NAVSEA OP 3565 Volume 2

0640-LP-002-5528 Twentieth Revision

ELECTROMAGNETIC RADIATION HAZARDS (HAZARDS TO ORDNANCE)

THIS PUBLICATION SUPERSEDES NAVSEA OP 3565 VOLUME 2 REVISION NINETEEN DATED 1 JULY 2016

DISTRIBUTION STATEMENT A: APPROVED FOR PUBLIC RELEASE. DISTRIBUTION IS UNLIMITED

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1 JULY 2025

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DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
1333 ISAAC HULL AVE SE
WASHINGTON NAVY YARD DC 20376-0001

IN REPLY REFER TO
8020
Ser 09-N84D/121
1 Jul 25

From: Commander, Naval Sea Systems Command (SEA 09)

Subj: REVISION 20 TO NAVAL SEA SYSTEMS COMMAND ORDNANCE PAMPHLET 3565 VOLUME 2, ELECTROMAGNETIC RADIATION HAZARDS (HAZARDS TO ORDNANCE)

Ref: (a) NAVSEA OP 3565 Vol 2 Rev 19

Encl: (1) Abstract of Significant Changes

1. This letter issues Naval Sea Systems Command (NAVSEA) Ordnance Pamphlet (OP) 3565 Volume 2, Revision 20. This revision supersedes reference (a).

2. The subject manual has been revised to incorporate regulations and procedures regarding the prevention of initiation of electrically initiated devices in ordnance from electromagnetic radiation. An abstract of the significant changes has been provided in enclosure (1).

3. The Naval Ordnance Safety and Security Activity point of contact is Mr. Michael Miller, NOSSA N84D, available at michael.d.miller4.civ@us.navy.mil.

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Digitally signed by CLARK.KERRY.A.1257532522
Date: 2025.07.01 08:07:04 -04'00'

K. A. CLARK
Acting

ABSTRACT OF SIGNIFICANT CHANGES

1. Updates have been made to paragraphs 1-4 and elsewhere to clarify that ordnance not containing electrically initiated devices (EID) is classified as No Hazards of Electromagnetic Radiation (HERO) Requirement.

2. Guidance regarding the processes and requirements for requesting a HERO survey, creating and implementing a HERO safety program, and maintaining a certified Emission Control (EMCON) bill have been updated.

3. Appendix D has been added to provide North Atlantic Treaty Organization (NATO) operational and procedural guidance for two approaching platforms.

4. Other administrative changes have been made as appropriate.

FOREWORD

1. The purpose of this volume is to prescribe operating procedures and precautions to prevent initiation of electrically initiated devices (EID) in ordnance from electromagnetic radiation (EMR) (hazards of electromagnetic radiation to ordnance (HERO)). NAVSEA OP 3565 Volume I provides operating procedures and precautions to prevent hazards of electromagnetic radiation to personnel (HERP) and fuel (HERF).

2. This manual supersedes NAVSEA OP 3565, Volume 2, Nineteenth Revision, dated 1 July 2016, which should be destroyed.

3. This volume provides technical guidance to assist commanding officers in carrying out their responsibilities for safety from a radio frequency (RF) hazards standpoint. The procedures and precautions prescribed herein apply in every instance within the Naval establishment (ships and shore stations) where an electrically-initiated explosive item is exposed to RF fields of potentially hazardous frequency and intensity. Operational commanders may waive compliance with any provision, when essential, under emergency conditions. When noncompliance with restrictions contained herein is essential, emergency procedures are provided in order to explain and minimize the risks involved.

4. Changes and revisions to this publication will be promulgated by Commanding Officer, Naval Ordnance Safety and Security Activity (NOSSA), in a timely manner following coordination with other cognizant commanders and commanding officers. Interim changes will be made by letter or message as advance change notices (ACN), which will be directed to the activities directly concerned.

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SAFETY SUMMARY

Caution statements appear throughout this manual. It is important that the significance of these statements be thoroughly understood by personnel using this manual.

CAUTION is used to highlight a statement or some other notification about an operation or maintenance procedure, practice, or condition that if not strictly observed could result in damage to or destruction of equipment, or loss of mission effectiveness.

This publication is a safety manual which defines the hazards of electromagnetic radiation to ordnance (HERO), and provides approved methods or procedures for minimizing accidents that could result from these hazards. Failure to observe operating procedures and precautions specified in this manual may lead to accidental initiation of electrically initiated devices (EID) contained in ordnance systems, causing injury or death to personnel or resulting in unreliable ordnance operation. The following caution statements appear in the text of this volume, and are repeated here for emphasis.

CAUTION

Low-Power Transceiver Devices Such As Cellular Telephones, Active Pagers, And some Walkie-Talkie And other RF devices may automatically transmit RF energy without operator action. These devices shall be turned off prior to entering magazine areas, and/or when approaching the established HERO separation distance for the specific device.

CAUTION

Do not attempt to handle an unevaluated ordnance item containing EIDs based on the restrictions for a similar device unless this action is specifically approved by the Commanding Officer, Naval Ordnance Safety and Security Activity (NOSSA) (N8).

In addition, notes in the text emphasize unusual or special procedures or conditions.

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CHAPTER 1
INTRODUCTION

1-1. PURPOSE.

This publication, volume 2, provides the precautions and procedures for safe handling, transporting, and storing of electrically initiated ordnance when the possibility of exposure to radio frequency (RF) environments exists. Hazards of electromagnetic radiation to ordnance (HERO) is the program concerned with prevention of accidental ignition of electrically initiated devices (EID) in ordnance due to RF electromagnetic fields. This volume will assist the user to accomplish the following:

a. Identify the HERO classification of electrically initiated ordnance (i.e., HERO SAFE, HERO SUSCEPTIBLE, and HERO UNSAFE).

b. Develop methods for calculating and controlling the RF environment.

c. Determine the safe separation distances for HERO UNSAFE and HERO SUSCEPTIBLE ORDNANCE.

d. Understand and apply general and operational HERO requirements.

e. Understand the use of Susceptibility Radiation Hazard (RADHAZ) Designator (SRAD) and Transmitter RADHAZ Designator (TRAD) codes and the management of HERO in the North Atlantic Treaty Organization (NATO) environment.

f. Understand and implement a HERO Emission Control (EMCON) Bill.

g. Determine the need for and request a HERO survey.

Users of this volume shall have a basic understanding of ordnance and RF emitter systems as well as some basic concepts of RF propagation.

1-2. SCOPE.

This volume has been prepared for use by U.S. Navy and U.S. Marine Corps activities engaged in the handling, storage, and transportation of electrically initiated ordnance. Appendixes provide definitions of terms, abbreviations, and symbols; a list of referenced documents; HERO EMCON Bill components, sample HERO Instructions for ships and shore activities, HERO survey periodicities, HERO evaluation process/test methodology for intentional emitters in below decks or enclosed spaces, and a HERO classification listing; and NATO operational procedure and guidance for two approaching platforms. Figure 1-1 is a flowchart for using Volume 2 to resolve particular HERO problems.

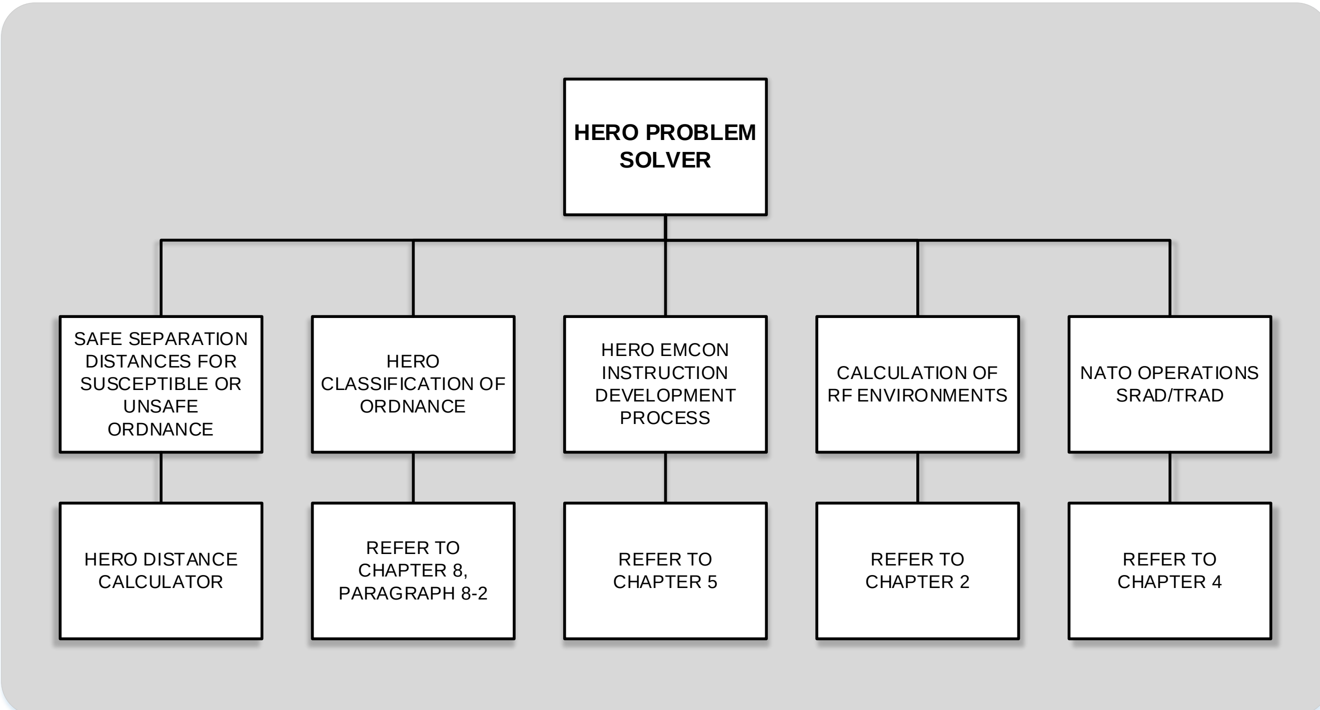


Figure 1-1. HERO Problem Solver

If a HERO problem cannot be resolved by using this manual, the problem shall be referred to:

Commanding Officer
Naval Ordnance Safety and Security Activity
Attn: Code N8
Building D-323, Suite 108
3817 Strauss Avenue
Indian Head, MD 20640-5151
COMM: 301-744-6003
DSN: 354-6003
EMAIL: NOSSA_HERO@us.navy.mil

1-3. BACKGROUND.

Electromagnetic radiation (EMR) hazards stem from the functional characteristics of electrically initiated ordnance. This EMR hazard is the result of absorption of electromagnetic (EM) energy by the firing circuitry of EIDs. Consequently, the induced energy causes heating of the EIDs bridgewire and primary explosive with which it is normally coated. (See figure 1-2). The ordnance EIDs may be accidentally initiated or their performance degraded by exposure to RF environments. In general, ordnance is most susceptible to RF environments during assembly, disassembly, handling, loading, and unloading. The HERO program (both surveys and testing efforts) addresses protection of ordnance from the electromagnetic environment (EME) during all stockpile-to-safe separation sequence (S4) phases. Figure 1-3 illustrates a typical progression through this sequence.

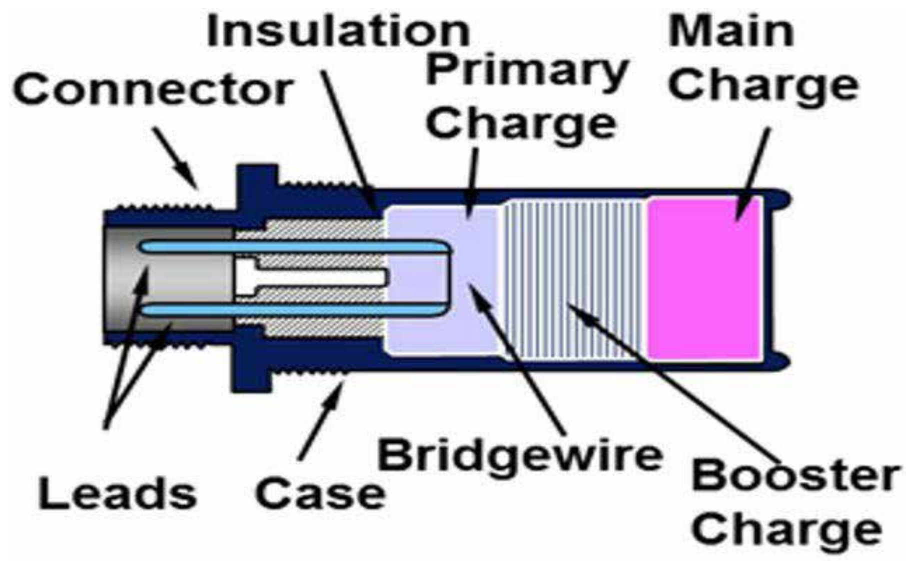


Figure 1-2. Example of an EID

Significant differences in the physical configuration of the ordnance item can be expected as the item transitions from one phase to another. Different physical configurations can provide different levels of protection. Furthermore, it is likely that the EME associated with each phase will be quite different. For example, the EME levels associated with air-launched ordnance handling/loading operations (at the flight deck or weather deck level) are generally less than those encountered during platform-loaded (main-beam levels). Thus, the potential for a HERO problem is highly dependent on both of these phase-dependent conditions. From a HERO protection standpoint, it is especially important to address all unique ordnance configurations. In the past, only two configurations were defined: handling/loading and presence; therefore, in previous revisions to this volume, HERO data sheets only address these two configurations. Presently, data found in the HERO data sheets assume the following "mapping" order: transportation/storage data map into the transportation/storage category; loading/unloading data map into the handling/loading category; and staged, platform-loaded and immediate post-launch map into the presence category. Assembly and disassembly operations are addressed in chapter 1 as fundamentally HERO UNSAFE ORDNANCE operations due to the exposure of internal circuitry or the addition of external wiring during check-out of the item.

1-3.1 THE NEED FOR HERO CONTROL. Technological advances have resulted in the proliferation of communication and radar equipment, many of which radiate high levels of EM energy. These advances, coupled with the increased trend to use more sensitive, low-power electronic circuits in the design of ordnance systems, perpetuate a long-standing hazard. The hazards that result from adverse interactions between the EME and the electrical initiators or initiating systems contained within ordnance systems are referred to in Department of Defense (DoD) terminology as HERO. The need for HERO control arises from a fundamental incompatibility between the EIDs or EID firing circuits contained within the ordnance and the external radiated EME that the ordnance encounters during its progression through the S4.

1-3.1.1 EIDs perform a variety of functions, such as initiating rocket motors, arming and detonating warheads, and ejecting chaff and flares. The need for HERO control arises so that these functions do not occur unintentionally or prematurely because of exposure to EM energy. There are two potential forms of such unintentional, RF-induced EID response:

a. Activation of the initiating device itself by EM energy coupled directly into the device or upset of an energized firing circuit, resulting in a firing signal erroneously sent to the EID.

b. Degradation or dudding of the initiating device by EM energy coupled directly into the device.

1-3.1.2 In the first case, accidental EID activation can have negative consequences on safety (for example, the premature initiation of explosive trains) or on reliability (for example, once initiated, EIDs can no longer perform their intended function, thus rendering the system incapable of performing its mission). In the second case, the presence of EM energy in an EID can alter its ignition properties without actually firing the device, so the device will not function when legitimate firing stimuli are applied; most likely, this will adversely affect system reliability. The combination of severe EME levels and sensitive, insufficiently protected components/ circuits can have disastrous consequences. Although the problem was recognized in the late 1950s, it has persisted even today for two reasons: first, the introduction of more powerful RF transmitters has raised operational EME levels, and second, the use of sensitive electrically initiated systems has continued.Today, MIL-STD-464 (series) requires that ordnance be designed to provide sufficient protection from the EME and that its performance be verified by testing and/or by an analysis.

1-3.1.4 Given this reality, HERO EMCON and ordnance handling restrictions form a compromise which allows safe ordnance operations ashore and at sea. EMCON is derived from an analysis of the fields produced by the existing RF transmitters or by direct measurement during HERO surveys and from the ordnance susceptibilities. Handling restrictions are the result of ordnance system tests performed under worst-case conditions using actual handling and loading procedures. The data gathered from these tests are the basis for the HERO classifications and recommendations provided in HERO data sheets.

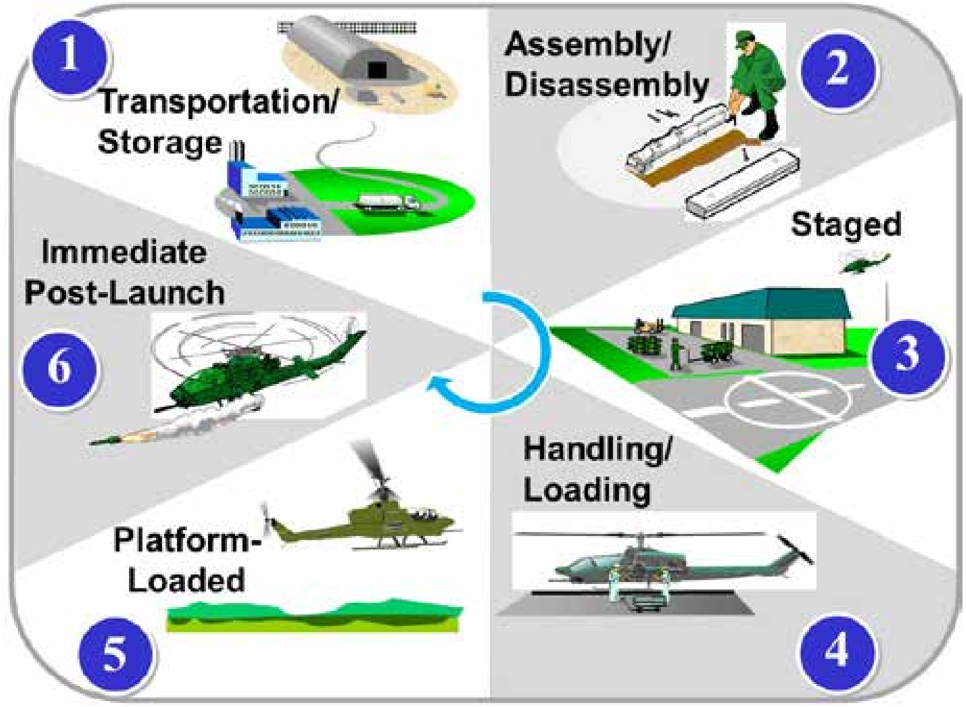


Figure 1-3. Ordnance Stockpile-to-Safe Separation Sequence

1-4. INTRODUCTION TO HERO CLASSIFICATION.

Three classifications pertinent to HERO for ordnance containing EIDs have been established. They are HERO SAFE ORDNANCE, HERO SUSCEPTIBLE ORDNANCE, and HERO UNSAFE ORDNANCE. The classification for ordnance not containing EIDs is No HERO Requirement. These classifications are based upon the degree of susceptibility in accordance with the pass/fail criteria of MIL-STD-464 (series). Items that meet the pass/fail criteria of MIL-STD-464 (series) are considered to be negligibly susceptible and require no RF environment restrictions beyond the general HERO requirements described in paragraph 7-3. These items are classified as HERO SAFE ORDNANCE. Items that are susceptible and require moderate RF environment restrictions are classified as HERO SUSCEPTIBLE ORDNANCE. HERO UNSAFE ORDNANCE may include either items that have never been evaluated for HERO or ordnance items which have a HERO SAFE or HERO SUSCEPTIBLE classification; however, by assembling, disassembling, or otherwise subjecting the ordnance to unauthorized conditions or operations, the performance of the ordnance may be degraded due to exposure to an RF environment, or the ordnance may accidentally ignite or detonate when exposed to an RF environment, rendering it HERO UNSAFE. Items without an EID are classified as No HERO Requirement. Refer to Appendix A for the complete definitions of HERO SAFE ORDNANCE, HERO SUSCEPTIBLE ORDNANCE, HERO UNSAFE ORDNANCE, and No HERO Requirement.

NOTE

The preceding classifications do not apply to percussion-initiated devices or systems. Ordnance or equipment which does not contain EIDs is classified as No HERO Requirement.

The following chapters provide instruction on how to determine the HERO classification of ordnance.

1-5. MANAGING HERO.

In general, risk-reduction measures developed using analytical methods may entail silencing all emitters during ordnance operations, ensuring ordnance operations are conducted in RF-free environments, or imposing safe separation distances (SSD) between the offending emitters and HERO SUSCEPTIBLE and HERO UNSAFE ORDNANCE. Unfortunately, these methods can be very restrictive and may reduce operational flexibility. For HERO, the term RF-free environment refers to a condition that exists in magazines where the use of intentional RF emitters is restricted/controlled, and the ambient EME is well below the HERO UNSAFE ORDNANCE curve presented in figure 2-2.

1-5.1 ASSESSMENT OF RISK. Managing HERO through the use of HERO EMCON Bills, particularly those derived from instrumented HERO surveys where the RF environment is characterized through measurements, minimizes operational restrictions for fleet operations. HERO EMCON Bills are a result of a risk assessment involving the comparison of ordnance susceptibility, expressed as the maximum allowable environment (MAE), against the expected operational EME. If the EME levels exceed the MAE levels, there is a risk of inadvertent initiation of EIDs, with negative consequences regarding safety and/or reliability.

