DEPARTMENT OF THE NAVY

NAVAL SEA SYSTEMS COMMAND
WASHINGTON, D.C. 20362-5101

IN REPLY REFER TO
NAVSEAINST 2450.2
OPR 06K2
24 Feb 92

NAVSEA INSTRUCTION 2450.2

From: Commander, Naval Sea Systems Command

Subj: ELECTROMAGNETIC COMPATIBILITY (EMC)

Ref: (a) OPNAVINST 2450.2
(b) OPNAVINST 5000.42C
(c) MIL-HDBK-237A, Interim Notice 2 (NAVY) (NOTAL)
(d) OPNAVINST 2400.20E
(e) NAVSEAINST 9070.5A
(f) NAVSEAINST 5000.3B

Encl: (1) Definitions
(2) Electromagnetic Compatibility (EMC) Management Milestones
(3) Applicability of EMC Documentation
(4) EMC Impact Statement
(5) E^3 Control ARB/CLR Review Schedule
(6) Ship E^3 Control Charts
(7) System/Equipment E^3 Control Charts

1. Purpose. To reissue Command policy, guidance and direction for electromagnetic compatibility (EMC) management within NAVSEA.

2. Scope. Electromagnetic environmental effects (E^3) control considerations, requirements and procedures apply for all NAVSEA acquisition program phases for ships, submarines, systems, subsystems, and equipments; and for the modernization of ships and submarines. This includes those NAVSEA procurements to meet specified requirements of the USMC.

3. Policy. The policies established by references (a) and (b) are mandatory except for those programs which do not affect or are not affected by electromagnetics as designated by the Deputy Commander for Weapons and Combat Systems (SEA 06). An EMC program shall be incorporated as a requirement in each phase of an equipment, system, ship, and submarine life cycle.

4. Responsibilities

a. Within the policy described in paragraph 3 above, Deputy Commanders and designated Program Managers are responsible for total ship, submarine, system, subsystem, and equipment EMC. Execution of this responsibility includes:

(1) Using the guidance in reference (c) and in close coordination with the NAVSEA EM Office (SEA 06K22) on the context and content of program plans, developing an effective E^3 control

program incorporating the applicable E^3 control requirements of reference (c). Program E^3 control requirements shall be documented in the Program Master Plan or, if appropriate because of the complexity of EM considerations and test requirements, in a separate EMC Program Plan (EMCPP). This applies to all equipments, systems, and platform designs which involve the use of electromagnetic radiations/receptions. General purpose electronic test equipment and fuses are excluded. The controlling EM program plan will be referenced in all frequency allocation applications (DD 1494) prepared in accordance with reference (d) and will be updated in accordance with enclosure (2) milestones. The Program Master Plan/EMCPP and subsequent revisions shall be routed to the NAVSEA EM Office for E^3 control review.

(2) Ensuring that planning, programming, and contractual documentation provide for EMC requirements, analyses, measurements, test and evaluation.

(3) Invoking applicable sections of approved military EMC standards and specifications, enclosure (3). Requests for waivers or deviations to equipment/systems/platforms contractual EMC requirements, including justification and EMC Impact Statement (enclosure (4)), shall be forwarded to the NAVSEA EM Office for approval.

(4) Establishing and utilizing an EMC Advisory Board (EMCAB) for all platforms and major systems [Acquisition Category (ACAT) I, II and those ACAT III programs designated by SEA 06] during acquisition phases and industrial availabilities in accordance with enclosure (2) milestones. Information copies of the minutes of EMCAB meetings shall be provided to the NAVSEA EM Office. The Program Manager shall formally notify SEA 06 via the NAVSEA EM Office when EMCAB recommendations are not accepted.

(5) Provide funding to perform required EMC analyses and measurements to comply with applicable EMC requirements and provisions of this instruction, and to resolve and correct EMC problems identified.

(6) Include the NAVSEA EM Office in the approval cycle for Ship Alterations (SHIPALTs), Machinery Alterations (MACHALTs), Ordnance Alterations (ORDALTs) and all Engineering Change Proposals (ECPs), including Field Changes and Technical Directives.

