systems (NSS)
DODI 4630.8	Procedures for Compatibility, Interoperability, and Integration of Command, Control, Communications, and Intelligence (C3I) Systems
DODD 4650.1	Management and Use of the Radio Frequency Spectrum
DODD 5000.1	The Defense Acquisition System
DODI 5000.2	Operation of the Defense Acquisition System
DODI 6055.11	Protection of DOD Personnel from Exposure to Radio Frequency Radiation and Military Exempt Lasers
SD-2	Buying Commercial and Non-Developmental Items
SD-16	Communicating Requirements
National Telecommunications and Information Administration	Manual of Regulations and Procedures for Federal Radio Frequency Management
American National Standards Institute	American National Standard Dictionary for Technologies of Electromagnetic Compatibility (EMC), Electromagnetic Pulse (EP), and Electrostatic Discharge (ESD)

APPENDIX I - ACRONYMS

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APPENDIX I - ACRONYMS

AAPG	Aircraft inter-Antenna Propagation with Graphics
AFFMA	Air Force Frequency Management Agency
APB	Acquisition Programming Baseline
ASD(C3I)	Assistant Secretary of Defense for Command, Control, Communications, and Intelligence
BFSK	Binary Frequency Shift Keying
C-E	Communications-Electronic
C4I	Command, Control, Communications, Computers, and Intelligence
C4ISP	Command, Control, Communications, Computers, and Intelligence Support Plan
C4ISR	Command, Control, Communications, Computers, and Intelligence Surveillance and Reconnaissance
CAD	Computer Aided Design
CEOI	Communications Electronics Operating Instructions
CI	Commercial Item
CINC	Commander in Chief
COI	Critical Operational Issue
COSAM	Cosite Analysis Model
CTF	Combined Test Force (DT & OT)
DEAL	Design Algorithm
DoD	Department of Defense
DOT&E	Director, Operational Test and Evaluation
DT	Developmental Test(ing)
DT&E	Developmental Test and Evaluation
E3	Electromagnetic Environmental Effects
EADSIM	Extended Air Defense Simulation
EASY	Environmental Analysis System
EC/S	Equipment Characteristics/Space
EEDS	Emitter Environmental Definition System
EID	Electrically Initiated Device
EM	Electromagnetic
EMC	Electromagnetic Compatibility
EME	Electromagnetic Environment
EMI	Electromagnetic Interference
EMP	Electromagnetic Pulse
EMR	Electromagnetic Radiation Hazards
EMV	Electromagnetic Vulnerability
EP	Electronic Protection
EP-RE	Electronic Protection - Radiated Emissions
EW	Electronic Warfare
FAA	Federal Aviation Administration
FCC	Federal Communication Commission
FDR	Frequency Dependent Rejection
FM	Frequency Modulation
FMO	Frequency Management Office

FP	Frequency Panel
FSK	Frequency Shift Keying
GATE	Graphical Analysis Tool for Electromagnetic Environments
GFE	Government Furnished Equipment
GUI	Graphical User Interface
HERF	Hazards of Electromagnetic Radiation to Volatile Materials, Including Fuels
HERO	Hazards of Electromagnetic Radiation to Ordnance
HERP	Hazards of Electromagnetic Radiation to Personnel
HF	High Frequency
HNC	Host Nation Coordination
HNFS	Host Nation Frequency Supportability
HQ	Headquarters
I/N	Receiver Noise
IPT	Integrated Product Team
IRAC	Interdepartmental Radio Advisory Committee
IRIG	Inter-Range Instrumentation Group
ITU	International Telecommunications Union
JEET	Joint E3 Evaluation Tool
JOERAD	JSC Ordnance E3 Risk Assessment Database
JRFL	Joint Restricted Frequency List
JSC	Joint Spectrum Center
LOS	Line of Sight
M&S	Modeling and Simulation
MAIS	Major Automated Information System
MDAP	Major Defense Acquisition Program
MAJCOM	Major Command
MCEB	Military Communications-Electronics Board
MILDEP	Military Department
MNS	Mission Needs Statement
NDI	Non-developmental Item
NEDWOP	Distance at a Power Density (Model)
NSA	National Security Agency
NTIA	National Telecommunications and Information Administration
OATS	Open Area Test Site
OPLAN	Operations Plan
ORD	Operational Requirements Document
OT	Operational Test(ing)
OT&E	Operational Test and Evaluation
OTA	Operational Test Agency
P-Static	Precipitation-Static
PDP	Power Density Program
PM	Program Manager
POWDEN	Power Density at a Distance (Model)
PWG	Permanent Working Group
RADHAZ	Radiation Hazard
RF	Radio Frequency

RTO	Responsible Test Organization
SAE	Society of Automotive Engineers
SAF	Satellite Antenna Footprint
S/I	Desired Signal
SC	Spectrum Certification
SCSAT	Spectrum Certification System Analysis Tool
SEM	Smooth Earth Propagation
SEER	Space-Earth EMC and Radiation
SGI	Silicon Graphics Incorporated
SIPRNET	Secure Internet Protocol Router Network
SM	Spectrum Management
SME	Subject Matter Experts or Subject Matter Expertise
SMO	Spectrum Management Office
SPEC	Space Environmental Compatibility
STU	Secure Telephone Unit
SYSCOM	Systems Command
TCP/IP	Transmission Control Protocol/Internet Protocol
TEMP	Test and Evaluation Master Plan
TIREM	Terrain Integrated Rough Earth Model
TMD	Theater Missile Defense
UAV	Unmanned Aerial Vehicle
US&P	United States and Possessions

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