1-5.2 RISK MANAGEMENT. HERO EMCON Bills are written to specify emitter restrictions for each Navy ship and shore installation when maximum operational EME levels exceed the MAEs for susceptible items at respective ordnance locations. The Navy categorizes all ordnance in terms of the relative immunity. For example, HERO SAFE ORDNANCE is designated for ordnance that can be exposed safely to EME levels as high as those specified in MIL-STD-464 (series). HERO UNSAFE ORDNANCE and HERO SUSCEPTIBLE ORDNANCE designations are reserved for items that have known susceptibilities revealed by a test or an analysis or have not been certified based on the HERO requirements in MIL-STD-464 (series). These terms, or HERO classifications, provide a convenient means for identifying whether or not a HERO concern exists during ordnance operations. The HERO Instruction cites each ordnance item stored or handled aboard a ship or shore installation, as well as any required local emitter restrictions necessary for safe operations.

1-5.2.1 Condition Code H Unserviceable Condemned. When an ordnance item no longer has a mission, is over-age, or is otherwise determined to be of no further use to the parent Service, its condition code is changed to “Hotel” (Code H Unserviceable Condemned), and a Notice of Ammunition Reclassification (NAR) message is issued to notify all ordnance activities of the circumstances for the change. The Naval Operational Logistics Support Center (NOLSC), at the direction of the item manager, moves the item to ammunition class “X” (Obsolete), where it will remain until all assets have been transferred to the final demilitarization site. Coordination among Systems Commands (SYSCOM) is necessary and ongoing to ensure proper classification of ordnance items.

1-5.2.2 The Navy’s HERO program treats all items containing EIDs that are Unserviceable Condemned and obsolete as HERO UNSAFE ORDNANCE regardless of the previous HERO classification. Upon receipt of a NAR moving a Navy Ammunition Logistic Code (NALC) to Condition Code H Unserviceable Condemned, the appropriate HERO data sheets will be modified to reflect “Unserviceable/Obsolete.” The secondary reference field of the data sheet will be annotated with the NAR number, the comment fields will be modified to show the item is no longer available for Fleet issue, and the MAEs will reflect the HERO UNSAFE ORDNANCE levels. If the item is used by other Services, the U.S. Navy or U.S. Marine Corps data sheets will be modified as described above with the notation in the comment section that only U.S. Navy or U.S. Marine Corps assets are affected. In the event that an Unserviceable Condemned item is encountered, further HERO guidance is available and can be provided upon request.

1-6. TRI-SERVICE APPROACH TO HERO.

The basic DoD HERO requirements for design and performance verification are found in MIL-STD-464 (series); however, because of the varied experiences with HERO within the Services, it is not surprising that Service-unique approaches have evolved over time to deal with HERO problems. Army, Navy, and Air Force HERO programs reflect fundamental differences in the perception of the problem's magnitude. Besides Service histories, other factors have influenced the respective HERO programs, such as the way the Services store, transport, and use ordnance, and the practical options available for minimizing hazards. For example, when operational EME levels exceed susceptibility thresholds, the Services can opt to use different risk-reduction measures. The U.S. Army and U.S. Air Force, for example, might stipulate a minimum separation distance between the susceptible ordnance and the offending transmitter; whereas, limited space aboard naval platforms/systems might leave no other option for the U.S. Navy than to impose restrictions on the emissions of the offending transmitter(s). Here, various methods are employed such as frequency management, reducing the transmitter output power, or limiting the antenna radiation zones, all of which are employed in a U.S. Navy HERO EMCON Bill in order to manage HERO while minimizing the operational restrictions.

1-6.1 COMMON APPROACHES. Despite differences in the way each Service manages HERO problems, there are certain essential elements that are common to all Services' HERO programs. These include the following:

a. A definition of the expected EME levels for all ordnance configurations.

b. Prescribed methods to quantify system degradation or deficiencies.

c. A process to develop and validate effective, practical "fixes" for known HERO deficiencies.

d. Establishment of operational procedures or restrictions to minimize risks when deficiencies are not corrected.

1-6.2 DOD-WIDE APPLICATION. It is important to note that the HERO SUSCEPTIBLE and HERO UNSAFE curves found in chapter 2 were derived from a tri-Service effort; whereby, all HERO test data for each of the Services were reviewed and a common rationale was used to develop the curves. Thus, the HERO curves found within this document can be used for all U.S. DoD ordnance when calculating SSDs once it has been established that the ordnance item is either HERO SUSCEPTIBLE or HERO UNSAFE ORDNANCE.

1-7. PERSONNEL REQUIREMENTS AND SAFETY PRECAUTIONS.

1-7.1 PERSONNEL REQUIREMENTS. The problems resulting from personnel and ordnance exposure to RF energy can be mitigated if all personnel follow the safety regulations as prescribed in this manual. It is the responsibility of the commanding officer of each ship or shore station to implement the requirements contained in this volume and implement and maintain a HERO safety training program to ensure annual training for all affected personnel. Procedures shall be established whereby RF transmitting equipment is positively controlled and coordinated with personnel working near emitters and/or handling ordnance. No personnel shall turn on any transmitting equipment without proper authorization from the supervisor in charge of operations. In addition, personnel should be familiar with:

a. RF radiation hazards as described in volume 1.

b. Placards, warning signs, symbols, labels, and painted safety circles and zones.

c. The proper use of this manual.

d. The ability to verify that the appropriate HERO EMCON procedures have been set as outlined in the ship- or shore-specific HERO EMCON Bill.

1-8. HERO WARNING SYMBOLS AND LABELS.

1-8.1 HERO WARNING SYMBOLS. Warning symbols shall be posted at any location where radar equipment or other possible sources of EMR might create the potential for premature initiation of ordnance due to HERO. An example of an RF warning symbol is shown in figure 1-4. This symbol is placed along ordnance transportation routes and at prescribed locations for ordnance operations (e.g., missile assembly, ammunition pier, etc.) to alert operators of mobile and portable emitter systems such as radios and cellular telephones to a potential hazard when using radios and cellular telephones past this point. Guidance for manufacturing symbols is provided below.

1-8.2 HERO WARNING LABELS. Warning labels shall be affixed to portable and mobile radios, and are for use both on ship and shore stations. An example of an RF warning label is shown in figure 1-5. This warning label alerts the emitter operator to a potential hazard if the emitter is operated within the prescribed distance of ordnance operations. The label has blank spaces for inserting HERO SUSCEPTIBLE or HERO UNSAFE ORDNANCE SSDs in feet. The distances are obtained by using the HERO Safe Separation Distance Calculator, which is available in the RADHAZ Tools on the Electromagnetic Environmental Effects (E3) Team Online Knowledge Management System (KMS) and is discussed in chapter 2 of this volume. A smaller label (NAVSEA Form 5104/4, size 1½ x 2⅓ inches) is recommended for hand-held portable radios and a larger (NAVSEA Form 5104/3, size 2 x 2⅔ inches) for mobiles. A camouflage label is provided for discretionary use in tactical, low-light situations.

Materials: Anodized aluminum, adhesive backing optional.

Colors: Base material of anodized silver background, black anodized messages in bottom triangle, alternating colored blocks of anodized red and yellow in a border surrounding black anodized logogram in top triangle.

Logogram: Design will be a pictorial presentation of a radar antenna consisting of a pylon with a dot simulating an antenna and concentric area simulating pulsed energy.

Wording: The title “WARNING: RADIO FREQUENCY HAZARD” is standard for all signs. The messages in the lower triangle will vary according to particular situation; use of descriptive wording or warning information is the user’s option.

Figure 1-4. HERO Warning Symbol

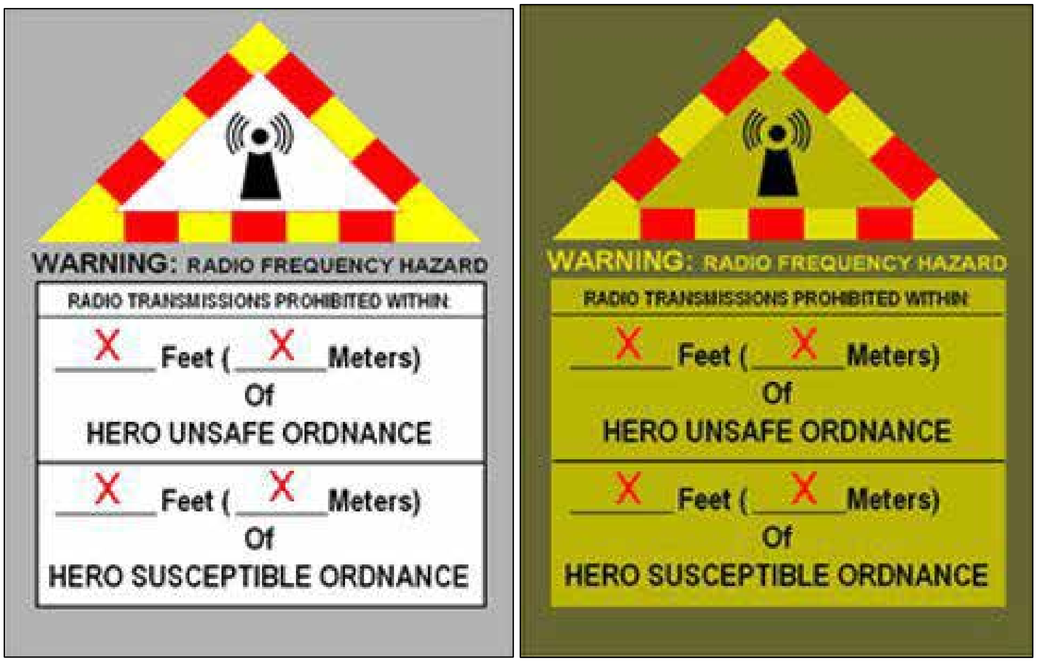


Figure 1-5. HERO Warning Labels

1-8.2.1 HERO warning labels (NAVSEA Forms 5104/3 and 5104/4), may be created as follows:

e. The label sheets are done in Adobe Acrobat (*.pdf).

f. Add the HERO UNSAFE and HERO SUSCEPTIBLE ORDNANCE SSDs (number obtained using the HERO Safe Separation Distance Calculator available in the RADHAZ Tools on the E3 Team Online KMS and discussed in chapter 2). To move to the next label press the “tab” key on your keyboard.

g. Ensure printer has full sheet 8½- x 11-inch labels and print.

h. The larger label, 5104/3 (2 x 2⅔ inches), is recommended for mobiles and the smaller label, 5104/4 (1½ x 2⅓ inches), for hand-held portable radios.

1-8.3 ORDERING HERO WARNING SYMBOLS AND LABELS. Table 1-1 provides stock numbers, descriptions, and sources of HERO warning symbols and labels.

Table 1-1. HERO Warning Symbols and Labels

NAVSEA Form	Stock Number	Description/Size
HERO WARNING SYMBOLS[1]		
NAVSEA 106-12	7690-01-377-5447	RF Hazard Warning, Secure Unauthorized Radio Transmitters/12 Inches
NAVSEA 107-5	7690-01-377-5901	RF Hazard Warning, Ordnance Handling/5 Inches
NAVSEA 108-5	7690-01-377-5902	RF Hazard Warning, Operating Transmitters/5 Inches
HERO WARNING LABELS[2]		
NAVSEA 5104/4	0116-LF-115-0800	RADHAZ Warning Label (Blank) Feet From/1½ by 2⅓ Inches
NAVSEA 5104/3	0116-LF-115-0700	RADHAZ Warning Label (Blank) Feet From/2 by 2⅔ Inches

NOTES:

1. Available from Defense Logistics Agency (DLA): (877) 352-2255, for information on how to requisition.
2. Available from Document Automation and Production Service (DAPS) Philadelphia: (877) 327-7226.

1-9. MANDATORY AND ADVISORY REGULATIONS

The requirements in this manual that use the commands “shall,” “will,” or “must” are mandatory unless they are specifically waived or exempted by the Chief of Naval Operations (CNO) per the provisions of OPNAVINST 8020.14 (series). Advisory requirements are those in which “may” or “should” are used. These advisory requirements shall be followed unless exceptions are authorized in writing by the commanding officer.

1-10. DEFINITIONS, ABBREVIATIONS, AND SYMBOLS.

The definitions of the terms and the meaning of the abbreviations and symbols used in this publication are listed in appendix A.

1-11. REFERENCE DOCUMENTS.

A list of documents containing all information sources referenced in this volume is presented in appendix B. These documents, together with ship/station instructions and notices, technical publications, and standard operating procedures (SOP), shall be maintained in appropriate libraries as a collection of current information pertaining to the hazards of RF radiation to ordnance which contain EIDs.

1-12. DATE OF PUBLICATION.

The date of publication of this technical manual, and of revisions and changes thereto, as shown on the title page, is the estimated date the publication is to be distributed. However, the manual, revision, or change is effective upon receipt, regardless of the date shown on the title page.

1-13. REPORTING DEFICIENCIES IN THIS MANUAL.

Ships, training activities, supply points, depots, Naval shipyards, and supervisors of shipbuilding are requested to arrange for the maximum practical use and evaluation of Naval Sea Systems Command (NAVSEA) technical manuals (TM). All errors, omissions, discrepancies and suggestions for improvement to NAVSEA technical manuals shall be submitted via one of the following methods:

1-13.1 UNCLASSIFIED TM FEEDBACK PROCESS (PREFERRED).

a. Submit feedback directly through the Model Based Product Support (MBPS) website at. https://mbps.navseaplm.navy.mil/Windchill/

b. To request an MBPS account submit a ticket to the National Help Desk (NHDSM), https://nhdsm.navair.navy.mil/ (DoD PKI Certificate required).

1-13.2 COMPLETED NAVSEA 4160/1, TECHNICAL MANUAL DEFICIENCY/EVALUATION REPORT.

a. Completed NAVSEA 4160/1 forms may be emailed to nav_helpdesk.fct@navy.mil. To expedite your submission, carbon-copy (cc) the NOSSA Explosives Safety Technical Manuals mailbox at NOSSA_ESTM@us.navy.mil.

b. Completed NAVSEA 4160/1 forms may be submitted via mail to Commanding Officer, NAVSURFWARCENDIV Port Hueneme (NSDSA Code 310 TMDERs), 4353 Missile Way BLDG 1389, Port Hueneme, CA, 93043-4307, with a copy mailed to Commanding Officer, Naval Ordnance Safety and Security Activity (N10G), 3817 Strauss Avenue, Suite 108, Indian Head, MD 20640-5151.

NOTE

All feedback submitted, either via MBPS feedback submission or completed NAVSEA 4160/1, must be unclassified.

1-14. ELECTROMAGNETIC ENVIRONMENTAL EFFECTS(E3) TEAM ONLINE KNOWLEDGE MANAGEMENT SYSTEM.

The E3 Team Online KMS is U.S. Fleet Cyber Command certified and accredited for supporting the creation, capture, storage, and dissemination of E3 information, particularly as it relates to the HERO program. This KMS contains the HERO database of over 18,000 records and provides a catalog of ordnance items by NALC/Department of Defense Identification Code (DoDIC) with specific information pertaining to each item, including current MAEs and HERO status. The E3 Team Online KMS contains HERO data sheets for ordnance systems and ordnance/platform/launcher combinations, for items containing EIDs that have been analyzed by design or tested for HERO, and for ordnance items that have No HERO Requirement.

a. The E3 Team Online KMS also has built-in e-tools to calculate SSDS and MAES and contains over 28,000 technical reports dating back to the 1960s, including all of the HERO test and survey reports. The E3 Team Online KMS provides an interface (platform management application) to manage and retrieve information pertaining to specific ship, shore, vehicle, and aircraft platforms.

Platform information includes HERO/HERP/HERF survey reports, transmitter/antenna configurations, photographs and drawings, EME measurement data, ordnance listings, aircraft/vehicles supported, and HERO EMCON bills.

b. To request an account and to log in to the E3 Team Online KMS upon account approval, users must visit https://E3.nswc.navy.mil. A valid common access card (CAC) is required for access to this web portal. The platform & ordnance guidance request link on the E3 Team Online KMS home page may be used to request clarification of content by Naval Surface Warfare Center, Dahlgren Division (NSWCDD), Electromagnetic Measurements & Engineering Branch (B55). If unable to reach this web portal, please contact usn.south-potomac.navsurfwarcendahva.mbx.e3-user-assistance@us.navy.mil. Questions regarding E3 Team Online KMS access and content should be directed to DLGR_NSWC_RADHAZ.Fct@navy.mil

CHAPTER 2
RADIO FREQUENCY ENVIRONMENTS

2-1. METHODS FOR CONTROLLING THE RF ENVIRONMENT.

The sources for electromagnetic environment (EME) levels that exist at ship and shore installation have been collected during Hazards of Electromagnetic Radiation to Ordnance (HERO), Hazards of Electromagnetic Radiation to Personnel (HERP), and flight deck EME surveys and that data can be found within the survey reports. In addition, main-beam calculations can be obtained once the transmitter and antenna specifications are known. These data can be found in transmitter databases, manufacturers' data sheets, technical manuals, HERO reports, HERP reports, and flight-deck EME survey reports.

The ensuing paragraphs are provided so that users of the HERO curves (figure 2-1 and figure 2-2) and the HERO Safe Separation Distance Calculator (available in the RADHAZ Tools on the Electromagnetic Environmental Effects (E3) Team Online Knowledge Management System (KMS)), understand the use and limitations of these tools. In general, when using the HERO Safe Separation Distance Calculator, it is important to use average power rather than peak power as the input parameter for calculating a safe separation distance (SSD). It is the average power that most often influences electrically initiated devices (EID). However, it is important to note that some ordnance items (e.g. electrical primers) have been experimentally shown to have peak responses, and certain emitter waveforms, specifically long pulse widths (PW), and high duty cycles (DC) relative to the EID response time may drive SSD calculations to consider EME levels in excess of the emitter average power and up to the full peak EME. For the HERO curves and the associated equations, it is also important to understand that the results given are only accurate in the far field; consequently, discussions related to the field regions associated with an antenna are provided. For example, if one were to manipulate the equations to solve for a power density/field intensity at a new distance, the results might not accurately reflect the true value. For calculating values in the near field of an antenna, one would need to use the equations found in NAVSEA OP 3565 Volume 1. Consequently, this chapter introduces information germane to calculating radio-frequency (RF) environments and helps provide a better understanding of the use of these tools.

2-1.1 PEAK AND AVERAGE POWER CALCULATIONS. Typically, communication systems are capable of continuous wave (CW) or modulation techniques, such as amplitude modulation (AM), frequency modulation (FM), and pulse-code modulation (PCM). In order to determine the root mean squared (rms) peak power for FM and PCM, a worst-case approach is used where the peak power is equal to the unmodulated carrier peak power. However, the peak envelope power (PEP) of a 100% modulated AM signal is twice the carrier peak power; therefore, it is used to provide the worst-case scenario from AM signals. Also, the DC of a CW signal equals unity and the average and peak rms power are the same. The aforementioned rationale is used when calculating EMEs because of the randomly changing nature of true peak power over a specific interval.

Pulse-modulated signals, typically radars, have differences between peak and average rms power. The average power is determined by the ratio of time-on to time-off over an interval. This time-on/off ratio is the DC and can be calculated using equation 2-1. The average power can be calculated by the product of peak power and DC as shown in equation 2-2.

$$DC = \frac{pw}{pri} \text{ or } DC = pw \times prf$$

Equation 2-1. Time On/Off Ratio

$$P_a = P_p \times DC$$

Equation 2-2. Average Power

where

DC = the duty cycle (unitless)

pw = the pulse width [second (sec)]

pri = the pulse repetition rate interval (sec)

prf = the pulse repetition rate frequency [hertz (Hz)]

P_a = the average power (watts)

P_p = the peak power (watts)

2-1.2 ANTENNA FIELD REGIONS. The fields around an antenna are divided into three regions: the reactive near-field; the radiating near-field or fresnel; and the far-field or fraunhofer. The boundaries for these field regions are defined by equations 2-3 through 2-6 respectively.

$$NF_r \leq 0.62 \times \sqrt{\frac{d^3}{\lambda}}$$

Equation 2-3. Antenna Near-Field Reactive Region

$$0.62 \times \sqrt{\frac{d^3}{\lambda}} < NF_{rad} < \frac{2 \times d^2}{\lambda}$$

Equation 2-4. Antenna Near-Field Radiating Region (For Aperture Antennas)

or

$$0.62 \times \sqrt{\frac{d^3}{\lambda}} < NF_{rad} < \frac{\lambda}{2\pi}$$

Equation 2-5. Antenna Near-Field Radiating Region (For Wire Antennas)

$$FF \geq \frac{2 \times d^2}{\lambda}$$

Equation 2-6. Antenna Far-Field Region

where

NFr = the reactive near-field region (meters)

$Nfrad$ = the radiating near-field region (meters)

FF = the far-field region (meters)

l = the wavelength (meters)

d = the largest dimension of antenna (meters)

NOTE

If the antenna is small compared to the wavelength (l > 10d), the radiating near-field does not exist.