(7) Ensuring that EMC considerations, including requirements recommended by the EMCAB, are outlined in Cost and Operational Effectiveness Analysis (COEAs), Top Level Specifications (TLSs), and Requests for Proposals (RFPs) which involve the use of electromagnetic radiation or reception.

(8) Subjecting all new electronic and electrical equipment/system developments to a thorough EMC analysis upon completion of concept exploration and definition, and prior to start of an Advance Development Model (ADM), to assure electromagnetic compatibility in the intended operational environment. Copies of EMC analysis results shall be forwarded to the NAVSEA EM Office.

(9) Incorporating EMC training as applicable in Communications-Electronics (C-E) equipment/system Navy Training Plans (NTPs).

(10) Incorporating E^3 control into Test and Evaluation Master Plans to meet the requirements of reference (a).

(11) Ensuring that standard stock electronic part and component redesigns are electromagnetically compatible as well as mechanically compatible.

(12) Ensuring that frequency allocation applications are submitted as required by reference (d) and that no contract is awarded for the development and/or procurement of C-E equipment/systems/subsystems within the scope of reference (d) without an approved frequency allocation. Frequency allocation applications will be submitted via the NAVSEA EM Office to SEA 06 for Command approval and forwarding.

(13) Adhering to the requirements of references (e) and (f) for formal technical reviews, submitting E^3 control program documentation to the NAVSEA EM Office for review as necessary, and at least 40 days prior to an Acquisition Review Board (ARB) or Ship Design Command Level Review (CLR). Enclosure (5) is a schedule for the E^3 control review prior to an ARB/CLR.

(14) Preparing Ship E^3 Control charts, enclosure (6), and System/Equipment E^3 Control Charts, enclosure (7), for the ARB/CLR.

(15) Designating a POC for E^3 control matters.

b. In support of the responsibilities described in paragraph 4.a above, the Deputy Commander for Weapons and Combat Systems, supported by the NAVSEA EM Office, is responsible for:

(1) Serving as Command focal point for EMC matters.

(2) Providing engineering assets, through the Shipboard Electromagnetic Compatibility Improvement Program (SEMCIP), to investigate operating fleet intra-ship EMC problems and providing interim solutions to mitigate operational impact of the problems found until cognizant item managers provide appropriate

equipment modification (field change, electronic change proposal, ordnance alterations, etc) or ship alteration to correct the problem.

(3) Reviewing E^3 control program documentation as requested by Deputy Commanders and designated Program Managers and providing an assessment of its adequacy.

(4) Assisting program managers in completing ARB/CLR E^3 Control charts (enclosures (6) and (7)).

(5) Reviewing and recommending approval or disapproval of requests for waivers or deviations to ship and equipment/system contractual EMC requirements.

(6) Reviewing frequency allocation requests, issuing Command approval or granting of waivers, and forwarding as appropriate.

(7) Establishing EMCAB support for ship and equipment/ system acquisition managers.

(8) Providing support in the identification and implementation of E^3 control requirements in ship and equipment/system design efforts.

(9) Providing guidance and direction in the implementation of radiation hazard (RADHAZ) protection, including ship surveys.

(10) Providing support for the analysis, engineering, and correction of fleet EMI problems.

(11) Providing guidance and direction in the implementation of EMI Certification requirements for surface ships.

5. Action. Addressees shall take action necessary to ensure effective implementation of this instruction.

KENNETH C. MALLEY

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(See next page)

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DEFINITIONS

1. Electromagnetic Environmental Effects (E^3). The impact of the electromagnetic environment upon the operational capability of equipment, systems, and platforms. It encompasses all electromagnetic environmental disciplines, including, electromagnetic compatibility (EMC), electromagnetic interference (EMI) control, electromagnetic pulse (EMP), electronic counter-countermeasures (ECCM), and hazards of electromagnetic radiation (RADHAZ) to personnel (HERP), ordnance (HERO), and volatile materials (HERF).

2. Electromagnetic Compatibility (EMC). Ability of electronic and electrical systems, subsystems, equipments, and devices to operate in their intended operational environment without suffering or causing unacceptable degradation because of electromagnetic radiation or response.