2-1.3 POWER DENSITY AND FIELD INTENSITY CALCULATIONS. The HERO Safe Separation Distance Calculator and SSDs are all derived using a far-field equation. In the far-field region, the power density is calculated using equation 2-7. All power density levels are calculated within the 3-decibel (dB) beam width of the main beam.

$$P_d = \frac{P_T \times G}{4 \times \pi \times r^2}$$

Equation 2-7. Power Density

where

P_d = the power density [watts per meter squared (W/m^2)]

P_T = the average or peak transmitter output power (watts)

G = the numerical antenna gain (unitless)

r = the distance or range from the antenna (meters)

In the near-field region, the power densities are calculated using the far-field equation 2-7 and a near-field gain reduction factor N. See NAVSEA OP 3565 Volume 1 for calculation of the near-field gain reduction factor. Power density is related to the electric field (E-field) by equation 2-8. When converting from power density to field intensity (or vice versa), the following relationship only exists for a plane wave (within the far field of the antenna where the relationship between the E-field and magnetic field (H-field) is orthogonal and clearly defined).

$$E = \sqrt{P_d \times Z_o}$$

Equation 2-8. Electric Field (E-Field)

where

E = the maximum E-field strength [volt per meter-root mean square (V/m-rms)]

Z_o = the intrinsic impedance of free space [120π or approximately 377 ohms (Ω)]

P_d = the power density (W/m^2)

In the near-field region, an antenna's E- and H-fields do not exhibit a constant ratio of 120π (approximately 377 Ω), the intrinsic impedance of free space. Depending on the source antenna's terminal voltage, impedance, and driver current, the E- and H-fields will vary at different rates where one field becomes dominant. As the far-field region is approached, the ratio of the E- and H-fields begins to approximate 377 Ω; variation between the fields becomes less, and any dominants of one field are reduced.

2-2. FIELD STRENGTH/DISTANCE RESTRICTIONS.

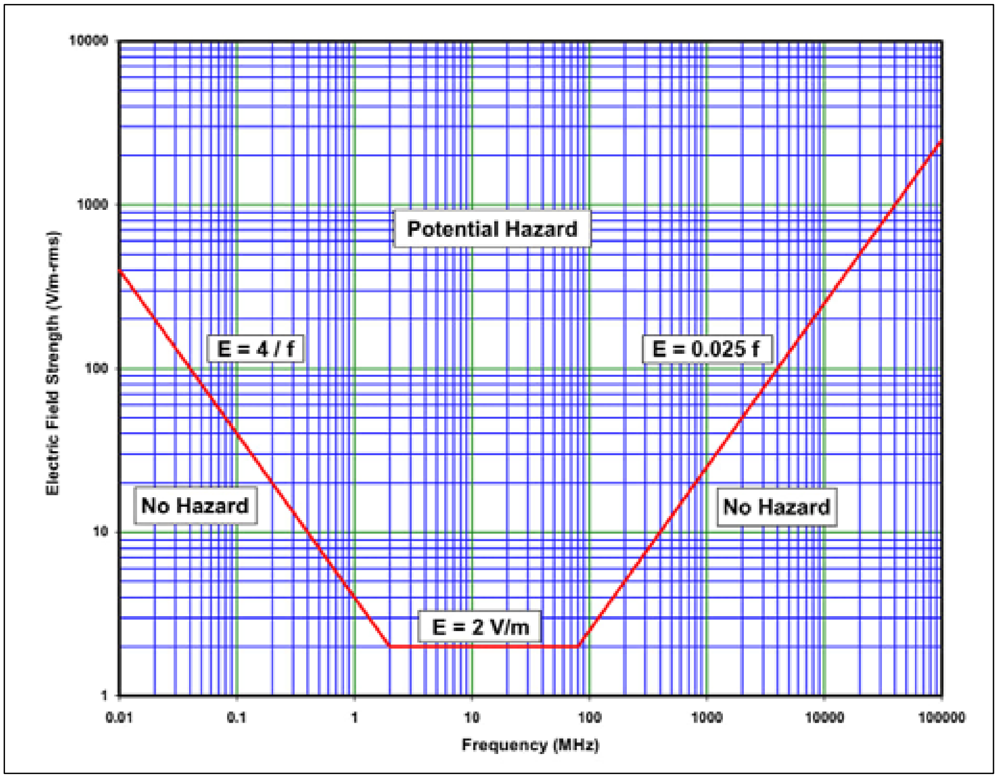
Figure 2-1 and figure 2-2 have been prepared on the basis of worst-case conditions for all HERO SUSCEPTIBLE and HERO UNSAFE ORDNANCE and may be used in determining the maximum RF environment for any ordnance system when specific maximum allowable environment (MAE) susceptibility data are not available or for ordnance that has not been HERO evaluated.

NOTE

Calculations in this chapter provide a relatively accurate measure of the maximum field strength at shore transmitter sites. They may be used for shipboard transmitters; however, the results are subject to beam reflections that may cause severe power differences from those calculated. The only accurate gauge of shipboard power density/field intensity is actual measurement data obtained through a HERO survey.

Data sheets are available on the E3 Team Online KMS for all Naval HERO program-evaluated ordnance that has been tested/analyzed against known environments. Individual data sheets generally provide MAEs that are less restrictive than the MAEs presented in the general HERO curves shown in figure 2-1 and figure 2-2. The HERO curves are also the basis for the equations found in the HERO Safe Separation Distance Calculator. Hence, the HERO curves provide a means for determining a general MAE for HERO SUSCEPTIBLE and HERO UNSAFE ORDNANCE when no specific MAE data are available, while the HERO Safe Separation Distance Calculator applies equation 2-7 to those equations to allow for a calculated SSD for HERO SUSCEPTIBLE and HERO UNSAFE ORDNANCE when no measured data are available.

2-2.1 SAFE FIELD STRENGTH/DISTANCE CALCULATION. The maximum safe field strengths for the various frequency ranges for HERO SUSCEPTIBLE and HERO UNSAFE ORDNANCE, shown on figure 2-1 and figure 2-2, when applied to the basic distance field strength equation, will determine the "worst-case" safe distance. The safe field strength/distance equations for HERO SUSCEPTIBLE ORDNANCE are derived from figure 2-1. The safe field strength/distance equations for HERO UNSAFE ORDNANCE are derived from figure 2-2. When using HERO equations and the HERO Safe Separation Distance Calculator to determine a safe separation distance, it is the average power of a transmitter, the antenna gain in decibels relative to isotropic (dBi), and the lowest operational frequency of the transmitter that are used to calculate the SSDs. The HERO Safe Separation Distance Calculator for these equations is available in the RADHAZ Tools on the E3 Team Online KMS.



Frequency Ranges (MHz)	Distance Equations
0.01 £ f < 2.0	$D = 1.37\ f\ \sqrt{PtGt}$ meters $D = 4.5\ f\ \sqrt{PtGt}$ feet
2.0 £ f < 80.0	$D = 2.74\ \sqrt{PtGt}$ meters $D = 9\ \sqrt{PtGt}$ feet
80.0 £ f < 100,000	$D = 219\ f^{-1}\ \sqrt{PtGt}$ meters $D = 718\ f^{-1}\ \sqrt{PtGt}$ feet

Where:

D is the distance in the units designated.

Pt is the average power output of the transmitter in watts.

Gt is the numerical (far-field) gain ratio (not the dB value) of the transmitting antenna, derived as follows:

$G_t = 1 \times 10^{G/10}$ where

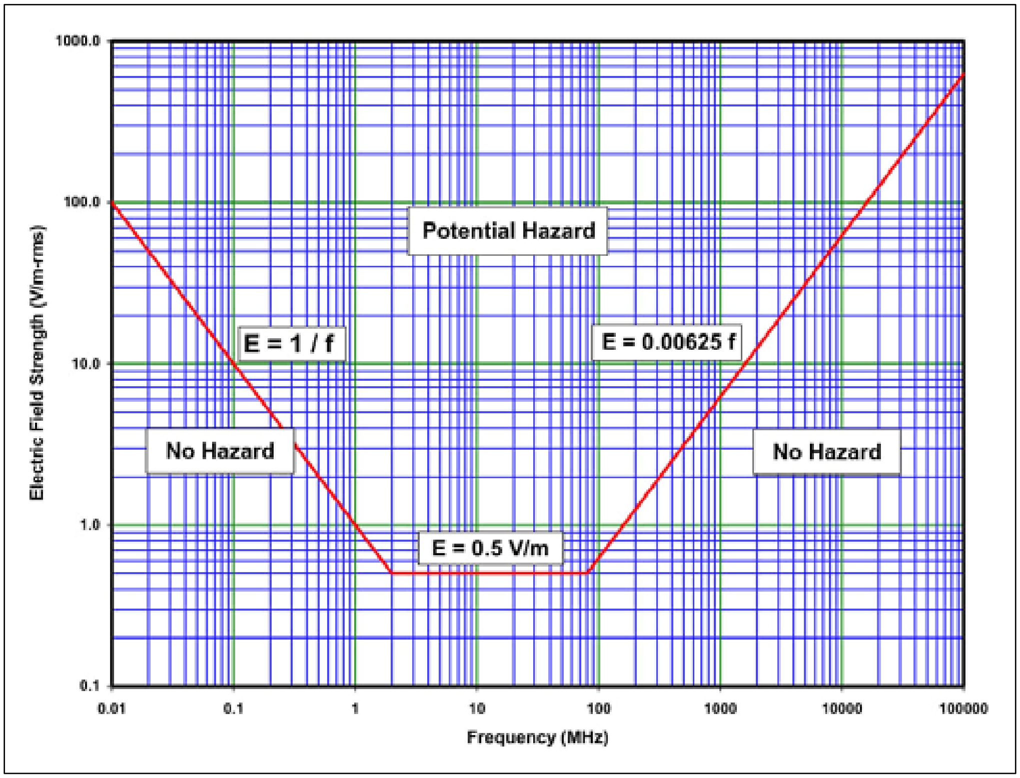
G = gain in dBi, and

f is the transmitting frequency in megahertz (MHz).

Notes:

1. The information above represents worst-case conditions for safe separation distance (SSD) required.
2. Equations are provided with the proper numerical multipliers to yield distances in either meters or feet.
3. In cases where the computed SSD is less than 10 feet (3 meters), refer to paragraph 7-3.1.16 and table 3-1 for guidance.

Figure 2-1. Graph and Equations for Computing Safe Field Strength/Distance for HERO SUSCEPTIBLE Ordnance



Frequency Ranges (MHz)	Distance Equations
0.01 £ *f* < 2.0	$D = 5.5\ f \sqrt{PtGt}$ meters $D = 18\ f \sqrt{PtGt}$ feet
2.0 £ *f* < 80.0	$D = 10.95 \sqrt{PtGt}$ meters $D = 36 \sqrt{PtGt}$ feet
80.0 £ *f* < 100,000	$D = 876\ f^{-1} \sqrt{PtGt}$ meters $D = 2{,}873\ f^{-1} \sqrt{PtGt}$ feet

Where:

D is the distance in the units designated.

Pt is the average power output of the transmitter in watts.

Gt is the numerical (far-field) gain ratio (not the dB value) of the transmitting antenna, derived as follows:

$G_t = 1 \times 10^{G/10}$ where

G = gain in dBi, and

f is the transmitting frequency in megahertz (MHz)

Notes:

1. The information above represents “worst-case” conditions for safe separation distance (SSD) required.
2. Equations are provided with the proper numerical multipliers to yield distances in either meters or feet.
3. In cases where the computed SSD is less than 10 feet (3 meters), refer to paragraph 7-3.1.16 and table 3-1 for guidance.

Figure 2-2. Graph and Equations for Computing Safe Field Strength/Distance for HERO UNSAFE Ordnance

Figure 2-3 has been prepared for all HERO SUSCEPTIBLE and HERO UNSAFE ORDNANCE and may be used in determining the maximum H-field limits for ordnance systems.

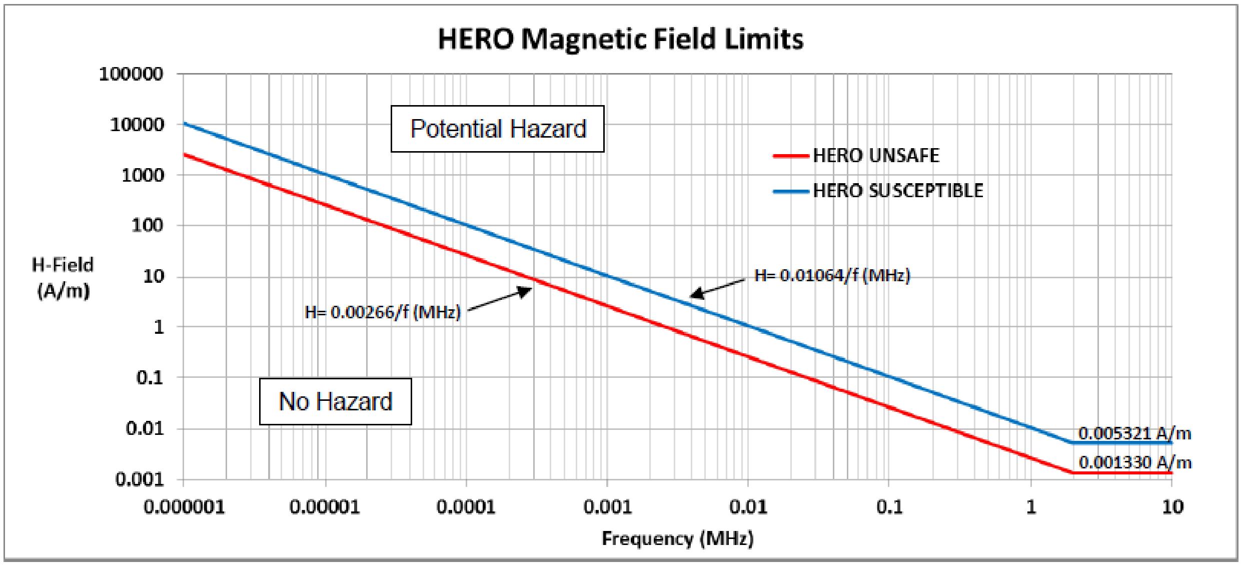


Figure 2-3. H-Field limits for HERO SUSCEPTIBLE and HERO UNSAFE Ordnance

2-2.2 10-FOOT RULE. Maintain a minimum SSD of 10 feet (3 meters) between transmitting antennas and all ordnance items regardless of their HERO classification. The separation distance applies to the ordnance item itself or to any metal structure or object attached to the ordnance item, such as a gun mount, aircraft or launcher. (General guidance to this effect is found in chapter 7).

2-2.3 RELAXATION OF 10-FOOT RULE. It is important to note that the HERO Safe Separation Distance Calculator provides SSDs for all ordnance and incorporates exceptions to the general requirement of a minimum 10-foot separation distance. In the past, the HERO philosophy was to maintain a 10-foot separation distance between all ordnance (including HERO SAFE ORDNANCE) and any transmitting antenna. (General guidance to this effect is found in chapter 3 and chapter 7.) Due to the proliferation of low-power devices, a relaxation of the 10-foot rule has been built into the HERO Safe Separation Distance Calculator so that these devices can be used closer than 10 feet to ordnance when required. Consequently, the HERO Safe Separation Distance Calculator may provide an SSD of less than 10 feet for certain emitters when used around ordnance.

2-2.4 MULTIPLE SUPERIMPOSED FIELD CALCULATIONS. Whenever an RF field is found to be hazardous to a system, a method is determined to reduce the field to an acceptable safe level. To determine if superimposed fields (no one of which, acting independently, is sufficient to create a hazard) present a combined hazard to the ordnance system, use equation 2-9.

$$E_T = \sqrt{(E_1)^2 + (E_2)^2 + (E_3)^2}$$

Equation 2-9. Multiple Superimposed Field Calculations

where E_T is the total E-field strength to be calculated and (E_1), (E_2), etc., are the individual field strengths to be added together.

NOTE

The calculated total field should then be compared with the maximum allowable field. If it is less, no hazard exists.

If a hazard exists, at least one transmitter must be silenced and the preceding formula recalculated, to determine if a safe condition now exists. If not, this process must be repeated until a combination of fields is found for which the total field is less than the maximum allowable field.

2-2.4.1 Example Calculation. A field strength of 10 volts per meter (V/m) represents a hazardous condition for a particular rocket in the frequency range of 2 to 32 megahertz (MHz). Assume that three radiating communication antennas (2 to 32 MHz) create fields of 8, 5, and 2 V/m, respectively, at the location in question. To determine if these superimposed fields represent a hazard to the rocket, calculate E_T as follows:

$$E_T = \sqrt{(8)^2 + (5)^2 + (2)^2}$$

$$= \sqrt{64 + 25 + 4}$$

$$= \sqrt{93}, \text{ therefore,}$$

$$E_T = 9.64 \text{ V/m.}$$

Since E_T is less than 10 V/m, no hazard exists from the combination of these fields.

2-2.5 EID RESPONSE TIME CONSIDERATIONS. When calculating the EME for specific emitter systems, it is important to consider the system waveforms, specifically the maximum PW and DC. For hot bridgewire (HBW) EIDs, the thermal response to a step input is characterized by an exponential rise in temperature. The EID response time is defined as the time it takes for the bridgewire temperature to reach 63 percent of the final (equilibrium) value and typical time constants for bridgewire devices vary between 1 and 100 milliseconds (ms). EIDs with thermal response times less than or equal to the radar PW are referred to as “pulse-sensitive” or “peak power-sensitive” devices. Additionally, bridgewire thermal stacking can occur when multiple emitter pulses induce current on the bridgewire within the EID’s response time. In such cases, the bridgewire temperature can incrementally increase (“stack”) with each radar pulse because there is insufficient cooling time to reach temperature equilibrium between pulses. Hence, an effective power ratio to determine the EME that the EID will respond to, and whether it is in excess of the true emitter average as calculated in paragraphs 2-1 and 2-1.3, is defined as shown in equation 2-10.

$$P_{ratio} = \frac{P_c}{P_{AF}} = \frac{\left(1 - e^{-\frac{T}{\tau}}\right)}{\left(1 - e^{-\frac{w}{\tau}}\right)\left(1 - e^{-\frac{nT}{\tau}}\right)}$$

Where

T Radar pulse period (ms)

w Radar PW (ms)

τ EID thermal time constant (ms)

n Number of pulses

Equation 2-10. EME/EID Power Ratio

The effective E-field to which a bridgewire EID with response time (τ) will respond is then defined as shown in equation 2-11 where P_d is defined as the maximum incident peak power density of the radar.

$$E_{eff} = \sqrt{\frac{P_d}{P_{ratio}} \cdot 377}$$

Equation 2-11. Effective E-Field

2-2.6 MM-WAVE CONSIDERATIONS FOR HERO. Transmitter systems in the millimeter (mm)-wave spectrum are beginning to be fielded within the U.S. Navy. The right side of the MAE curves in figure 2-1 and figure 2-2 are calculated based on a tuned dipole model. At mm-wave frequencies, the tuned dipole becomes physically very small; hence, the MAE limits may become overly conservative for certain applications. Additionally, localized structural heating of ordnance items becomes a consideration in the mm-wave spectrum, specifically for high-power systems. Therefore, for specific mm-wave systems, SSD calculations must be considered on a case-by-case basis, considering expected ordnance configurations. Please contact NOSSA (N84) or NSWCDD (B55) for guidance.

2-3. CONTROL OF RF ENVIRONMENTS.

In the absence of specific shipboard or shore facility HERO emission control (EMCON) bill guidance (found in the HERO survey reports), the following paragraphs provide guidance for the control of RF environments during HERO SUSCEPTIBLE and HERO UNSAFE ORDNANCE operations.

2-3.1 CONTROL OF RF ENVIRONMENTS FOR HERO SUSCEPTIBLE AND HERO UNSAFE ORDNANCE. Ordnance classified as HERO SUSCEPTIBLE or HERO UNSAFE ORDNANCE must never be permitted in RF environments that exceed the MAE levels in figure 2-1 and figure 2-2. The commanding officer is responsible for ensuring that HERO UNSAFE ORDNANCE is not handled in RF environments which exceed those shown by figure 2-2. By maintaining the calculated SSDs, the user can ensure that the RF environment does not exceed the MAE for HERO SUSCEPTIBLE and HERO UNSAFE ORDNANCE. For the user's convenience, and to aid in obtaining HERO distances and

MAEs, a HERO Safe Separation Distance Calculator is available in the RADHAZ Tools on the E3 Team Online KMS.

2-3.2 NOTIFICATION OF TRANSFER OF OTHER THAN HERO SAFE ORDNANCE. Cautionary measures should be taken to ensure that positive notification is given when HERO SUSCEPTIBLE and HERO UNSAFE ORDNANCE is transferred from one ship or station to another. Methods of reducing environments to safe levels can be found within the HERO EMCON Bills provided in the HERO survey reports.

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CHAPTER 3
USE OF RF EMITTERS IN PROXIMITY TO ORDNANCE

3-1. INTRODUCTION.

Inasmuch as the U.S. Navy Hazards of Electromagnetic Radiation to Ordnance (HERO) program has been in existence for a number of years, a baseline HERO survey exists for each U.S. Navy and U.S. Marine Corps shore activity required to be surveyed and for each ship or ship class. Within those survey reports, virtually all typical emitter systems (i.e., shipboard, fixed emitter systems at shore installations, land mobile, vehicle, aircraft, portable and handheld radios) are documented along with calculated safe separation distances (SSD) and specific guidance for setting HERO emission control (EMCON). Chapter 6 provides information germane to why and when to conduct a survey in order to update existing HERO EMCON Bills. In general, the HERO Safe Separation Distance Calculator available in the RADHAZ Tools on the Electromagnetic Environmental Effects (E3) Team Online Knowledge Management System (KMS) can be used to calculate an SSD for radar and communication systems with the understanding that the distances provided assume main-beam radiation, and consider no system losses (i.e., worst case assumption). In the past, the results of the HERO Safe Separation Distance Calculator defaulted to no less than 10 feet for a safe separation distance for many of the larger emitter systems, as well as for most portable, mobile, and handheld systems. This result was generally adequate as there was no real need to get closer than 10 feet to an ordnance item. This 10-foot rule is also consistent with the guidelines found in chapter 7 and the HERO program's test methodology found in MIL-HDBK-240 (series).

3-1.1 EXCEPTIONS TO 10-FOOT RULE. There are a number of exceptions whereby sources of radio-frequency (RF) emissions (some of which are unintended and some of which are low-power devices) are expected to be, or are required to be, closer than 10 feet to ordnance (e.g., Automatic Identification Technology (AIT) devices, as well as wireless laptops, passive radio-frequency identification (RFID) and active RFID)). These devices are generally very low output devices (i.e., less than 1 watt) and their proximity to ordnance and low output power require different techniques for mitigating HERO. In fact, with very low output devices the result is often the relaxation of the 10-foot rule. The ensuing paragraphs provide discussions germane to these types of devices and subsequent exceptions to the minimum general SSD of 10 feet, as well as general guidance for the use of these types of devices in and around ordnance locations and aircraft. Table 3-1 provides exceptions to the minimum safe separation distance requirement of 10 feet (3 meters) and is particularly useful for handheld devices radiating at less than 1 watt in and around areas that have HERO UNSAFE or HERO SUSCEPTIBLE ORDNANCE. These exceptions are built into the HERO Safe Separation Distance Calculator. (See chapter 7 for general HERO requirements).

3-2. INSTALLATION OF NEW EMITTER SYSTEM OR SOURCES OF RF EMISSIONS ON SHIP AND SHORE INSTALLATIONS.

It is important to understand that the HERO Safe Separation Distance Calculator and table 3-1 are not to be used in place of the site approval process. For ships, see NAVSEAINST 8020.7 (series) and chapter 7 regarding the requirements for HERO and new emitter installations. For shore activities, all new transmitter and antenna installations shall be submitted for HERO review in accordance with NAVFAC data form, NAVFAC 11010/30, Part I, Request for Project Site Approval, in conjunction with Electromagnetic Radiation (EMR) Safety Siting Process: Navy Shore Installation Project Site Approval Request HERP/HERF/HERO/EMI data form, hereafter referred to as Part II, instructions for which are contained in NAVFACINST 11010.45 (series) and associated NAVFAC Business Process Management System (BPMS) guidance documents.

Table 3-1. Minimum Safe Separation Distance Exceptions

MINIMUM SEPARATION DISTANCE (feet)	HERO CLASSIFICATION		
	SAFE	SUSCEPTIBLE	UNSAFE OR UNRELIABLE
≥ 10	General HERO Requirements	Use Calculated Distance per OP 3565	Use Calculated Distance per OP 3565
5	0.5 < EIRP ≤ 5 watts All Frequencies	EIRP ≤ 0.5 watts Frequencies ≥ 100 MHz	0.025 < EIRP ≤ 0.1 watts 200 MHz ≤ Freq < 1 GHz
1	0.1 < EIRP ≤ 0.5 watts All Frequencies	0.025 < EIRP ≤ 0.1 watts Frequencies ≥ 200 MHz	0.025 < EIRP ≤ 0.1 watts Frequencies ≥ 1 GHz
0	EIRP ≤ 0.1 watts All Frequencies	EIRP ≤ 0.025 watts All Frequencies	EIRP ≤ 0.025 watts Frequencies ≥ 100 MHz

NOTES:

All Ordnance

Maintain 5 feet (1.5 meters) from rigid waveguide routed through magazines

HERO SAFE ordnance

Maintain 5 feet (1.5 meters) from the vertical projection of a lowered deck-edge antenna with the transmitter operating at an average Effective Isotropic Radiated Power (EIRP) of 1000 watts or less, provided all loading procedures have been completed.

Maintain a minimum separation of 50 feet (15 meters) from any transmitting shipboard antenna during vertical replenishment (VERTREP) operations.

$EIRP = P_t \times G_t$

Where:

EIRP is the effective isotropic radiated power in watts.

P_t is the average power output of the transmitter in watts.

G_t is the numerical (far-field) gain ratio (not the dB value) of the transmitting antenna, derived as follows:

Gt = 1 × 10G/10 where

G = gain in dBi

Example: If the antenna far-field gain is 2.1 dBi, the far-field gain ratio is $1 \times 10^{2.1/10} = 1 \times 10^{0.21} = 1.62$

3-3. ELECTRICAL AND ELECTRONIC DEVICES IN ORDNANCE AREAS.

3-3.1 PRIVATE AND AMATEUR EQUIPMENT.

CAUTION

Low-Power Transceiver Devices Such As Cellular Telephones, Active Pagers, And some Walkie-Talkie And other RF devices may automatically transmit RF energy without operator action. These devices shall be turned off prior to entering magazine areas, and/or when approaching the established HERO separation distance for the specific device.

3-3.1.1 All operators/users of mobile and portable transmitter systems (e.g., cellular phones, citizens band radios, and pagers) who have access to or are able to pass close to ordnance operation areas (e.g., storage and assembly areas) must know and understand the HERO UNSAFE and HERO SUSCEPTIBLE ORDNANCE SSD requirements for the transmitters under their control. These distances must be maintained between ordnance operation areas and the transmitter system; otherwise, the transmitter system must be turned off.

3-3.1.2 In addition to personal transceiver devices such as cell phones and pagers, there are emerging technologies such as personal electronic devices (PED) (e.g., Apple watch and other smart watches), personal wearable fitness devices (PWFD) (e.g., Fitbit, Nike Fuel Band, and Jawbone UP), and personal wireless medical devices (PWMD) (e.g., hearing aids, body monitors, and artificial limb controls) which can automatically transmit RF energy without operator action. These devices, while typically authorized for use in U.S. Navy and DoD spaces, shall be turned off prior to entering magazine and assembly areas, and/or encroaching the established HERO separation distances for ordnance. All operators/users of these devices must know and understand the HERO UNSAFE or HERO SUCEPTIBLE ORDNANCE SSD requirements for the transmitters under their control. These distances must be maintained between ordnance operation areas and the transmitter system; otherwise, the transmitter system must be turned off. As is stated in chapter 1, the use of RF devices inside magazine and assembly areas is prohibited, unless Commanding Officer, Naval Ordnance Safety and Security Activity (NOSSA) (N8), approval is granted, and certification of these devices does not constitute approval for use in a magazine unless specifically stated in the certification.

3-3.2 WIRELESS TECHNOLOGY. Within the Department of Defense (DoD), there is a growing interest in the use of wireless technology to improve the efficiency of a number of operations. Such technology can be useful especially as the numbers of military personnel are downsized. The proliferation of wireless technologies, however, can introduce E3 challenges. These challenges can adversely affect mission assurance and safety.

3-3.2.1 Among the wireless technologies currently being planned for DoD-wide application are passive and active RFID devices for use in inventory tracking and enhancing logistics efficiency. Other components of RFID systems include wireless local area network (WLAN) gateways, or access points, bar code scanners, docking stations, wireless printers, RF tag interrogators, and repeater/base stations, etc.

3-3.2.2 Prior to service use, all electronic equipment that intentionally generates RF energy to identify or track ordnance or to be used in the vicinity of magazine or ordnance assembly/disassembly and build-up areas shall be evaluated by the Commanding Officer, NOSSA (N8), and certified for use. The certification process involves comparing the radiated emission characteristics of the device with respect to potential ordnance susceptibilities and determining the potential hazards described in the ensuing paragraphs and in appendix C.

3-3.2.3 Appendix C outlines the U.S. Navy's HERO program certification process for intentional emitters in below deck or other enclosed spaces and provides the steps a Program Manager (PM) must take to obtain a HERO certification for new or modified equipment. This certification shall be a system level evaluation and is mandatory in accordance with NAVSEAINST 8020.7 (series) in order to address safety prior to fleet introduction particularly, for those devices that are used in and around ordnance locations and in the vicinity of magazines and assembly and build-up areas.

NOTE

Software can be a safety critical path for controlling RF (i.e., RF tags/interrogators) and the RF properties of the hardware as well as the system software (fault-tree analysis) will be evaluated. Even though an item has been certified for use, there may still be an associated restriction (i.e., SSD).

3-3.2.4 As is stated in chapter 1, the use of RF devices inside magazines and assembly areas is prohibited, unless Commanding Officer, NOSSA (N8) approval is granted, and certification of these devices does not constitute approval for use in a magazine unless specifically stated in the certification.

3-3.3 ELECTRONIC DEVICES. Electronic devices, including desktop computers, laptops, and associated hardware (such as printers, mouse) without any RF wireless capabilities are authorized for use in storage, build-up, and assembly areas when ammunition and explosives are present with the following restrictions:

a. Unintentional. Unintentional radiating digital devices must be certified to meet Federal Communications Commission (FCC), Part 15, Class A or B limits for unintentional radiators and labeled accordingly. These devices require no SSD and can be used in proximity to ordnance; that is, "up-to-touching" but must not come in direct contact with ordnance.

NOTE

Renewable energy items such as solar/wind farms, electric vehicle charging stations, and hydro-electric stations without any RF wireless capabilities are considered unintentional emitters and as such require no SSD.

b. Intentional. Intentional radiating digital devices with RF wireless capabilities are prohibited inside magazines and assembly areas. Exceptional cases must be certified as described in paragraph 3-3.2.

c. If laptops are connected to power via power cords, the battery must be removed. Batteries shall not be charged in the magazine or in storage, build-up, or assembly areas when ammunition and explosives are present.

3-3.4 UNEXPLODED ORDNANCE (UXO) DETECTION EQUIPMENT. Prior to service use, all electronic transmitting equipment used for detection of UXO, such as ground-penetrating radars, time-domain conductivity meters, and metal detectors must be evaluated and certified by Commanding Officer, NOSSA (N8). When conducting UXO operations, ensure only certified equipment is used as required by NOSSAINST 8020.15 (series).

3-3.5 X-RAYING OF ORDNANCE. X-ray machines are often used to assess ordnance or weapon conditions. X-rays fall into the category of ionizing radiation and in the past were not considered part of the HERO program. However, high exposure levels of X-ray radiation could potentially cause initiation of explosives. The following HERO guidance is provided for use when ammunition/explosives are irradiated.

3-3.5.1 Background. Examination of archival literature, primarily a document entitled “Encyclopedia of Explosives and Related Items,” indicates that in 1948, Aberdeen Proving Ground, Maryland, conducted studies wherein various samples of explosive materials were exposed to X-ray radiation. These materials included trinitrotoluene (TNT), Tetryl, lead azide, black powder, and three propellants: M1, M8, and M15. Samples were exposed to 1 million electronvolts (MeV) X-rays for one hour at a dose rate of 12 radiation absorbed doses per second (rads/sec). A total dose rate of 40,000 rads produced no observable rise in temperature or any significant changes in the sensitivity of any of the exposed materials. Additional experiments attempted to initiate sensitive primary explosives by all types of nuclear radiation. These experiments used 220 kilovolt (kV) X-rays with a beam strength of 15 milliampere (mA) and an intensity of 700 radiation absorbed doses per minute (rads/min). Lead azide and silver azide were irradiated for two hours and no explosions occurred. With crystals 2 millimeters (mm) thick, only a small percentage of the energy was absorbed, and the only observable effects were color changes and metallic nuclei produced on the material surfaces. Another similar program conducted by Armour Research Foundation irradiated both alpha and beta lead azide in an intense X-ray beam. The dosages were not indicated, but both types of material crystals demonstrated extreme deterioration, with marked red discoloration and a breakup of crystal morphology (form and structure). However, the explosives did not detonate.

3-3.5.2 Guidance. Based on the above archival U.S. Army study, it is concluded that the extent of damage to explosives resulting from exposure to X-ray radiation is related to total dose, exposure time (dose rate in some instances), and the physical properties of the material. With the addition of a safety margin, it is recommended that the X-ray dose rate does not exceed 1,400 rads/min, and/or the total dosage does not exceed 100,000 rads. Under these conditions, no HERO problems are expected and explosives should remain safe and reliable. Total doses that exceed 100,000 rads will likely change decomposition rates and increase the time to explosion.

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CHAPTER 4
GUIDANCE FOR MANAGING HERO DURING NATO AND ALLIED OPERATIONS

4-1. INTRODUCTION.

This chapter covers the procedures for controlling Hazards of Electromagnetic Radiation to Ordnance (HERO) during Allied Operations or exercises involving U.S. and North Atlantic Treaty Organization (NATO) forces, particularly cross-deck operations. These procedures are not intended to replace the U.S. Navy ordnance HERO classifications or HERO emission control (EMCON) procedures described elsewhere in NAVSEA OP 3565, or within the ship- specific HERO survey reports, but are provided so that HERO can be appropriately addressed when operating in a NATO or Allied environment. Unlike the U.S., most nations do not assign classifications (i.e., SAFE, SUSCEPTIBLE or UNSAFE) to ordnance or manage HERO through HERO EMCON Bills. Instead, Susceptibility Radiation Hazards (RADHAZ) Designator (SRAD) and Transmitter RADHAZ Designator (TRAD) codes are assigned to ordnance and emitters, respectively, and define a level of susceptibility (for ordnance) and a level of radiated emissions (for emitters). Once assigned, the two are compared to identify HERO concerns and establish safe separation distances (SSD).

4-1.1 NATO RADHAZ. NATO Radio and Radar RADHAZ procedures are fully defined in the Allied Environmental Conditions Publication (AECP)-2, “NATO Naval Radio and Radar Radiation Hazards Manual,” and Supplement. The U.S. Navy accepted use of these procedures by ratification of Standard NATO Agreement (STANAG) 1380. As previously mentioned, there are some significant differences in the methods of AECP-2 and the current U.S. Navy approach to defining and implementing HERO EMCON procedures. It is the intent of this chapter to introduce the NATO RADHAZ methodology, explain the differences between the NATO/Allied and U.S. Navy approach to HERO mitigation, and to provide a means for integrating the two approaches. The basis for determining and setting HERO EMCON in a NATO/Allied environment is the use of SRAD and TRAD codes as described in the ensuing paragraphs.

4-1.2 ORDNANCE SRAD CODES. AECP-2 does not use the Navy’s HERO classifications: HERO SAFE, HERO SUSCEPTIBLE, or HERO UNSAFE ORDNANCE. Rather, ordnance susceptibilities are given a 14/18-character alphanumeric SRAD code, in seven/nine two-character sets, that identifies the general susceptibility of an ordnance item or a platform containing ordnance. The first character of each set of the SRAD code is an upper-case letter that identifies the frequency range of the susceptibility. The letters used are “R,” “T,” “U,” “V,” “W,” “Y,” and “Z,” covering frequencies from 150 kilohertz (kHz) to 45 gigahertz (GHz). The second character of each set of the SRAD code is a number that describes the level of susceptibility in that frequency range. The indices are from zero (0), being the most susceptible to radio frequency (RF) energy, to seven (7) being the least susceptible. An index of 0 would compare to an OP 3565 HERO classification of HERO UNSAFE ORDNANCE. An index of 7 would compare to an OP 3565 HERO classification of HERO SAFE ORDNANCE. A complete SRAD code for an ordnance item will contain seven/nine alphanumeric sets, such as R3 T1 U5 V0 W2 Y6 Z4. In the event all indices are the same (e.g., R7 T7 U7 V7 W7 Y7 Z7), the SRAD is simplified to read “SRAD = 7.” Table 4-1 shows the distribution of frequencies within the bands for each letter of the alphanumeric code and the maximum allowable environment (MAE) for each index number. To summarize, the letter identifies the frequency band and the index number identifies the MAE within each band to which the ordnance may be safely exposed.

4-1.2.1 As an update to AECP-2, table 4-1 has been modified to allow further refinement of specific guidance for the frequencies in the W and Y bands. The W band covers the frequency range from 790 MHz to 4.5 GHz and was broken into two sub-bands: the WA sub-band from 790 MHz to 2.7 GHz and the WB sub-band from 2.7 to 4.5 GHz. The Y band covers the frequency range from 4.5 to 18 GHz and was also broken into two sub-bands: the YA sub-band from 4.5 to 8.5 GHz and the YB sub-band from 8.5 to 18 GHz. The SRAD codes can be developed using either the entire W and Y bands (e.g, R3 T1 U5 V0 W2 Y6 Z4) or redefined to the sub-bands (e.g., R3 T1 U5 V0 WA2 WB7 YA6 YB7 Z4). The benefit to splitting the W and Y bands into smaller bands is that a single emitter which operated in a narrow frequency range will not drive the code for the entire band. The use of W and Y sub-bands are optional; however, using the new sub-bands will reduce the EMCON restrictions placed on emitter systems and/or ordnance items. As a result, it should minimize the impact to U.S., NATO, and Allied operations and improve mission success.

Table 4-1. SRAD Code Schematic*

<table>
<tr><th rowspan="2">SUSCEPTIBILITY INDEX</th><th colspan="3">FIELD INTENSITY (V/m)</th><th colspan="6">POWER INTENSITY (W/m²)</th></tr>
<tr><th>R
150 kHz
600 kHz</th><th>T
600 kHz
32 MHz</th><th>U
32 MHz
150 MHz</th><th>V
150 MHz
790 MHz</th><th>WA
790 MHz
2.7 GHz</th><th>WB
2.7 GHz
4.5 GHz</th><th>YA
4.5 GHz
8.5 GHz</th><th>YB
8.5 GHz
18 GHz</th><th>Z
18 GHz
40 GHz</th></tr>
<tr><td>7</td><td>200</td><td>300</td><td>200</td><td>400</td><td>1500</td><td>10000</td><td>8000</td><td>10000</td><td>800</td></tr>
<tr><td>6</td><td colspan="2">200</td><td>150</td><td>200</td><td>1250</td><td>4000</td><td>4000</td><td>4000</td><td>600</td></tr>
<tr><td>5</td><td colspan="3">100</td><td>26</td><td colspan="4">1000</td><td>500</td></tr>
<tr><td>4</td><td colspan="3">60</td><td>10</td><td colspan="5">400</td></tr>
<tr><td>3</td><td colspan="3">20</td><td>1</td><td colspan="5">200</td></tr>
<tr><td>2</td><td colspan="3">10</td><td>0.26</td><td colspan="5">100</td></tr>
<tr><td>1</td><td>6</td><td colspan="2">3</td><td>0.1</td><td colspan="2">10</td><td colspan="2">40</td><td>50</td></tr>
<tr><td>0</td><td>2</td><td colspan="2">0.5</td><td>0.05</td><td colspan="2">1</td><td colspan="3">10</td></tr>
</table>

* This table has been extracted from AECP-2 and reformatted for use in this document.

4-1.2.2 As outlined in AECP-2, each nation is responsible for determining the SRAD codes for its ordnance and weapon systems containing EIDs. SRAD codes for U.S. Navy and U.S. Marine Corps ordnance are determined by the HERO program authorities; these codes can be derived from the HERO classifications. That information is provided in the data sheets (available on the Electromagnetic Environmental Effects (E3) Team Online Knowledge Management System (KMS)). Ordnance personnel, aircraft crews, or others who may be transferring ordnance from one NATO/Allied platform to another are responsible for providing SRAD codes to the host nation's platform. In the absence of pre-operational planning, aircraft approaching another NATO platform are expected to transmit their SRAD code at a minimum distance of 5000 meters. The SRAD code for a platform, such as an aircraft, would be based upon the most susceptible ordnance item on that platform within each frequency range and is referred to as a platform SRAD code. This platform SRAD code can be created through the SRAD/TRAD calculator available on the main page of the E3 Team Online KMS, and should be known prior to deployment.

4-1.3 EMITTER TRAD CODES. Unlike the U.S. Navy HERO program, AECP-2 also provides a means for transmitter/antenna systems to be given classifications similar to ordnance. These codes are referred to as TRAD codes. Similar to an SRAD code, the alphanumeric TRAD code consists of a leading letter identifying the frequency range followed by an index number identifying the effective isotropic radiated power (EIRP) of the system. An individual emitter system will usually have only one alphanumeric set, as opposed to seven sets for ordnance due to its generally narrow frequency band; although more than one alphanumeric set is possible if the emitter has broadband characteristics. For those broadband emitters, all applicable TRAD alphabetical sets shall be used. A calculator is available on the E3 Team Online KMS for determining the TRAD designator for a transmitter-antenna system. A platform TRAD code will take on the same format as an SRAD code for a platform; whereby, the letter designator represents the frequency range and the numeric index represents the highest EIRP value within each frequency band. This worst-case platform TRAD code can be created through the SRAD/TRAD Calculator available on the main page of the E3 Team Online KMS.

4-1.3.1 The TRAD designator for a transmitter-antenna system may also be determined manually if there is no ability to use the tools on the E3 Team Online KMS. The letter character(s) of the TRAD code identifies the frequency range(s) of the emitter, which can be found in table 4-1. The numerical index of the TRAD code is determined by the average power and the antenna gain using figure 4-1. By identifying the system average power (watts) on the horizontal axis (x-axis) and the antenna gain (dBi) on the vertical axis (y-axis), the index is determined by the number indicated in the zone that occurs at x- and y- value intersection. The indices range from 1 to 19, 1 representing the lowest EIRP and 19 representing the highest EIRP.

4-1.3.2 For example, consider a transmitter/antenna combination transmitting at a frequency of 5000 MHz, with an average power of 500 watts and an antenna gain of 16.5 dBi. Using table 4-1, the TRAD letter designation would be YA and using figure 4-1, numeric index would be 9. Therefore, the TRAD code for this system would be YA9.