3. Electromagnetic Interference (EMI). Electromagnetic disturbance which interrupts, obstructs, or otherwise degrades or limits the effective performance of electronic/electrical equipment. It can be induced intentionally, as in some forms of electronic warfare, or unintentionally, as a result of spurious emissions and response, intermodulation products, and the like.

4. EMC Program. The EMC Program is the management program for attaining intrasystem, intersystem and intraplatform EMC.

5. EMC Program Plan (EMCPP). The EMCPP is the document delineating the process by which EMC will be assured during one or more of the acquisition phases of an equipment, subsystem, system or platform.

6. EMC Advisory Board (EMCAB). The EMCAB is a formal board chaired by Navy personnel which identifies and examines potential and existing EMC problems, and recommends resolution actions. The EMCAB function applies to joint Navy/contractor and SYSCOM/SYSCOM responsibilities as well as internal Command responsibilities.

7. Electrical. As used herein, the term "electrical" applies to major components designed to generate, distribute or control electrical power.

8. Frequency Allocation. A frequency band established for specific categories of radio service (e.g., radio location, radio navigation, mobile, space telemetry, etc.). The same term (frequency allocation) is also used to mean authorizing the procurement of C-E equipment for subsequent experimentation, development, or operation in a specific frequency band(s), as outlined in reference (d).

9. Frequency Assignment. The discrete frequency or frequencies on which a C-E equipment or system is authorized to operate within its allocated frequency band at the location(s) designated and within the constraints of the authorizing assignment.

10. Communications-Electronics (C-E). Any transmission, emission, or reception of signs, signals, writing images, and sounds, or intelligence of any nature conveyed by wire, radio, optical, or other electromagnetic systems. In this instruction, C-E systems include communications, radar, navigation, and all other systems that use electromagnetic radiation/reception.

ELECTROMAGNETIC COMPATIBILITY (EMC) MANAGEMENT MILESTONES

1. Acquisition Programs. An Electromagnetic Compatibility Program Plan (EMCPP) shall be prepared, updated, and submitted at the beginning of an Acquisition Phase as indicated below. To identify potential EMC problems, especially in regard to joint Navy/contractor and SYSCOM/SYSCOM responsibilities, and to recommend means of resolution, an Electromagnetic Compatibility Advisory Board (EMCAB) will be established and sustained for the following Acquisition Phases as indicated.

a. Equipment/System:

Acquisition Phase	EMCPP	EMCAB
Concept Exploration	NONE	NONE
Demonstration/ Validation	X	X
Engineering and Manufacturing Development	X (UPDATE)	X
Limited/Full Rate Production/Deployment	X (UPDATE)	X

b. Platform:

Acquisition Phase	EMCPP	EMCAB
Feasibility Studies	X	NONE
Preliminary Design	X (UPDATE)	X
Contract Design	X (UPDATE)	X
Detail Design and Construction	X (UPDATE)	X
Operational (Support Responsibility Transition from SHAPM to SLM)	NONE	NONE

2. Fleet Modernization and Repair. An EMCPP shall be prepared or updated, as applicable, upon the initiation of planning for each of the following evolutions as indicated. An EMCAB will be established upon planning initiation and be sustained through conclusion of the industrial effort as delineated below:

Industrial Effort	EMCPP	EMCAB
Restricted Availability (RAV)	NONE	NONE
Selected Restricted Availability (SRA)	NONE	NONE
Industrial Effort	EMCPP	EMCAB
Regular Overhaul (ROH)	X[1]	X
Complex Overhaul (COH)	X[1]	X
Conversion/Service Life Extension Program (SLEP)	X[1]	X

1 As determined by EMCAB

3. Assistance. Guidance and assistance in the preparation and conduct of an E^3 control program, EMCPP or EMCAB is available from the NAVSEA EM Office.