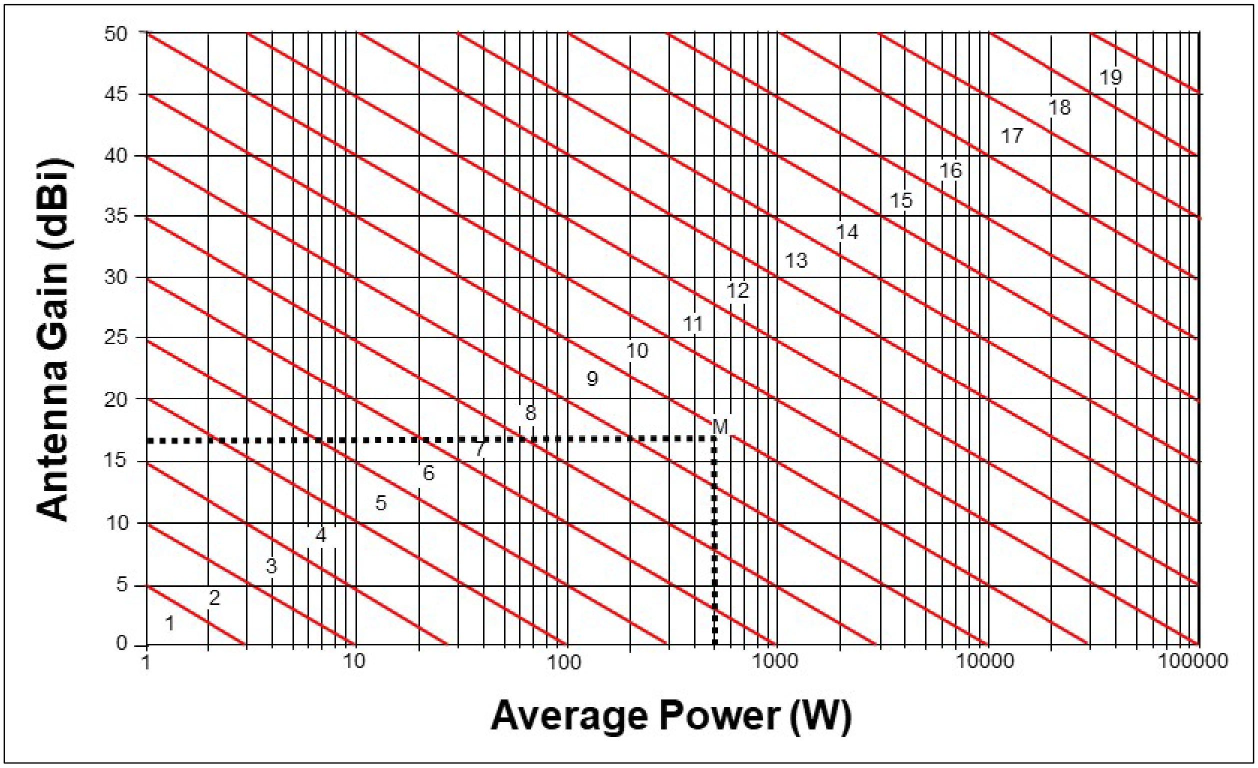

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Figure 4-1. TRAD Code Numerical Index

4-1.4 AECP-2 RADHAZ PROCEDURES. When using SRAD and TRAD codes, the basic procedure for RADHAZ control is through the comparison of the SRAD code of the approaching ordnance and/or platform to the TRAD code of the receiving or host platform. For shipboard applications, this comparison has been performed and is provided in the HERO EMCON Bill in the form of acceptable SRADs for each EMCON condition. If, in any circumstances, the SRAD code exceeds the acceptable SRAD codes provided in the HERO EMCON Bill for a particular frequency range, the potential exists that the emitter system's electromagnetic environment (EME) is greater than the MAE of the ordnance. If it is possible to relocate the ordnance or weapon system, the SRAD/TRAD calculator available on the main page of the E3 Team Online KMS or table 4-2 should be used to determine a minimum safety distance (in meters) between ordnance/weapon and the transmitting antenna. If relocating is not possible, the ship will set appropriate EMCON condition for the incoming NATO/Allied platform through the guidance provided by Naval Ordnance Safety and Security (NOSSA)-certified EMCON bill. For shore/ground operations, a comparison of the SRAD code of the approaching ordnance and/or platform to the TRAD code of the receiving or host platform will need to occur using either the SRAD/TRAD Calculator or table 4-2. Using table 4-2, the user will select appropriate SRAD code row on the left-hand side of the table, and the appropriate TRAD code column on the right; an SSD between the ordnance/platform and transmitter system will be provided at the intersection of the SRAD/TRAD. It is important to note that the SSD between a transmitter/antenna and a specific ordnance item as identified by the calculator and in table 4-2 will be somewhat larger than the U.S. Navy HERO program approach to calculating an SSD for the equivalent transmitter/antenna system and an ordnance item with the same susceptibility. This is because the result in the calculator and table 4-2 are the result of an EIRP based on a range of values, not a calculation based on the transmitter/antenna system's specific characteristics. It is recommended that the online SRAD/TRAD calculator be used first, since it is the most up-to-date and able to accept the input of multiple SRAD or TRAD codes at one time, to create the platform SRAD/TRAD codes, and to provide the minimum safety distance (in meters) for all ordnance/weapons and the transmitting antennas. Table 4-2 should be used in the event that connectivity to the E3 Team Online KMS is not possible prior to or during operations.

4-1.4.1 Similar to the U.S. Navy HERO approach, when SSDs are not a viable solution, AECP-2 prescribes other options such as:

a. reducing power,

b. blanking sector,

c. finding an alternate landing position that provides the minimum safety distance, or

d. if possible, jettisoning the susceptible ordnance.

4-1.5 U.S. NAVY EMCON PROCEDURES. The U.S. Navy's approach to HERO, as described elsewhere in this technical manual, is to evaluate ordnance items and determine the MAEs through HERO testing, determine the shipboard EMEs through instrumented HERO surveys, and, based on the information obtained during HERO tests and surveys, provide specific HERO EMCON Bills to the ships. HERO tests and evaluations determine an item's susceptibility or MAE and provide a HERO classification. All ordnance items are given a data sheet with MAEs below which the ordnance is safe in any of its Stockpile-to-Safe Separation Sequence (S4) configurations (see figure 1-3). Ships and shore facilities are "surveyed" for HERO to determine the actual EME at ordnance locations and transportation routes. If measured EMEs do not exceed the MAEs for specific ordnance items, then there are no HERO restrictions. If the EMEs exceed the MAEs for specific items, HERO EMCON restrictions are required. These HERO EMCON restrictions are provided in a HERO EMCON Bill and can take the form of maintaining safe separation distances, silencing the offending emitter, frequency or power management, sectoring, or implementing operational controls on either the weapon and/or the emitter. HERO EMCON Bills provide HERO conditions that specifically identify all of the emitters that must be restricted for ordnance items of concern. The U.S. Navy's HERO process for determining HERO EMCON restrictions goes one step further than the procedures of AECP-2 to ease the setting of HERO EMCON; in essence, making the process of calculating SRAD and TRAD codes transparent and going directly to a defined HERO EMCON condition with specific HERO restrictions.

Table 4-2. Safety Distances (in meters)[1 2 3]

SRAD									TRAD R, T, U, V, WA, YA, YB, Z																		
R	T	U	V	WA	WB	YA	YB	Z	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
							7		3	3	3	3	3	3	3	3	3	3	3	3	10	10	20	30	50	90	160
					7				3	3	3	3	3	3	3	3	3	3	3	3	10	10	20	30	50	90	160
						7			3	3	3	3	3	3	3	3	3	3	3	10	10	10	20	40	60	100	180
						6			3	3	3	3	3	3	3	3	3	3	3	10	10	20	30	50	80	150	250
				7					3	3	3	3	3	3	3	3	3	3	10	10	20	30	40	80	130	240	400
				6					3	3	3	3	3	3	3	3	3	3	10	10	20	30	50	80	140	260	440
					5				3	3	3	3	3	3	3	3	3	3	10	10	20	30	50	90	160	290	490
								7	3	3	3	3	3	3	3	3	3	10	10	10	20	40	60	100	180	320	550
								6	3	3	3	3	3	3	3	3	3	10	10	20	20	40	70	120	200	370	640
								5	3	3	3	3	3	3	3	3	3	10	10	20	30	40	70	130	220	400	700
			7			4			3	3	3	3	3	3	3	3	3	10	10	20	30	50	80	150	250	450	780
	7								3	3	3	3	3	3	3	3	10	10	10	20	40	60	100	190	320	580	1000
			6			3			3	3	3	3	3	3	3	3	10	10	20	20	40	70	110	200	350	640	1100
7/6	6	7				2			3	3	3	3	3	3	3	3	10	10	20	30	50	90	160	290	490	900	1600
		6				1	1	1	3	3	3	3	3	3	3	10	10	20	30	50	80	150	250	450	780	1500	2500
		5							3	3	3	3	3	3	10	10	10	20	30	60	100	180	300	550	950	1800	3000
		4		1		0	0		3	3	3	3	3	3	10	10	20	30	50	100	160	290	500	920	1600	2900	>5000
		3		0					3	3	3	3	10	10	20	30	50	90	150	280	480	870	1500	2800	4800	>5000	>5000
		2							3	3	10	10	10	20	40	60	100	180	300	550	950	1800	3000	>5000	>5000	>5000	>5000
1			1						3	3	10	10	20	30	60	90	160	190	490	900	1600	2900	4900	>5000	>5000	>5000	>5000
			0						3	10	10	20	30	40	80	130	230	400	700	1300	2200	4000	>5000	>5000	>5000	>5000	>5000
	1								10	10	20	20	40	60	110	190	330	580	1000	1900	3200	>5000	>5000	>5000	>5000	>5000	>5000
0									10	10	20	30	50	90	160	280	490	870	1500	2800	4800	>5000	>5000	>5000	>5000	>5000	>5000
	0								20	40	70	110	200	350	620	1100	2000	3500	>5000	>5000	>5000	>5000	>5000	>5000	>5000	>5000	>5000

1 This table has been extracted from AECP- 2 and reformatted for use in this document.

2 When TRAD and SRAD codes have been allocated to transmitters, materiel, ships, aircraft, and shore stations, respectively; the safety distances between these platforms and susceptible materiel are obtained from table 4-2 where the seven vertical columns on the left side refer to the SRAD and the two horizontal lines on the upper right side refer to the TRAD.

3 The procedure to determine the safety distances is explained by the following example: Take a materiel with an SRAD code of U1 and a transmitter with a TRAD code of U5. Identify the SRAD index of 1 in the left hand U column and read across to the column for a TRAD of numerical index 5; the safety distance is 131 feet (40 meters).

4-1.6 U.S. NAVY MODIFIED AECP-2/EMCON PROCEDURES. While SRAD codes are provided on individual data sheets for each Navy Ammunition Logistic Code (NALC), the U.S. Navy HERO Program Office has provided the worst-case platform TRAD and the acceptable SRAD code for each EMCON condition pertaining to flight operations, in order to facilitate the process for determining HERO EMCON requirements. If none have been provided through the ship's HERO survey report, the HERO Program Office has provided a capability to calculate the SSD through comparison of the SRAD and TRAD of both the incoming and receiving platforms. HERO Survey Reports will include the appropriate TRAD code(s) for each emitter and a platform TRAD code. As long as the received SRAD code is more than the numerical index of the HERO condition SRAD code, no further restrictions will be required. If the incoming SRAD code is equal to or less than the SRAD code for a given EMCON condition, the next more restrictive HERO condition must be used.

Ships requiring SRAD or TRAD code information for their EMCON Bills may contact the Commanding Officer, NOSSA (N8), for assistance. Alternatively, the Guidance Request link on the main page of the E3 Team Online KMS may be used to request SRAD or TRAD code information.

4-1.6.1 Appendix D provides operational and procedural guidance for two approaching platforms and covers all U.S. and NATO military platform configurations.

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CHAPTER 5
HERO EMISSION CONTROL (EMCON) BILL

5-1. GENERAL.

5-1.1 HERO EMCON. Hazards of Electromagnetic Radiation to Ordnance (HERO) Emission Control (EMCON) is the management of electromagnetic emissions to prevent the inadvertent actuation of electrically initiated devices (EID) contained in ordnance items. The HERO EMCON Bill is a set of procedures developed for managing HERO onboard ships and shore installations and is the main product of the HERO survey and ordnance testing processes. Chapter 1 provides discussions on the requirements for periodic HERO surveys. The purpose of the HERO EMCON Bill is to prescribe, through advance planning, the easiest and most efficient method of managing the conflict between the electromagnetic environment (EME) created by transmitting equipment and electrically initiated ordnance.

5-1.1.1 Each Department of the Navy (DON) activity and/or installation ashore and afloat is required to establish and maintain an effective HERO Safety Program. Directions and procedures (e.g., a set of local instructions) must be established for implementation to support the HERO EMCON Bill that provides operational guidance for all operations, exercises, and activities involving ordnance. The HERO program remains as an assessable area of both shore and shipboard explosives safety inspections per NOSSAINST 8020.14 (series) and NOSSAINST 8023.12 (series), respectively, and requires the implementation of a current HERO EMCON Bill, which shall be separated and stand-alone from any local Hazards of Electromagnetic Radiation to Personnel (HERP)/Fuel (HERF) Instruction. The DON process for ships and shore installations starts with the conduct of a HERO survey or survey update, the subsequent development of the HERO EMCON Bill, and the review/certification of the HERO EMCON Bill by the Commanding Officer Naval Ordnance Safety and Security Activity (NOSSA (N8) prior to delivery/implementation. The development and certification of HERO EMCON Bills ensures that all aspects of HERO have been considered, and that the final HERO EMCON Bill provides a near-zero risk-based solution for managing ordnance operations.

5-1.1.2 The severity of the HERO EMCON restrictions is dependent upon two factors:

a. The type of ordnance involved, and

b. The EME levels present during the applicable transportation/storage, assembly/ disassembly, staged, handling/loading, platform-loaded, and immediate post-launch S4 phases.

5-1.2 PROCESS. This chapter describes the process of how the HERO EMCON Bill is developed for ships and shore stations. All ship and shore installations are required to have a Naval Ordnance Safety and Security (NOSSA)-certified HERO EMCON Bill. Any alternations to a ship or shore installation must be reported.

NOTE

It is important that HERO EMCON Bills are updated whenever changes have occurred to the ordnance operations conducted onboard the ship or shore station, or when the emitter system configuration of the ship or shore station has changed. Ordnance changes include the introduction of new ordnance items, weapons platforms, or ordnance operation areas. Emitter changes include the introduction of new/modified emitter systems or the relocation of existing emitter antennas.

5-2. HERO EMCON BILL DEVELOPMENT.

5-2.1 DEVELOPMENT PROCESS. The HERO EMCON Bill development process is shown in figure 5-1. The three critical elements necessary for the development of the HERO EMCON Bill are the emitter list, ordnance inventory list, and drawings highlighting ordnance storage, operations, and transportation locations. The figure 5-1 flowchart shows how these critical elements cumulate into a HERO EMCON Bill. The following paragraphs describe each block of the flowchart and how it relates to the HERO EMCON Bill development process.

5-2.2 EMITTER LIST. The emitter list contains an inventory of all fixed, mobile, and portable emitter systems installed or used on the ship or shore station. The two-fold importance of this listing is that it provides the user the location designation for each transmitting antenna as well as the calculated HERO SUSCEPTIBLE and HERO UNSAFE ORDNANCE safe separation distances (SSD). For a sample emitter listing, see the Platform Data HERO SSD tab (available on the Electromagnetic Environmental Effects (E3) Team Online Knowledge Management System (KMS)). These calculated distances are considered to be worst-case in that they assume main-beam illumination and maximum efficiency of the transmitter/antenna system as it relates to the radio-frequency (RF) output power (i.e., no system losses). Also, these calculated distances do not consider system losses and derive SSDs for a category of ordnance (i.e., HERO SUSCEPTIBLE or HERO UNSAFE) based on the worst-case susceptibility for that category and not on the specific susceptibility for an ordnance item. Most often, the HERO EMCON Bill is developed from an instrumented survey (i.e., measurements of the EME) and considers all of the transmitter systems documented and generally is not based on calculated SSDs, but rather measured data. As such, the measurement-based HERO EMCON Bill obtained from a HERO survey is more than a two-dimensional SSD paper study in that it measures the true RF environment and considers system operation parameters (i.e., elevation and azimuth restrictions), off-axis radiation levels, and their proximity to ordnance locations and the surrounding superstructure or terrain. These data provide a less restrictive means for managing HERO and minimize the impact on operations. Consequently, the calculated SSDs are a general indicator of a potential for HERO for fixed emitter systems, but in the HERO EMCON Bill, apply more specifically to portable, mobile, and aircraft radios since these systems are not used at any fixed location. However, the SSDs for fixed emitter systems do apply to main-beam illumination of in-flight aircraft.

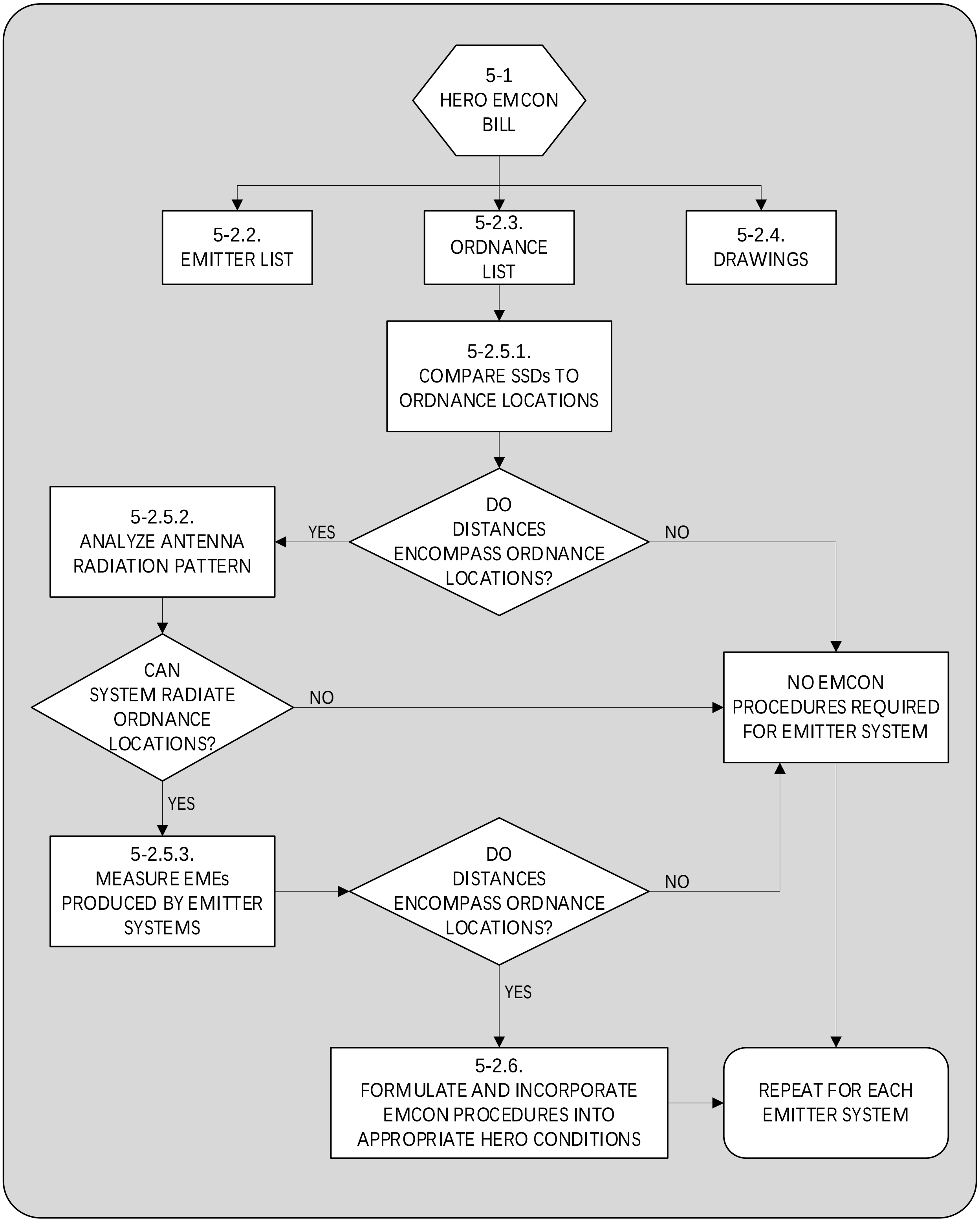

Figure 5-1. HERO EMCON Bill Development

a. For ships, each antenna typically is assigned an antenna number that is used to label the antenna on the ship drawings. For shore stations, each antenna normally is correlated to a building or structure that is assigned a building/structure identification number in order to specify its location.

b. The list also contains the emitter system specifications that were used to calculate the SSDs. The emitter system specifications necessary to calculate the separation distances for both communications and radar equipment are the same: transmitter maximum average output power, frequency range, and antenna gain. Depending on how the equipment is used, the maximum average output power for each mode of operation may also be listed.

NOTE

The lowest frequency capability of the transmitter is used when calculating the SSDs. The exception to this rule is for frequencies below 2 megahertz (MHz), where the highest frequency is used.

c. The emitter listing shall be updated whenever new emitter equipment is installed or existing emitter equipment is relocated. Emitter equipment removed from service shall also be annotated. The responsibility to maintain the emitter list normally resides with the electronics officer in conjunction with the ordnance/weapons officer.