Enclosure (2)

APPLICABILITY OF EMC DOCUMENTATION

DOCUMENTS APPLICABLE TO	MIL-STD-188	MIL-HDBK-235	MIL-HDBK-237	MIL-E-6051	MIL-E-16400	MIL-STD-461 & 462	MIL-STD-469	MIL-STD-1310	MIL-STD-1605	MIL-STD-449	MIL-STD-241	MIL-STD-1385	MIL-STD-1399 Sec. 104, 106, etc.	MIL-STD-1399 Sec 408	MIL-STD-1399 Sec 409	RADHAZ/HERO	EMCON CRITERIA	FREQUENCY ALLOCATION
SYSTEM																		
Platforms																		
Aircraft		X	X	X														
Shore Stations		X	X												X			
Surface Ships		X	X					X	X			X	X	X	X			
Submarines		X	X					X				X	X	X	X			
SUBSYSTEMS																		
Surveillance/Acq/Track																		
Radar/IFT		X	X	X	X	X	X	X		X	X		X	X	X	X	X	X
E-O/IR Devices		X	X	X	X	X					X		X					
Electronic Warfare																		
ESM/ELINT		X	X	X	X	X		X		X	X		X					
ECM		X	X	X	X	X		X		X	X		X	X	X	X	X	X
Communications/Command & Control																		
Exterior Communications	X	X	X	X	X	X		X		X	X		X	X	X	X	X	X
Interior Communications		X	X	X	X	X					X		X					
Data Processing		X	X	X	X	X		X		X	X		X					
Satellite Systems		X	X	X	X	X		X		X	X		X			X	X	X
Navigation																		
LORAN		X	X	X	X	X		X		X	X		X	X	X	X	X	X
TACAN, Doppler		X	X	X	X	X	X	X		X	X		X	X	X	X	X	X
OCA, ILS, OCA		X	X	X	X	X	X	X		X	X		X	X	X	X	X	X
IFF		X	X	X	X	X		X		X	X		X	X	X	X	X	X
DF		X	X	X	X	X		X		X	X		X					
Satellite		X	X	X	X	X		X		X	X		X			X	X	X
Expendable Ordnance												X						
EQUIPMENTS																		
Transmitting																		
Radiating	X		X	X	X	X		X		X	X					X	X	X
Conducting			X	X	X	X		X		X	X							
Receiving	X	X	X	X	X	X		X		X	X							X
Processing, Display, Terminal Equipment		X	X	X	X	X		X		X	X							
Power Generation Equipment				X	X	X		X		X								

EMC IMPACT STATEMENT

Title of Proposed Change:
System Affected:
Subsystem Affected:
Item Nomenclature:

The following information is needed by the NAVSEA EM Office to properly analyze the EMC impact of this proposed change.
Does the proposed change affect any of the following: (Attach additional sheets for details as necessary)
Location:
Equipment Operating Characteristics (frequency, bandwidth, power, etc.):

Antenna Radiation:_____
Cabling:_____
Connectors:_____
Bonding/Grounding:_____
Shielding:_____
EMI Filtering:_____
Other (describe):_____
_____

Originator's assessment of proposed change's impact on shipboard EMC and supporting rationale. (Use separate sheet as needed)

_____
_____
_____
_____
_____
_____

E^3 CONTROL ARB/CLR REVIEW SCHEDULE

ACTION	DAYS PRIOR TO ARB/CLR 40 25 15 10 5 0
DOCUMENT ASSESSMENT	------->
IDENTIFY RISKS, PROBLEMS, ISSUES	-------->
CONSIDER ALTERNATIVE SOLUTIONS FOR UNRESOLVED ISSUES	-------->
REPORT ON SIGNIFICANT RISKS, PROVIDING ISSUES TO SEA 06	----->
PREPARE E^3 CONTROL CHART	----->
IMPROVE PROGRAM E^3 CONTROL STATUS	---------->
ARB/CLR	<>

SHIP E^3 CONTROL CHARTS

FEASIBILITY STUDIES	STATUS
• PLANNING	●
• POTENTIAL EM INCOMPATIBILITIES	●
• TOPSIDE EME/EMI CONSTRAINTS	●

OVERALL E^3 STATUS ●

G **SATISFACTORY** Y **MARGINAL** R **UNSATISFACTORY**

- HAS PLANNING FOR E^3 CONTROL IN THE SHIP ACQUISITION BEEN INITIATED?
- IS PLANNED FUNDING FOR E^3 CONTROL ADEQUATE?
- HAVE POTENTIAL EM INCOMPATIBILITIES, BASED ON COEA, BEEN IDENTIFIED?
- HAVE EME/EMI CONSTRAINTS AFFECTING TOPSIDE LOCATIONS BEEN FORMULATED?

SHIP E^3 CONTROL CHARTS

PRELIMINARY DESIGN	STATUS
• PLANNING/PROGRAMMING	•
• EMI PROBLEM IDENTIFICATION/RESOLUTION	•
• SYSTEM COVERAGE/RESTRICTIONS	•
• CONTRACTUAL COVERAGE FOR CONTRACT DESIGN	•

OVERALL E^3 STATUS •

G **SATISFACTORY** Y **MARGINAL** R **UNSATISFACTORY**

- HAVE WE IDENTIFIED EMI PROBLEMS AND THEIR RESOLUTION?
- HAS THE TOPSIDE ARRANGEMENT BEEN INCLUDED IN THE IDENTIFICATION AND RESOLUTION OF EMI PROBLEMS?
- IS THE CONTRACTUAL COVERAGE FOR THE CONTRACT DESIGN PHASE ADEQUATE FOR E^3 CONTROL?
- HAS E^3 CONTROL IN THE SHIP ACQUISITION BEEN ADEQUATELY PLANNED AND PROGRAMMED?

Enclosure (6)

SHIP E^3 CONTROL CHARTS

CONTRACT DESIGN	STATUS
• PLANNING/PROGRAMMING UPDATE	•
• EMI PROBLEM IDENTIFICATION/RESOLUTION	•
• SYSTEM COVERAGE/RESTRICTIONS	•
• CONTRACTUAL COVERAGE FOR DETAIL DESIGN AND CONSTRUCTION	•

OVERALL E^3 STATUS •

G **SATISFACTORY** Y **MARGINAL** R **UNSATISFACTORY**

- HAVE POTENTIAL EMI PROBLEMS BEEN UPDATED BASED ON TOPSIDE ARRANGEMENT AND EQUIPMENT LIST?
- IS PROBLEM RESOLUTION SATISFACTORY?
- HAS THE TOPSIDE ARRANGEMENT BEEN ADJUSTED TO FACILITATE EMI PROBLEMS RESOLUTION?
- IS THE UPDATED E^3 CONTROL PROGRAM CONTRACTUAL COVERAGE ADEQUATE FOR THE DETAIL DESIGN AND CONSTRUCTION PHASE?
- HAS THE PLANNING/PROGRAMMING FOR E^3 CONTROL BEEN REALISTICALLY UPDATED?

SHIP E^3 CONTROL CHARTS

DETAIL DESIGN AND CONSTRUCTION	STATUS
• EMI PROBLEM RESOLUTION	•
• CONFIGURATION CONTROL	•
• SHIP EMC VERIFICATION	•

OVERALL E^3 STATUS •

G **SATISFACTORY** Y **MARGINAL** R **UNSATISFACTORY**

- HAS RESOLUTION OF EMI PROBLEMS BEEN VALIDATED?
- HAS EQUIPMENT BEEN CERTIFIED TO MEET MIL-STD-461/469 REQUIREMENTS?
- DOES CONFIGURATION CONTROL PROCESS PROVIDE FOR THE RESOLUTION OF ADVERSE IMPACT ON E^3 CONTROL?
- DO TEST PLANS PROVIDE FOR VERIFICATION OF SHIP EMC?

SYSTEMS/EQUIPMENT E^3 CONTROL CHARTS

MILESTONE 0 - CONCEPT DEFINITION	STATUS
• LESSONS LEARNED	•
• COEA	•

OVERALL E^3 CONTROL STATUS •

G **SATISFACTORY** Y **MARGINAL** R **UNSATISFACTORY**

- HAVE WE LEARNED FROM THE PAST ABOUT EMI PROBLEMS WITH LIKE AND SIMILAR EQUIPMENT

- HAS THE COEA ADEQUATELY ADDRESSED EMC RISK AND POTENTIAL EMI?