NOTE

The installation of new fixed emitter equipment or the relocation of existing fixed emitter equipment on the shore station must be submitted through the NAVFAC Service Desk. Each shore facility has a NAVFAC Public Works Department (PWD) supporting that station. NAVFAC form 11010/31 Parts I and II is used for submission and request, and can be found at the Public Works department. NAVFAC issues a work order number (WON) that is used to track status. Instructions for completing NAVFAC form 11010/31 are contained in NAVFACINST 11010.45 (series) and associated NAVFAC Business Process Management System (BPMS) guidance documents. These requests are ultimately reviewed by Naval Surface Warfare Center, Dahlgren Division (NSWCDD), Electromagnetic Measurements & Engineering Branch (B55) for HERO consequence. The results of the analysis are provided to the shore station with an addendum to the existing HERO EMCON bill.

5-2.3 ORDNANCE LIST. The purpose of the ordnance list is to show each ordnance item's respective HERO classification (e.g., No HERO Requirement, HERO SAFE ORDNANCE, HERO SUSCEPTIBLE ORDNANCE, or HERO UNSAFE ORDNANCE). The ordnance items are sorted by the Navy Ammunition Logistic Code (NALC) or Department of Defense Identification Code (DoDIC). The items of HERO concern are those that contain EIDs, indicated by a HERO classification of HERO SAFE ORDNANCE, HERO SUSCEPTIBLE ORDNANCE, or HERO UNSAFE ORDNANCE. For a sample ordnance listing, see the Platform Data Ordnance List tab (available on the E3 Team Online KMS).

a. The ordnance inventory susceptibility listing is auto-generated by the web-based E3 Team Online platform ordnance application that contains the Navy's HERO database and platform management tool. The ordnance application produces an output report that lists the NALC/DoDIC, description, and HERO classification for each item. The application also enables the user to access the ordnance data sheets electronically. These data sheets provide a wealth of information on each item including overall HERO classification, maximum allowable environments (MAE) for each applicable S4 phase, National Stock Number (NSN), part numbers, packaging, and application on which the item has been tested or evaluated. It is important to note that an item's susceptibility can vary depending on its application and/or platform. This listing can also be compiled manually by referencing the E3 Team Online KMS for the item's description and HERO classification.

NOTE

Ordnance items that are listed as Unserviceable Condemned components of all-up rounds (AUR) or HERO untested ordnance items (i.e., items that contain EIDs and are not listed in the E3 Team Online KMS) are to be treated as HERO UNSAFE ORDNANCE until a new HERO status is established by NOSSA.

b. The ordnance list shall be updated whenever there are new ordnance items introduced or changes have occurred to existing ordnance items' HERO classification. Ordnance items that are no longer used also should be annotated, and then it is simply a matter of removing them from the existing HERO EMCON Bill. The responsibility to maintain the ordnance list normally resides with the ordnance/weapons officer.

NOTE

NSWCDD (B55) can be contacted to request assistance with updating the ordnance list by using the Platform & Ordnance Guidance Request link on the main page of the E3 Team Online KMS.

5-2.4 DRAWINGS. The purpose of the drawings is to show the locations of all the installed emitter equipment, as well as identify ordnance operation areas. Ordnance locations include all locations that are represented in the S4 phases: transportation/storage, assembly/disassembly, staged, handling/loading, and platform-loaded. For sample ship and shore station drawings, see the Platform Data Drawings tab (available on the E3 Team Online KMS).

a. Ship ordnance locations include the flight deck, hangar, bridgewings, vertical replenishment (VERTREP) stations, Close-In Weapon System (CIWS) mounts, 5-inch gun mounts, ready service lockers (RSL), missile launchers, and magazines/build-up rooms that open to the weather decks. Below-decks magazines and build-up rooms are not typically annotated on the drawings, but are considered in the development of the HERO EMCON Bill.

b. Shore station ordnance locations include combat aircraft loading areas (CALA), combat aircraft parking areas (CAPA), arm/de-arm areas, red label areas, hot cargo areas, build-up areas/facilities, ordnance loading piers, RSLs, assembly buildings, magazine areas, and ordnance transportation routes.

c. The drawings shall be updated whenever there are changes to the fixed emitter configuration or when new ordnance operation areas are established or relocated. Emitter equipment that has been removed from service and ordnance operation areas that have been disestablished should also be annotated on the drawings. The responsibility to update and maintain the drawings shall reside with the Ground Electronic Maintenance Officer (GEMO) or the activity/installation designated frequency manager or HERO Officer with assistance of the activity/installation Explosives Safety Officer (ESO) and base weapons officer/Navy munitions officer in charge (OIC). For U.S. Marine Corps installations, the responsibility to update and maintain the drawings shall reside with the G-6/S-6/Communications Officer or the activity/installation designated frequency manager or HERO Officer with assistance of the activity/installation ESO and base weapons officer/Navy munitions OIC.

NOTE

NSWCDD (B55) can be contacted to request assistance with updating drawings by using the Platform & Ordnance Guidance Request Link on the main page of the E3 Team Online KMS.

5-2.5 HERO EMCON PROCEDURES. The next step in the HERO EMCON Bill development process is determining the emitter systems that require HERO EMCON. This is accomplished in a three-phased approach.

5-2.5.1 SSD Comparison. A comparison of the emitter's calculated HERO UNSAFE and HERO SUSCEPTIBLE ORDNANCE SSD arcs with respect to ordnance operation areas is conducted to determine if the emitter equipment can potentially impact ordnance operation areas. These distances represent the worst-case condition for HERO UNSAFE and HERO SUSCEPTIBLE ORDNANCE (see chapter 2 for details). This comparison is accomplished by superimposing these SSD arcs onto the drawings to determine if the arcs impinge upon ordnance operation areas. The emitter equipment that does not impinge upon ordnance operation areas will not require HERO EMCON, and no further action is required. However, emitter equipment whose SSD arcs do impinge upon ordnance operation areas is identified for further study and possible HERO EMCON. Further analysis is necessary because these calculations are worst-case and do not take into consideration antenna location, antenna orientation, antenna pattern, or system losses that can potentially reduce the efficiency of the system, thus reducing the EME levels produced. This, in turn, reduces the actual distances where the ordnance MAEs are exceeded.

NOTE

For portable and mobile transmitter systems, the HERO SSDs must be maintained between the emitter equipment antenna and ordnance operation areas.

5-2.5.2 Antenna Radiation Pattern Analysis. An analysis of the antenna's vertical location (i.e., height above ground), vertical beam width, and azimuth radiation pattern, including any installed radiation cutouts in relation to ordnance operation areas, is conducted to determine if the emitter equipment can potentially impact ordnance operation areas. Emitter equipment that is determined to not be capable of illuminating ordnance operation areas does not require HERO EMCON. Systems that are capable of directly illuminating ordnance areas are identified for measurement in order to quantify the EME levels. The measured EME levels are used as the basis for formulating the appropriate HERO EMCON procedures to manage the emitter equipment for HERO.

5-2.5.3 EME Measurements. EME measurements are taken during the HERO survey process and used to formulate system-specific HERO EMCON procedures. These HERO EMCON procedures may end up being as restrictive as the SSD comparison, but usually result in less restrictive procedures due to the reasons stated in paragraphs 5-2.2 and 5-2.5.2.

NOTE

In all instances, the general HERO requirements outlined in paragraph 7-3 must be observed.

5-2.6 HERO EMCON CONDITIONS. The next step in the process is to establish HERO conditions. HERO conditions are a set of HERO EMCON procedures that are applicable to specific ordnance locations.

5-2.6.1 For ships, this could be a specific location or an area of the ship that requires a common set of HERO EMCON procedures. Different locations may have identical HERO conditions as a result of this process; i.e., the same emitter equipment will be restricted by HERO EMCON imposed in more than one location. For example, HERO CONDITION 4 may apply to both CIWS Mount 21 and CIWS Mount 22.

5-2.6.2 HERO Zones. Since shore stations are larger than ships and generally have more emitter equipment and ordnance locations, a station will be divided into several parts called HERO zones to facilitate the setting of HERO EMCON. Creating HERO zones assists in managing the number of emitters that must be silenced during ordnance evolutions, and reduces the number of HERO conditions. Ordnance locations that are similar in type, geography and EMCON restrictions are grouped, or zoned, into localized areas in order to simplify the application of HERO EMCON. Roadways and landmarks are used to designate the zone perimeter. Some typical examples of these zones are:

a. Ordnance magazine areas consisting of storage magazines and missile, bomb, and torpedo assembly areas.

NOTE

The magazine area should be maintained as a "safe haven," where HERO UNSAFE, untested, and retrograde ordnance is stored. No transmissions should be permitted in this area.

b. Runway and hangar areas, including CALA/CAPA, arm/de-arm, hot cargo, and red label areas, and parking aprons.

NOTE

An exception is made for hangars that are separated from the runway where helicopters or special aircraft are maintained. This area should be zoned separately.

c. Administrative areas through which ordnance is transported to/from runways, magazine areas, or gates.

5-2.7 HERO EMCON BILL. The HERO conditions, along with the emitter equipment and ordnance lists, make up the HERO EMCON Bill. All ship and shore installations are required to have a NOSSA-certified HERO EMCON Bill. Although this material may be incorporated into the ship's tactical EMCON bill, it is recommended that a separate (stand-alone) HERO EMCON Bill be maintained. In addition to the specific guidance provided in the HERO EMCON Bill, the general HERO requirements during ordnance operations found in chapter 7 also apply. The activity/installation HERO EMCON Bill, coupled with the chapter 7 requirements, provides a near-zero risk-based solution for managing HERO. A documented annual review of the HERO EMCON Bill shall be conducted by the GEMO, activity/installation designated frequency manager or HERO officer, or G-6/S-6/Communications Officer to ensure new emitters (portable or fixed) or new ordnance configurations have been appended properly to the HERO EMCON Bill to reflect the current HERO posture.

5-2.8 HERO INSTRUCTION. The Hero Instruction is a ship- or shore station-wide instruction implementing the HERO program, and is a two-part document consisting of procedures for managing HERO and setting HERO EMCON during ordnance operations (i.e., a HERO EMCON Bill), and an administrative section that assigns responsibilities for establishing/maintaining a HERO program, monitoring the HERO posture of the installation, and procedures for setting HERO EMCON. The HERO EMCON Bill contained within the HERO Instruction provides distinct HERO procedures for specific ordnance and their locations. Sample HERO Instructions can be downloaded from the Platform Data Recommended HERO Instructions tab (available on the E3 Team Online KMS).

5-2.8.1 The purpose of the HERO Instruction is to promulgate the policy and procedures that ensure the safe handling, transportation, and stowage of ordnance with regard to HERO onboard the ship or shore station.

5-2.8.2 A HERO EMCON Bill's implementation shall be the responsibility of the combat system officer (CSO) or Electronic Maintenance Officer (EMO) onboard ships and GEMO or installation's designated frequency manager or HERO Officer onboard shore stations. For U.S. Marine Corps installations a HERO EMCON Bill's implementation is the responsibility of the G-3/S-3, the G-6/S-6/Communications Officer, Frequency Manager, or the HERO Officer.

5-2.8.3 Onboard shore activities/installations, the HERO program/EMCON Bill's oversight shall be the responsibility of the designated ESO.

5-2.9 IMPLEMENTING HERO EMCON. To determine the appropriate HERO EMCON condition to set, identify the HERO classification of the ordnance item(s) involved in the operation (see the E3 Team Online KMS).

a. For ordnance item(s) listed as HERO UNSAFE or HERO SUSCEPTIBLE:

   (1) Identify the location where the ordnance operation will occur (see drawing).

   (2) Select the proper HERO condition associated with the location and HERO classification.

   (3) Apply the appropriate HERO EMCON procedures.

b. For ordnance item(s) listed as HERO SAFE ORDNANCE, set HERO CONDITION 0.

c. Ordnance items listed as “No HERO Requirement” require no HERO EMCON.

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CHAPTER 6
HERO SURVEY

6-1. GENERAL.

A Hazards of Electromagnetic Radiation to Ordnance (HERO) survey provides actual measurements of radio-frequency (RF) electromagnetic (EM) fields, as well as a more detailed look at the operational environment. In many instances, data gathered by the survey will alleviate some restrictions imposed by this manual. This chapter describes the survey process. It explains when and how to request a survey, cites specific data requirements that the activity to be surveyed must provide as input for the pre-survey analysis, describes the on-site procedure, and discusses the content of the survey report. The electromagnetic environments (EME) of ships and shore facilities change with new/modified radar, electronic warfare (EW), communications, and navigation transmitter installations. Changes may also occur to ordnance configuration, inventories, and operations.

6-1.1 WHEN TO REQUEST A SHIPBOARD HERO SURVEY. The Naval Sea Systems Command (NAVSEASYSCOM) requires ships to revise HERO Emission Control (EMCON) Bills or to request a new HERO survey if one or more of the following apply:

a. The ship has no previous HERO survey or existing HERO EMCON Bill,

b. The most recent HERO survey was performed more than five years ago and/or the current HERO EMCON Bill does not contain specific EMCON procedures to be implemented,

c. Emitter systems have been added or relocated since the last survey,

d. Emitter or ordnance systems have been upgraded as a result of a Ship Alteration (SHIPALT) or Ordnance Alteration (ORDALT),

e. Ordnance handling/loading/storage locations and/or procedures have changed since the last survey,

f. New ordnance items which are not addressed in the current version of NAVSEA OP 3565 or HERO survey report,

g. The ship's mission statement has changed, requiring the ship to support new aircraft not addressed in the current HERO survey report,

h. The ship has experienced a HERO-related ordnance incident and needs assistance in resolving ordnance safety issues.

6-1.2 WHEN A HERO SURVEY IS NOT REQUIRED. HERO instrumented surveys requested by individual ships may not always be required. Surveys can only be scheduled after pertinent technical information has been reviewed by Commanding Officer, Naval Ordnance Safety and Security Activity (NOSSA) (N8) and Naval Surface Warfare Center, Dahlgren Division (NSWCDD), Electromagnetic

Measurements & Engineering Branch (B55) personnel. In many cases, current survey reports (and HERO EMCON Bills) can be updated through specific line item pen-and-ink changes provided via official Naval correspondence.

6-1.3 HERO SURVEY TEAMS. NOSSA sponsors HERO survey teams that are trained and equipped to perform on-site instrumented surveys of the EME in ordnance operation areas. Survey teams take measurements of the EME in ordnance handling areas and along transportation routes and compare the data to ordnance item maximum allowable environments (MAE) to determine the specific HERO safety measures required for handling, storing, and transporting ordnance items in these areas.

6-1.4 HERO SHORE SURVEY PERIODICITY REQUIREMENTS. NOSSA, with input from NSWCDD, has reviewed ways of reducing the overall cost of HERO surveys while still maintaining the appropriate levels of safety. The HERO survey periodicity for shore installations is as follows:

a. Five (5) Year Periodicity. High transmitter density (population) with frequent upgrades and high-intensity ordnance operations. These installations constantly undergo changes to their transmitter/antenna systems and ordnance facilities/operations. These changes are tracked by NSWCDD through the Naval Facilities Engineering Systems Command (NAVFAC) safety site approval process. Some of these installations are involved in the Base Realignment and Closure (BRAC) program.

b. Seven (7) Year Periodicity. Moderate transmitter density and a stable, moderate intensity of ordnance operations. These facilities have some changes to the transmitter and antenna systems or ordnance operations that are submitted through the NAVFAC site approval process.

c. Ten (10) Year Periodicity. Stable, low-density transmitter and ordnance population. These installations maintain consistent operation with very few changes. Some of these facilities are U.S. Air Force, U.S. Army, and U.S. Navy reserve units that are very limited or restricted in the use of weapons.

6-1.4.1 NOSSA and NSWCDD personnel have reviewed past survey reports and transmitter site approval data in order to determine a periodicity for the activities. The results of this review are published in the E3 Team Online KMS, which lists U.S. Navy and U.S. Marine Corps activities and shows the periodicity and the date for the next scheduled survey. The periodicity designated to a facility may change as a result of changes in its HERO posture, i.e., transmitter/antenna or ordnance operation changes. Generally, the information obtained during a HERO survey indicates a facility's future periodicity. Periodicity changes, if warranted, will be reflected in the facility's HERO survey report as well as in the E3 Team Online KMS. It is emphasized, however, that the periodicity schedule provided in the E3 Team Online KMS is based on emitters and ordnance as recorded during the last HERO survey. If any changes occur in emitter power output or the frequency of the emitters, or if there are any changes in the type of ordnance handled, a survey or engineering analysis may be required sooner than the scheduled periodicity date.

6-1.4.2 Shore facilities, including all tenant commands, that store, transfer, or use minimal amounts of ordnance containing electrically initiated devices (EID) or use only percussion-initiated ordnance shall request a HERO survey or apply for waiver of HERO survey requirements. If approved, the waiver exempts the facility from HERO surveys for five years. NOSSA may grant a facility two consecutive waivers (10 years), at which time a physical survey must occur to re-establish the facility's baseline configuration. Facilities using only percussion-initiated ordnance may continue to apply for waivers. If the mission of the facility or any of the tenant commands changes to include operations involving ordnance containing EIDs, then the waiver is voided and the facility must request a HERO survey. The waiver approval letter shall be maintained by the activity/installation and will be reviewed by NOSSA every five years.

6-1.5 THE HERO SURVEY PROCESS. NOSSA survey teams perform HERO surveys in accordance with policies set forth in OPNAVINST 8020.14/MCO P8020.11 (series) and NAVSEAINST 8020.7 (series). The survey process is initiated by a survey request from a ship or shore activity. The survey team performs an analysis of the data provided by the requesting activity and develops a plan for conducting an instrumented survey. An on-site survey is conducted; the results are analyzed; and a detailed report is developed. The report provides survey findings, analysis results, conclusions, and recommendations tailored to the command. Experience has shown that surveys result in more efficient use of ordnance areas and decreased impact on communication, radar, or other facilities.

6-2. REQUEST.

Ship or shore activities desiring a HERO survey shall submit a request to NOSSA (N8) at (nossa_hero@us.navy.mil). An information copy of the survey request shall be forwarded to NSWCDD (B55) at (DLGR_NSWC_RADHAZ.fct@navy.mil). The request shall identify a specific point of contact with a defense switched network (DSN) and commercial telephone number. Informal communication regarding the HERO survey process may be established with NOSSA (N8) at (nossa_hero@us.navy.mil) or NSWCDD (B55) at (DLGR_NSWC_RADHAZ.fct@navy.mil). NSWCDD (B55) can also be contacted to request a HERO survey by using the Platform & Ordnance Guidance Request link on the main page of the E3 Team Online KMS.

6-3. PRE-SURVEY REQUIREMENTS.

When a HERO survey request has been received and acknowledged, the most complete and accurate data available must be provided to the HERO survey team by the requesting activity. Pre-survey data contribute significantly to an accurate, effective, and expeditious survey result. Figure 6-1 is a checklist of pre-survey data required for a HERO survey. The following paragraphs discuss requirements expected to be completed by the requesting activity.

6-3.1 MAPS AND DRAWINGS. Provide up-to-date station maps or ship topside drawings annotated to show:

a. Ordnance storage areas,

b. Ordnance assembly/handling areas,

c. Ordnance transportation routes, and

d. Specific transmitters and accurate transmitting antenna locations.

6-3.2 ESO AND/OR ORDNANCE/WEAPONS OFFICER. Identify the Explosive Safety Officer (ESO) and/or Ordnance/Weapons Officer by name and provide a telephone number and email. List all ordnance systems and items and their Department of Defense Identification Code (DoDIC)/Navy Ammunition Logistic Code (NALC). Do not list quantities. Indicate what ordnance is handled at each location listed in 6-3.1a and 6-3.1b.

6-3.3 EMO OR GEMO/FREQUENCY MANAGER/HERO OFFICER. Identify the Electronic Maintenance Officer (EMO) onboard ships, the Ground Electronic Maintenance Officer (GEMO) or installation's designated Frequency Manager or HERO Officer onboard shore stations by name and provide their telephone number and email. For U.S. Marine Corps installations a HERO EMCON Bill's implementation is the responsibility of the G-3/S-3, the G-6/S-6/Communications Officer, Frequency Manager, or the HERO Officer. List all transmitters and antennas identified by military nomenclature or, if appropriate, manufacturer and model. All transmitter and antenna facilities must be cited, including fixed, mobile, relay, etc. Provide operating parameters such as average power in watts, frequency range in megahertz (MHz), and antenna gain in decibels relative to an isotropic antenna (dBi). A format such as the ones shown in figure 6-2 or figure 6-3 is recommended for reporting this data.

6-3.4 ANTICIPATED CHANGES. Provide information relating to anticipated changes in ordnance items, storage sites, or transportation routes and emitter systems.

6-3.5 TENANT AND/OR NEIGHBORING INSTALLATIONS. When appropriate, provide the data listed in paragraphs 6-3.2 and 6-3.3 for tenant and/or neighboring installations. Annotate the station map to indicate the location of transmitters and antennas and ordnance areas. Establish and identify a point of contact for tenant/neighbor activities. Provide a copy of the current Host/Tenant HERO agreement.

6-3.6 AIR OPERATIONS. Ships and shore stations that conduct air operations shall provide the data listed in paragraphs 6-3.2 and 6-3.3 for those fixed and rotary wing aircraft routinely operated.

6-3.7 CURRENT HERO EMCON BILL/INSTRUCTION. Provide a copy of the ship's or station's current HERO EMCON Bill and/or HERO Instruction.

6-3.8 NAVSEA OP 3565 VOLUME 2. Report the latest revision, change number and date of NAVSEA OP 3565 Volume 2, held by the command.

6-3.9 LOCAL HERO CONSIDERATIONS. Address specific questions and concerns related to local HERO considerations. This will allow the survey team to research answers/recommendations during the planning phases of the survey.

6-3.10 SHIP OR STATION INFORMATION PACKAGE. If the command routinely provides a ship or station information package, include that data with the pre-survey material. Information regarding local military and commercial accommodations for survey team personnel should also be included.

6-3.11 ON-SITE SURVEY. The on-site survey will be more efficient if the following are provided:

a. A memorandum requesting the cooperation of all command departments, resident squadrons, tenant/host commands, and adjacent installations advising them of the survey and its purpose;

b. Security and visit clearance for the HERO survey team to all appropriate agencies;

c. Dedicated on-site transportation such as a pickup or van, with driver for the survey team and their equipment;

d. Access for the survey team to all ordnance, transmitter, and antenna locations; and

e. Authorization for the survey team to photograph antenna and measurement sites (sensitive and classified material will be protected).

Data items should be checked off, as available.

( ) 1. Ship Drawings/Station Map(s):

- a. Ordnance storage locations.
- b. Ordnance assembly/handling locations.
- c. Ordnance transportation routes.
- d. Arming/de-arming areas.
- e. Transmitter and antenna locations.

( ) 2. Ordnance Information

- a. Weapons/Ordnance Officer's/ESO's name and telephone number (commercial and DSN).
- b. A list of all ordnance items and systems.
- c. DoDIC/NALC or manufacturer's part number.
- d. Indicate which ordnance is assembled/handled/present at the locations listed in 1a and 1b.

( ) 3. Emitter Information

- a. CSOs/EMOs (onboard ships) and the GEMO's or installation designated frequency manager's/a HERO Officer's (onboard shore stations) name, email and telephone numbers (commercial and DSN).
- b. Transmitter identification (for all transmitters; i.e., fixed, mobile, and portable).
- c. Average power output.[1]
- d. Frequency range.
- e. Antenna identification/type and nomenclature.
- f. Antenna gain in dBi (dB relative to an isotropic antenna) or dBd (dB relative to a ½-wave dipole antenna).

[1] For radars, provide:

- a. Peak power
- b. Pulse duration
- c. Pulse repetition frequency

Figure 6-1. Checklist for HERO Pre-Survey Data (Sheet 1 of 2)

( )	4.	Anticipated Changes. Identify and provide the appropriate information (as in items 2 and 3) for ordnance and transmitting equipment that is expected to be added/installed.
( )	5.	Tenant/Host/Neighbor Transmitter and Antenna Information. Provide information (as in items 2 and 3) for tenant/host/neighbor sites.
( )	6.	Aircraft. Provide emitter and ordnance information (as in items 2 and 3) for all fixed and rotary wing aircraft normally operated (aviation installations only).
( )	7.	HERO EMCON and Aircraft Operation Bills. Provide copy of current bills.
( )	8.	NAVSEA OP 3565, Volume 2: Provide: a. Revision number. b. Change number/date. c. ACNs held.
( )	9.	Local HERO Concerns. Describe local HERO concerns and considerations in a brief narrative.
( )	10.	"Welcome Aboard" Package. If available, include with pre-survey data.

Figure 6-1. Checklist for HERO Pre-Survey Data (Sheet 2 of 2)

1	2	3	4	5	6	7	8
Transmitter Nomenclature	Location (Frame #/Site)	Frequency (MHz)	Average Power (W)	Antenna Nomenclature	Location (Frame #/Site)	Antenna Gain (dBi)	Antenna Type

Figure 6-2. Communications Transmitter/Antenna Characteristics

1	2	3	4	5	6	7	8
Transmitter	Location	Frequency (MHz)	Peak/Average Power (W)	Pulse Repetition Frequency (PPS)*	Pulse Width (µs)* Location	Antenna Gain (dBi)	Antenna Location

*This information not required if average power is shown in column 4 and labeled as such

Figure 6-3. Radar Transmitter/Antenna Characteristics

6-4. PROCEDURES.

6-4.1 CONFERENCE AND TOUR. Upon arrival, the survey team leader will conduct an arrival conference to brief ship/station personnel on the survey process and answer any questions they may have. Along with the survey team, participants in the conference should include the GEMO G-6/S-6 or ship's EMO, frequency manager, HERO officer, communications officer, ESO, weapon or ordnance officer, safety officer and representatives from applicable tenant activities/commands. The conference agenda should address the survey plan, special concerns, and a review of ordnance and electronics emission data. The survey team should be given a familiarization tour of the ship or station, with particular emphasis on the electronic emitter and ordnance handling arming/de-arming areas, storage sites, and transportation routes. The conference and tour allow the survey team to identify any potential ordnance/emitter hazards that may have been overlooked in the preparation of the pre-survey materials.

6-4.2 MEASUREMENT OF EME. The survey team will carry out the survey plan by measuring the EME in a greater-to-lesser order of potential hazards. The team will assess measurement results based on current and future ordnance operations. Prior to survey team departure, the team leader will brief the Commanding Officer (CO) on preliminary significant findings.

6-4.3 REPORT. The HERO survey team leader is responsible for developing a detailed written report. It sets forth the field survey results along with an analysis of measurements with relevant technical data. Conclusions and recommendations regarding the use of transmitters during ordnance operations are presented with supporting documentation. A certified HERO EMCON Bill and recommended HERO Instruction are also provided.

6-4.4 RECOMMENDED SAMPLE HERO INSTRUCTIONS. For both ship and shore installation, the HERO survey report will contain an updated recommended sample HERO Instruction to be implemented upon command review and approval. Ships will also be provided with a HERO EMCON Bill to be posted at the appropriate watch stations.

CHAPTER 7
HERO REQUIREMENTS DURING ORDNANCE OPERATIONS

7-1. INTRODUCTION.

The process for reducing potential electromagnetic radiation (EMR) hazards through proper ordnance handling operations is covered in this chapter; specifically, maintaining appropriate separation distances between ordnance and transmitting antennas, covering ordnance electrical connectors, transporting ordnance in sealed, all-metal containers, etc. This chapter also discusses how to determine the Hazards of Electromagnetic Radiation to Ordnance (HERO) classification of an ordnance item as well as the general HERO requirements for shore facility and shipboard ordnance operations. The general HERO requirements apply to all ordnance items containing electrically initiated devices (EID) regardless of their HERO classification. The intent of this chapter is to provide specific guidance for operations involving HERO SUSCEPTIBLE or HERO UNSAFE ORDNANCE when such ordnance is exposed to electromagnetic environments (EME).

7-2. ORDNANCE HERO CLASSIFICATIONS.

7-2.1 HOW TO DETERMINE HERO CLASSIFICATION. To determine the HERO classification of a particular ordnance item, first refer to figure 7-1 and then to the Electromagnetic Environmental Effects (E3) Team Online Knowledge Management System (KMS), which contains the HERO classification (HERO SAFE, HERO SUSCEPTIBLE, or HERO UNSAFE) of all ordnance items that have been evaluated for HERO by Department of Defense Identification Code (DODIC), Navy Ammunition Logistic Code (NALC), or National Stock Number (NSN). Ordnance items without EIDs are classified as No HERO Requirement.

7-2.2 HOW TO USE HERO DATA. If the ordnance item is listed in the E3 Team Online KMS as HERO SAFE ORDNANCE, then only the general HERO requirements given in paragraph 7-3 must be followed. If the ordnance item is listed as HERO SUSCEPTIBLE or HERO UNSAFE ORDNANCE, then EME restrictions will be required in addition to the general HERO requirements of paragraph 7-3. The data sheets stored in the E3 Team Online KMS provide specific information about the HERO susceptibility of the ordnance item, including frequency, maximum allowable environment (MAE), and situations where the item is susceptible to EMEs. In some instances, the data sheet also provides procedures to mitigate potential HERO problems.

7-2.3 HERO UNSAFE ORDNANCE. An ordnance item that contains an EID or an item whose EID status is unknown and is not listed in the E3 Team Online KMS must be treated as HERO UNSAFE ORDNANCE and handled in accordance with the general guidance contained in this chapter for HERO UNSAFE ORDNANCE. Contact the Naval Ordnance Safety and Security Activity (NOSSA) for specific guidance related to HERO UNSAFE ORDNANCE.

7-2.3.1 Ordnance items normally classified as HERO SAFE or HERO SUSCEPTIBLE ORDNANCE can be degraded to HERO UNSAFE ORDNANCE during assembly, disassembly, or testing or by subjecting the items to unauthorized conditions and operations. Care should be taken to ensure that such conditions and operations occur in a radio-frequency (RF)-free environment as defined in chapter 1. Examples of conditions leading to HERO UNSAFE ORDNANCE are:

a. Assembly or disassembly of ordnance systems such as those undergoing modification, repair, maintenance, parts exchange, strikedown, etc.;

b. Tests involving additional electrical connections to the ordnance system such as resistance checks, continuity checks, etc.;

c. Squibs, primers, blasting caps, impulse cartridges, and other EIDs having exposed leads or primer buttons that are unshielded and/or unfiltered, such as flash signals, igniters, tracking flares, etc., and have not been HERO-evaluated in these configurations;

d. Unshielded ordnance subassemblies such as rocket motors, warheads, exercise heads, and fuzes; and

e. Damaged ordnance items that have internal components exposed, seams or joints that are no longer intact, or HERO shielding [such as barrier plates on 2.75-inch folding fin aircraft rocket (FFAR) launchers] breeched.

7-2.3.2 If the above conditions are encountered and exposure to EMEs cannot be avoided, HERO UNSAFE ORDNANCE can be protected by completely enclosing the item in a sealed, all-metal container.

NOTE

Ordnance items packaged in a wooden, cardboard, or plastic containers or stacked on a metal pallet without additional approved electro-static inner packaging material are not protected from the EME.

Further, HERO UNSAFE ORDNANCE shall only be removed from protective packaging in an EME that does not exceed the levels provided in chapter 2, figure 2-2. Such areas may be found below decks of ships or in buildings designed with EM shielding. HERO UNSAFE ORDNANCE shall not be permitted on the flight deck, the hangar deck, or any weather deck of ships unless appropriate emission control (EMCON) conditions are invoked. (See chapter 2.)

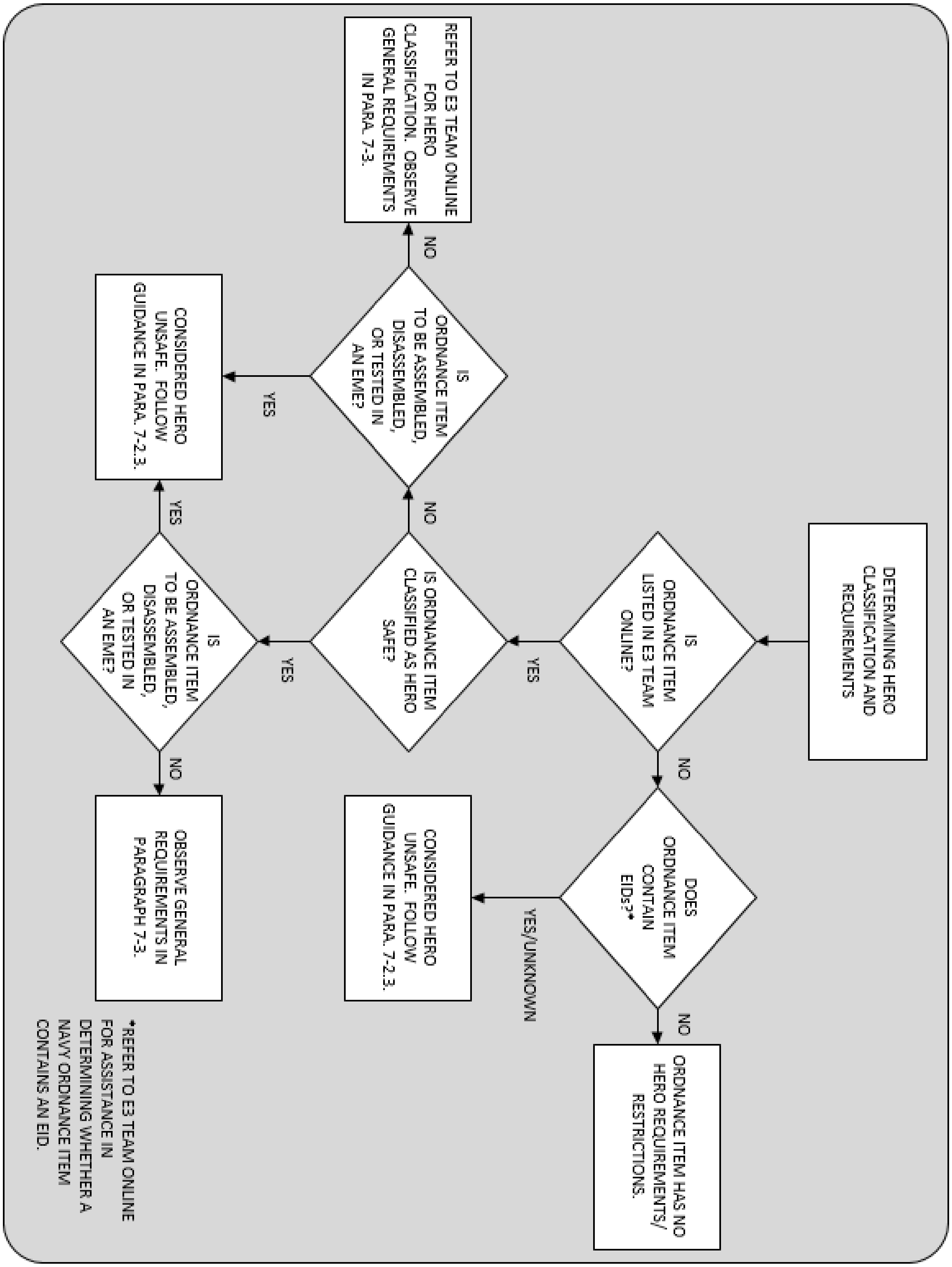

Figure 7-1. HERO Classification Guidelines

7-2.3.3 Unexploded ordnance (UXO) is considered to be HERO UNSAFE ORDNANCE. The detection equipment used to locate UXO (i.e., ground-penetrating radar, ground conductivity meters, etc.) may be capable of generating sufficient electromagnetic (EM) energy to cause inadvertent actuation of EIDs in UXO. Prior to commencing operations with UXO, contact Commanding Officer, Naval Ordnance Safety and Security Activity (NOSSA) (N8) to determine the safety of the detection equipment. Contact the Commanding Officer, NOSSA (nossa_hero@us.navy.mil) for specific guidance related to HERO UNSAFE ORDNANCE.

7-2.4 COMPONENTS OF ALL-UP ROUNDS. All-up rounds (AUR) that contain EIDs must be considered for HERO. Typically, HERO tests do not evaluate the individual components of an AUR separate from the AUR unless operational requirements dictate the need (e.g., blasting caps, ejector cartridges, and some bomb fuzes). Individual components that contain EIDs and are not listed in the E3 Team Online KMS shall be considered HERO UNSAFE ORDNANCE and require EMCON during all ordnance operations involving these components. This general guidance may be tailored if specific information is known about the individual component configuration and its projected use within the Department of Defense (DoD). The following provide additional guidance for tailoring the EMCON requirements for individual components:

a. Presence of Components/Subassemblies (transportation/storage phase). Components/subassemblies shipped in sealed, all-metal containers or metal foil packages do not require HERO EMCON. The unopened container/packaging may be safely/reliably transported, handled, or stored in the typical shore facility/shipboard EME. See NAVSEA SW020-AC-SAF-010 for specific packaging or description of material composition of containers used for transporting and storing the item.

NOTE

The container/packaging must not be opened during this phase. Components/subassemblies that are shipped in non-metal containers or packages require HERO EMCON.

b. Removal of individual components/subassemblies from their containers or packaging and assembly/disassembly of the components must be performed in an area designated for HERO UNSAFE ORDNANCE; otherwise, HERO EMCON is required.

c. Handling, removing, or installing components in subassemblies of AURs or assembly of AURs requires HERO EMCON.

d. Once all the components have been assembled or installed into the system, HERO guidance is based on the HERO classification of the resultant AUR. Refer to the E3 Team Online KMS for HERO classification of the AUR.

7-3. GENERAL HERO REQUIREMENTS.

The following general HERO requirements must be implemented when conducting operations with any ordnance item that contains EIDs, regardless of the ordnance item's HERO classification.

7-3.1 GENERAL HERO REQUIREMENTS FOR ORDNANCE OPERATIONS.

7-3.1.1 Comply strictly with authorized ordnance loading manuals and checklists.

7-3.1.2 Plan ordnance operations so that the ordnance has a minimal exposure to the EME.

7-3.1.3 Do not alter ordnance systems (ordnance item, electrical cables, etc.) unless NOSSA and/or NAVAIRSYSCOM have been contacted to determine the HERO impact of such alterations.

7-3.1.4 Do not allow electrical contacts, electrodes (primer buttons), or connector pins to touch any object capable of conducting EM energy during handling and loading operations. Objects capable of conducting EM energy include aircraft, vehicles, launchers, hoists, bomb carts, bomb racks, cartridge breeches and connectors, tools, personnel, other cartridges, and cartridge actuated devices (CAD). Intentional contact with CAD primer buttons and connector pins that is not required to complete authorized handling and loading and/or unloading operations is prohibited.

7-3.1.5 Do not handle umbilical cables and cable connectors unnecessarily.

7-3.1.6 Do not make electrical connections to air-launched ordnance systems before the ordnance is racked to the aircraft unless:

a. Procedures have been specifically authorized in the checklist or loading manual,

b. The appropriate HERO conditions for HERO UNSAFE ORDNANCE contained in the current HERO survey have been implemented, or

c. The HERO UNSAFE ORDNANCE safe separation distances provided in figure 2-2 are maintained between transmitting antennas and the ordnance operation. Electrical connections between aircraft and ordnance are the most likely entry paths for RF energy.

NOTE

Racking an ordnance item to the aircraft first and tightening the sway braces before making electrical connections reduces the amount of EM energy induced into the item's internal circuitry.

7-3.1.7 Transport all HERO UNSAFE ORDNANCE in sealed, all-metal containers.

NOTE

By definition, a pallet is not a container. Therefore, metal pallets shall not be considered all-metal containers.

7-3.1.8 Cover all open electrical connectors on ordnance items with non-shorting caps to prevent accidental contact with the pins of these connectors. The caps should be removed just prior to connector mating and reinstalled promptly upon connector unmating.

7-3.1.9 Do not expose the ordnance item's internal wiring and firing circuits by assembling or disassembling the ordnance in an EME exceeding the levels for HERO UNSAFE ORDNANCE, figure 2-2.

7-3.1.10 Test procedures that involve making electrical connections to the ordnance are permitted only if authorized by the loading manual or checklist.

7-3.1.11 Flexible waveguides shall not be routed through magazines. Rigid, continuous-run waveguides with no splices are authorized in magazines. However, do not store igniters, primers, detonators, and other items containing EIDs within 5 feet (1.5 meters) of rigid, continuous-run waveguides. Ordnance items stored in magazines shall be stored in sealed, all-metal containers whenever possible.

7-3.1.12 Only coaxial cables that are part of an installed (approved) transmitter system may be routed through magazines. “Lossy line” coaxial cable runs (e.g., HYDRA) shall not be installed, used, or terminated (i.e., with an antenna) in magazines without the approval of NOSSA. Do not store igniters, primers, detonators, and other items containing EIDs within 5 feet (1.5 meters) of approved, coaxial cables. Ordnance items shall be stored in sealed, all-metal containers whenever possible. Refer to table 3-1.

7-3.1.13 No transmitter/antenna systems including handheld transceivers shall be present, installed, or used in magazines or ordnance assembly areas without approval of NOSSA.

7-3.1.14 Prior to aircraft/vehicle ordnance operations (loading/unloading), perform the following:

a. Silence all transmitters on the aircraft/vehicle being loaded/unloaded with ordnance.

b. Silence transmitters on all other aircraft and vehicles or maintain the safe separation distances (SSD) (obtained using the HERO Safe Separation Distance Calculator available in the RADHAZ Tools on the E3 Team Online KMS) from the ordnance operation. Do not conduct maintenance or operational checks that could cause the aircraft transmitters to radiate; however, transmitters may operate into dummy loads.

7-3.1.15 When in-flight aircraft are carrying HERO UNSAFE or HERO SUSCEPTIBLE ORDNANCE, maintain the SSDs (obtained using the HERO Safe Separation Distance Calculator or the current shore facility or ship HERO survey report) for the transmitter/antenna systems, or silence the transmitter.

7-3.1.16 10-Foot Rule. Maintain a minimum SSD of 10 feet (3 meters) between transmitting shipboard antennas and all ordnance items regardless of their HERO classification. The separation distance applies to the ordnance item itself or to any metal structure or object attached to the ordnance item, such as a gun mount, aircraft, or launcher. Refer to figure 7-2. For HERO SUSCEPTIBLE or HERO UNSAFE ORDNANCE, greater distances may apply based on transmitter/antenna parameters (i.e., power, frequency, antenna gain). Refer to the current HERO survey report and/or chapter 2. Table 3-1 provides exceptions to the minimum safe separation distance requirement of 10 feet (3 meters). The 10-foot rule does not apply to ordnance items that are classified as No HERO Requirement.