SYSTEMS/EQUIPMENT E^3 CONTROL CHARTS

MILESTONE I - DEMONSTRATION AND VALIDATION	STATUS
• FUNDING	•
• PLANNING/PROGRAMMING	•
• DESIGN AND TEST CONTRACT COVERAGE	•

OVERALL E^3 CONTROL STATUS •

G SATISFACTORY Y MARGINAL R UNSATISFACTORY

- HAS THE SELECTED OPTION BEEN ADEQUATELY FUNDED FOR E^3 CONTROL?

- HAS E^3 CONTROL IN THE OVERALL ACQUISITION OF THAT OPTION BEEN ADEQUATELY PLANNED AND PROGRAMMED?

- HAVE KEY TEST OBJECTIVES THAT MUST BE DEMONSTRATED TO ASSURE EQUIPMENT AND SYSTEM LEVEL DESIGN MEETS E^3 CONTROL REQUIREMENTS BEEN IDENTIFIED?

SYSTEMS/EQUIPMENT E^3 CONTROL CHARTS

MILESTONE II - ENGINEERING AND MANUFACTURING DEVELOPMENT	STATUS
• FUNDING	•
• PLANNING/PROGRAMMING UPDATE	•
• DESIGN AND TEST CONTRACT COVERAGE UPDATE	•
• FLEET RESOURCES	•
• TEST OBJECTIVES	•

OVERALL E^3 CONTROL STATUS •

G SATISFACTORY Y MARGINAL R UNSATISFACTORY

- HAS CONTINUED E^3 CONTROL DEVELOPMENT BEEN ADEQUATELY FUNDED?
- HAS THE PLANNING/PROGRAMMING FOR E^3 CONTROL BEEN REALISTICALLY UPDATED?
- HAVE TEST RESULTS DEMONSTRATED ADEQUATE E^3 CONTROL?
- HAVE CHANGES NECESSARY TO ENHANCE E^3 CONTROL BEEN IDENTIFIED?
- HAVE KEY TEST OBJECTIVES THAT MUST BE DEMONSTRATED TO VALIDATE E^3 CONTROL IN THESE CHANGES BEEN IDENTIFIED?
- HAVE FLEET RESOURCES NECESSARY TO DEMONSTRATE EMC BEEN IDENTIFIED?

SYSTEMS/EQUIPMENT E^3 CONTROL CHARTS

MILESTONE IIIA - LIMITED PRODUCTION	STATUS
• FUNDING	•
• DEVELOPMENT TEST RESULTS	•

OVERALL E^3 CONTROL STATUS •

G **SATISFACTORY** Y **MARGINAL** R **UNSATISFACTORY**

- IS E^3 CONTROL FUNDING SUFFICIENT TO VALIDATE READINESS FOR PRODUCTION?

- DOES TESTING DEMONSTRATE ADEQUATE E^3 CONTROL?

- HAVE THE E^3 CONTROL OBJECTIVES FOR TECHEVAL/OPEVAL BEEN IDENTIFIED?

SYSTEMS/EQUIPMENT E^3 CONTROL CHARTS

MILESTONE IIIB or III - FULL PRODUCTION	STATUS
• MAINTAIN FUNDING	•
• TECHEVAL/OPEVAL TEST RESULTS	•
• FIRST ARTICLE ACCEPTANCE TEST RESULTS (IF AVAILABLE)	•
• (OTHERWISE) PROTOTYPE INSTALLATION TEST RESULTS	•
• ALL KNOWN EMI PROBLEMS RESOLVED	•

OVERALL E^3 CONTROL STATUS •

G **SATISFACTORY** Y **MARGINAL** R **UNSATISFACTORY**

- IS THERE ASSURANCE THAT THE EQUIPMENT HAS MET ALL E^3 CONTROL REQUIREMENTS?

- DID A REVIEW OF DEVIATIONS AND WAIVERS INDICATE ANY PROBABLE E^3 CONTROL PROBLEMS?