7-3.1.17 During hoisting operations, EM energy can be induced on cranes, booms and burtoning wires. These large metal structures act as proxy antennas for RF energy emitted by nearby transmitting antennas. The high EM energy can produce voltages that may be discharged as arcs to personnel, ordnance, or other handling equipment. Nonconductive rope or other insulators that link the loading hook and the crane, boom or burtoning wire are required to prevent such EM energy discharge. Insulating links for installation between the cargo hook and the wire may be ordered using the following NSNs:

a. 15-Ton rating NSN 2H-4010-418-2118

b. 30-Ton rating NSN 2H-4010-418-2119

c. 50-Ton rating NSN 2H-4010-418-2120

NOTE

An exception may be made to the requirement for insulating links if a HERO EMCON Bill is available that provides specific HERO guidance. When applying the HERO EMCON Bill, the general condition for HERO SUSCEPTIBLE ORDNANCE must be set. Otherwise, maintain the safe separation distances (obtained using the HERO Safe Separation Distance Calculator available in the RADHAZ Tools on the E3 Team Online KMS) between the ordnance operation and affected antennas.

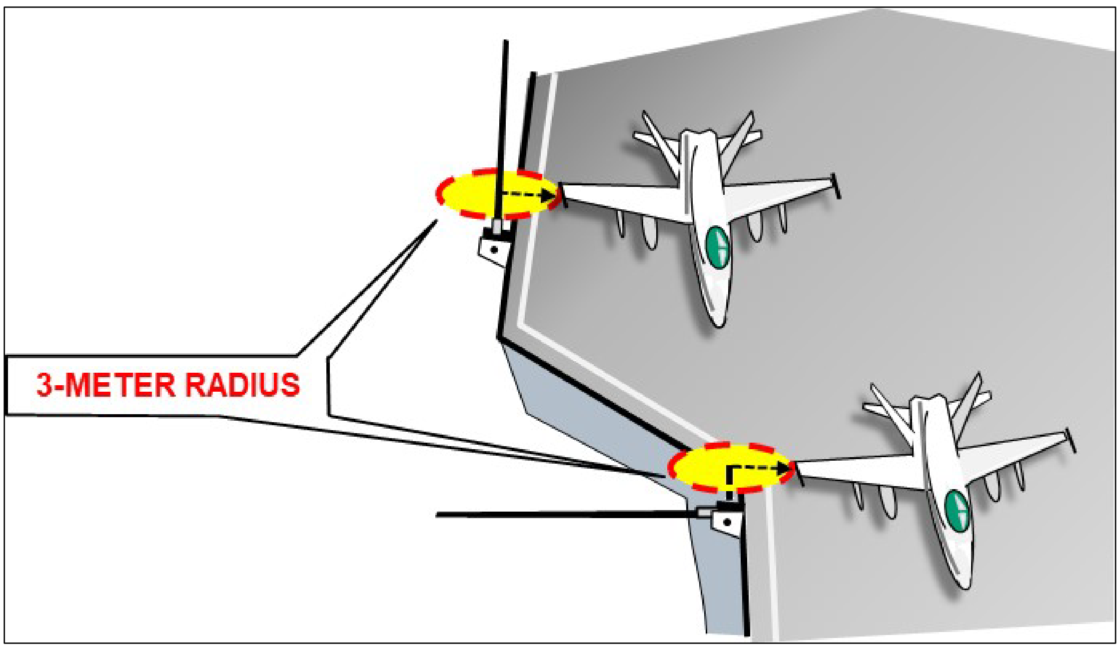

Figure 7-2. Example of HERO SAFE Distances

7-3.2 HERO REQUIREMENTS FOR TRANSPORTATION OF ORDNANCE ON SHORE STATIONS. When transporting ordnance in a vehicle, consult the HERO EMCON Bill or maintain the calculated SSD. Please see HERO Safe Separation Distance Calculator available in the RADHAZ Tools on the E3 Team Online KMS.

NOTE

HERO UNSAFE and HERO SUSCEPTIBLE ORDNANCE may be protected from EMEs by enclosing the ordnance in sealed, all-metal containers.

7-3.3 HERO REQUIREMENTS FOR SHIPBOARD ORDNANCE OPERATIONS.

7-3.3.1 During vertical replenishment (VERTREP) operations, maintain a separation of 50 feet between HERO SAFE ORDNANCE and any radiating antenna. This also applies to HERO SUSCEPTIBLE or HERO UNSAFE ORDNANCE transported in sealed, all-metal containers. For HERO SUSCEPTIBLE or HERO UNSAFE ORDNANCE, maintain SSDs between the ordnance operation and affected shipboard antennas; otherwise, silence the applicable shipboard antennas.

7-3.3.2 During connected replenishment (CONREP) operations, when physical contact between ships has been made using metal cables, silence transmitter/antenna systems operating in the frequency range of 2 to 30 megahertz (MHz) on both ships when HERO SUSCEPTIBLE or HERO UNSAFE ORDNANCE is present on the weather decks of either ship. During underway replenishment (UNREP) operations, silence or sector-blank directional antennas (i.e., satellite communications (SATCOM) and fire control radars) that can directly illuminate these same operations on either ship. Apply the appropriate EMCON, if any, for air- and surface-search radars. Navigational radars aboard either ship need not be silenced.

7-3.3.3 When traveling in company with other ships, employ a common HERO EMCON plan; i.e., apply the appropriate separation distance(s) for affected antenna(s) with respect to HERO-classified ordnance that could be present on weather decks. Joint operations involving non-U.S. Navy ships pose a unique and potentially hazardous situation that requires special HERO guidance. Contact NOSSA for directions in coordinating HERO requirements.

7-3.3.4 If HERO SUSCEPTIBLE or HERO UNSAFE ORDNANCE is exposed on the flight deck, hangar deck, vehicle deck, or in the well deck, silence transmitters on all aircraft and vehicles located on the same deck or maintain SSD. Also, do not conduct maintenance or operational checks that could cause transmitting antennas to radiate; however, transmitters may operate into dummy loads.

The use of personal wireless devices is prohibited in below decks spaces during ordnance assembly operations, such as bomb build-up on the mess deck. Personal wireless devices (gaming systems, laptops, cellular telephones, etc.) shall be turned off or removed prior to the conduct of operations. Shipboard wireless devices and systems that have been certified for use must also be secured, unless specifically stated in the certification.

CHAPTER 8
LISTING OF HERO-CLASSIFIED ORDNANCE

8-1. INTRODUCTION.

The Electromagnetic Environmental Effects (E3) Team Online Knowledge Management System (KMS) provides data sheets for all electrically initiated ordnance systems and items which have been tested or analyzed for radio-frequency (RF) susceptibility.

8-2. HERO CLASSIFICATION LISTING.

E3 Team Online is a listing of ordnance systems or items containing electrically initiated devices (EID) that have been analyzed by design or tested for Hazards of Electromagnetic Radiation to Ordnance (HERO). Each item is listed by Department of Defense Identification Code (DoDIC)/Navy Ammunition Logistic Code (NALC), National Stock Number (NSN), or nomenclature, with its HERO classification. E3 Team Online data sheets specify the consequence of accidental initiation of the ordnance. The E3 Team Online data sheets supply detailed information for handling the ordnance in RF environments, and descriptive notes supporting the assigned classification. Descriptive and conditional notes are also included in the data sheets. Data sheets are described in detail in paragraph 8-3. The E3 Team Online KMS also includes data sheets for ordnance items which are no longer available for Service issue. These items shall always be treated as HERO UNSAFE ORDNANCE and the maximum allowable environments (MAE) limited to those specified in figure 2-2 of this manual.

CAUTION

Do not attempt to handle an unevaluated ordnance item containing EIDs based on the restrictions for a similar device unless this action is specifically approved by the Commanding Officer, Naval Ordnance Safety and Security Activity (NOSSA) (N8).

NOTE

Items are listed in the E3 Team Online KMS by DoDIC/NALC, NSN, or nomenclature. Do not use the shipping name or Department of Transportation (DOT) container marking to identify items or systems in E3 Team Online.

8-2.1 UNLISTED ELECTRICALLY INITIATED ITEMS. If an electrically initiated item is not listed in the E3 Team Online KMS, it shall be considered HERO UNSAFE ORDNANCE. Before attempting any operations in an RF environment, the data for the proper HERO classification and handling procedure for the item shall be requested, via message, from NOSSA (N8). Include in the message the item's nomenclature, DoDIC/NALC, part number, function, and the associated equipment or ammunition item as appropriate. Alternatively, Naval Surface Warfare Center, Dahlgren Division (NSWCDD), Electromagnetic Measurements & Engineering Branch (B55) can be contacted to request assistance with an electrically initiated item not listed in the E3 Team Online KMS by using the Guidance Request link on the main page of the E3 Team Online KMS.

8-2.2 DATA SHEETS. All data sheets for non-security classified items are contained in the E3 Team Online KMS.

8-2.3 CODE H UNSERVICEABLE CONDEMNED ITEMS. Included in the E3 Team Online KMS are items which have been declared Code H Unserviceable Condemned for use. Some items may have been deleted from the Navy Master Item Listing and may not be available for procurement. The applicable HERO data for Unserviceable Condemned items has been retained for information purposes.

8-2.4 AMMUNITION. Because ammunition is catalogued and inventoried by DoDIC/NALC, items are listed in the E3 Team Online KMS by DoDIC/NALC. If a DoDIC/NALC has not been assigned, the item is listed by NSN or by nomenclature. E3 Team Online data sheets address multiple scenarios for a single DoDIC/NALC where applicable. If HERO SUSCEPTIBILITY can be determined by NSN, then data sheets are accessed by NSN. Conversely if HERO SUSCEPTIBILITY is determined by part number vice NSN, data sheets are accessed using the part number. Determinations are further made using platform, then launcher, then other conditions. The tier system used in the E3 Team Online KMS is illustrated in table 8-1. In the sample in table 8-1 the HERO SUSCEPTIBILITY has been determined based on the item's launching configuration. It should be noted that table 8-1 illustrates the tier system with annotations in all of the tier levels. The entries in the E3 Team Online KMS are only detailed as necessary to determine the HERO classification of the listed item in the configuration of concern and only those tier levels affecting the HERO classification are annotated.

Table 8-1. Tier System for Presentation of Data in the E3 Team Online KMS

DoDIC/NALC [NSN]	Nomenclature/Platform/ Launcher	HERO Classification	Susceptibility Consequence	Platform-Loaded SRAD
[NSN]	Nomenclature text			
	· Platform			
	· Launcher	SUSCEPTIBLE	Safety	R3T5U1V5W0Y0Z4

8-3. DATA SHEETS.

Data sheets contain all information necessary for determining an ordnance item's HERO classification and appropriate restriction(s), if applicable, in an RF environment. Items determined to be HERO SAFE ORDNANCE require only the general HERO requirements as cited on the specific data sheet. Data sheets provide appropriate MAEs for six distinct stockpile-to-safe-separation sequences (S4). These S4s can be thought of in terms of the progressive stages of an ordnance system or item that begin with its manufacture and subsequent delivery to the U.S. Government, and continue until it has either been fully expended, or until it reaches a safe separation distance (SSD) from the launch vehicle/platform/system. The following paragraphs provide the definition of these various phases of the S4 and the HERO implications relevant to each phase.

8-3.1 TRANSPORTATION/STORAGE. The phase in which the ordnance is packaged, containerized, or otherwise prepared for shipping or stored in an authorized magazine area. This includes transporting the ordnance. Some ordnance items/systems are transported and/or stored as all-up rounds (AUR), meaning they are completely assembled, while others are shipped as sections or components. AURs, as well as system components containing EIDs, must be considered and evaluated for HERO. The aforementioned ordnance items can be protected from hazardous electromagnetic environments (EME) by use of a completely closed all-metal container or a barrier material fabricated to the requirements of MIL-PRF-81705 Type 1. Of particular importance and concern are those items or systems shipped, stored, or packaged in other (nonmetallic) containers. AURs, system sections, EIDs, and components or subsystems which are transported or stored using nonmetallic container materials can be extremely susceptible to EME under these unprotected conditions since their internal electronics, wiring, or EIDs may be directly exposed to the EME. Evaluation of system components and sections, subsystems, etc., can be very difficult and complex because, at this stage of the acquisition process, the logistics, including containers and packaging, are usually not well-defined.

8-3.2 ASSEMBLY/DISASSEMBLY. The phase involving all operations required for ordnance build-up and/or breakdown and typically involving personnel. Ordnance items or systems, subassemblies, and components shipped in or as sections, components, or entities will require assembly/disassembly sometime during their deployment cycle. This may occur at the field activity or onboard a U.S. Navy ship. This assembly/disassembly process must be carefully reviewed to determine the components involved, the procedures to be performed, the location at which the components will be assembled/disassembled, and the expected EME at this location. Typically, assembly/disassembly will take place in a designated area, which is an essentially RF-free environment.

8-3.3 HANDLING/LOADING. The phase in which physical contact is made between the ordnance item and personnel, metal objects, or structures during the process of preparing, checking out, performing built-in-tests, programming/reprogramming, installing, or attaching the ordnance item to its end-use platform or system; for example, aircraft, launcher, launch vehicle, or personnel. These procedures may involve making and/or breaking electrical connections, opening and closing access panels, removing or installing safety pins, shorting plugs, clips, wings and fins, and dust covers. This configuration also includes all operations required for unloading; that is, removing, disengaging, or repackaging the ordnance item. The handling/loading phase of an ordnance item or system is a crucial part of the S4 and the evaluation process. Personnel contact with the ordnance item or system, making and breaking electrical connections, performing diagnostic tests, and attaching or removing the ordnance from large metal structures, such as launchers and platforms or systems and aircraft, can have a significant impact on the electromagnetic (EM) susceptibility of the ordnance system.

8-3.4 STAGED. The phase in which the ordnance has been prepared for loading and is pre-positioned in a designated staging area. Once an ordnance item or system has been prepared for loading operations, it is sometimes pre-positioned in a designated area until the actual loading operation begins. Usually, the designated area is not a controlled environment and, therefore, the ordnance item or system may be exposed to high-level EMEs.

8-3.5 PLATFORM-LOADED. The phase in which the ordnance item has been installed on or attached to the host platform or system and all loading procedures have been completed. This phase will include the ordnance item or system in its fully assembled and loaded, operational ready configuration. It will include not only the ordnance item or system itself, but the firing circuits, launcher, the platform or system, aircraft, all interface cables, lanyards and umbilicals, etc., associated with the ordnance item or system connected to the system as applicable. Additionally, systems that have safety pins and arm/de-arm mechanical devices that may affect the EM energy coupling to the EID firing circuits must be evaluated in all appropriate positions. <u>It is again emphasized that the platform type can have a significant impact upon the EM susceptibility of an ordnance item.</u> There are dramatic examples of this phenomenon where an ordnance system or item may be HERO SAFE ORDNANCE on one platform type and HERO SUSCEPTIBLE ORDNANCE on another (different) platform type.

8-3.6 IMMEDIATE POST-LAUNCH. The phase in which the ordnance item has been launched from its platform or system, but has not reached its safe ordnance separation distance with regard to the actuation of its explosives, pyrotechnics, or propellants. The ordnance item or system phase defined by the configuration immediately after launch, ejection, or implementation may sometimes be difficult to ascertain, replicate, or simulate. This phase is typically very different from the pre-launch configuration since the item or system may have undergone profound changes in its physical state. For example, some EIDs may no longer be of concern because they have been expended, firing circuits may have been altered and energized, and/or additional apertures may have been created by the jettison of components and sections or the extension of wings and fins.

APPENDIX A
DEFINITIONS AND ABBREVIATIONS

A-1. INTRODUCTION.

This appendix contains definitions of terms and abbreviations related to the radio- frequency radiation hazards to ordnance.

A-2. DEFINITIONS.

The terms used in this volume are defined as follows:

10-Foot Rule. The minimum safe separation distance (SSD) of 10 feet (3 meters) to be maintained between transmitting antennas and all ordnance items regardless of their HERO classification. The separation distance applies to the ordnance item itself or to any metal structure or object attached to the ordnance item, such as a gun mount, aircraft, or launcher.

Antenna. That part of a receiving or transmitting system which is designed to radiate or receive electromagnetic fields.

Average Power (W) (in a waveguide). For a periodic wave, the time-average of the power passing through a given transverse section of the waveguide in a time interval equal to the fundamental period. The time-average rate of energy transfer:

$$W = \frac{1}{t_2 - t_1} \int_{t_1}^{t_2} W(t)\,dt$$

For radar calculation average power (W) = peak power x pulse width (PW) x pulse-repetition frequency (PRF).

Bridgewire. A metal wire heated by the passage of electric current, which initiates the deflagrating or detonating charge surrounding the wire.

Cartridge Actuated Devices (CAD). Explosive-loaded devices designed to act as a gas generator, or to provide a stroking action or a special purpose action. Actuation devices may be reusable, employing an expendable cartridge for each design action or may be a sealed unit with a one-time function capability. The amount of explosive contained in these devices is normally small.

Charge. The explosive material either by itself or contained in an ordnance item such as a mine, projectile, or bomb.

Communications Equipment. Transmitter/antenna system which uses that portion of the electromagnetic spectrum normally reserved for telephony and telegraphy. For purpose of this manual the frequencies covered under this definition include those between 2 and 440 megahertz (MHz) and are usually written in the form "HF (2-30 MHz) communications," etc.

Decibel (dB). A dimensionless unit which is a measure of the ratio of two powers. The number of decibels, n, corresponding to the ratio of powers P_1 and P_2 is as follows:

$$n = 10 \log_{10} \frac{P_1}{P_2} \text{If}$$

$$n = 10 \log_{10} \frac{P_1}{P_2} = 20 \log_{10} \frac{I_1}{I_2}$$

or

$$n = 10 \log_{10} \frac{P_1}{P_2} = 20 \log_{10} \frac{V_1}{V_2}$$

Downloading. Unloading.

Electric Field (E-Field). A vector field of E-field strength or of electric flux density.

E-Field Strength. The magnitude of the E-field vector.

Electrically Initiated Device (EID). A single unit, device or subassembly that uses electrical energy to produce an explosive, pyrotechnic, thermal, or mechanical output. Examples include: EEDs (such as hot bridgewire, semiconductor bridge, carbon bridge, and conductive composition), laser initiators, exploding foil initiators, burn wires, and fusible links.

Electro-explosive Device (EED). Any single discrete unit, device, or subassembly whose actuation is caused by the application of electric energy which, in turn, initiates an explosive, propellant or pyrotechnic material contained therein. The term EED does not include complete assemblies which have electric initiators as subassemblies, but includes only subassemblies themselves. Synonymous with electric initiator.

Electromagnetic Radiation (EMR). The emission of electromagnetic energy from a finite region in the form of unguided waves.

Electromagnetic Environment (EME). The resulting product of the power and time distribution, within various frequency ranges, and includes the radiated and conducted electromagnetic emission levels that may be encountered. It is the totality of electromagnetic energy, from man-made and natural sources, to which a platform/system, or subsystem/equipment will be exposed within any domain, that is, land, air, space, and sea, while performing its intended mission throughout its operational life cycle (in the case of ordnance, during its S4.) When defined, the EME will be for a particular time and place. Specific equipment characteristics, such as operating frequencies, emitter power levels, and receiver sensitivity, operational factors such as distances between items and force structure, and frequency coordination all contribute to the EME. In addition, transient emissions and their associated rise and fall times such as from electromagnetic pulse, lightning, and p-static also contribute.

Electronic Equipment. Equipment which produces useful internal signals, or serves functionally by generating, transmitting, receiving, storing, processing or using information in the broadest sense. Examples are communications, radar, sonar, countermeasures, navigation, computers, test equipment, etc.

Emission Control (EMCON). The EMCON of high-powered transmitters to remove or reduce EMR to safe levels in those areas where HERO SUSCEPTIBLE or HERO UNSAFE ORDNANCE is being handled or loaded.

EMCON Bill. A set of directions for implementing HERO restrictions on each ship or shore station.

Far Field (Fraunhofer Region). The region in which the field of antenna is focused. The field decays as 1/distance. For most radar antennas, the boundary between the near and far fields occurs at $2d^2/l$ where d is the largest linear dimension of the antenna. For communications antennas the far field begins at one wavelength (l).

Field Intensity. The measure of the magnitude of an electromagnetic field. Field intensity of electromagnetic fields at communication frequencies (200 kilohertz (kHz) to 1.0 gigahertz (GHz)) is referred to in terms of vertical E-field strength in units of volts per meter (V/m), and the field intensity of electromagnetic fields at radar frequencies (200 MHz to 100 GHz) is referred to in terms of the average power density in units of milliwatts-per-square-centimeter (mW/cm^2).

Fraunhofer Region. See Far Field.

Handling. All operations, excluding normal loading and unloading operations, performed on an ordnance item wherein contact may be made between the ordnance and personnel or any metallic objects or structures attached to it.

Hazards of Electromagnetic Radiation to Fuels (HERF). HERF is the danger of igniting volatile combustibles by spark ignition due to radio frequency electromagnetic fields of sufficient intensity.

Hazards of Electromagnetic Radiation to Ordnance (HERO). The situations in which transmitting equipment (for example, radios, radar, electronic countermeasures, electronic counter-countermeasures, ground penetrating radar) or other electromagnetic emitting devices can generate radiation of sufficient magnitude to: induce or otherwise couple electromagnetic energy sufficient to exceed specified safety and/or reliability margins in EIDs contained within the ordnance, or cause radiation-induced damage or degradation of performance in ordnance containing EIDs.

Hazards of Electromagnetic Radiation to Personnel (HERP). HERP is the danger of producing harmful biological effects in humans by exposure to RF electromagnetic fields.

HERO SAFE ORDNANCE. Any ordnance item that is proven by test or analysis to be sufficiently shielded, or otherwise so protected that all EIDs contained by the item are immune to adverse effects (safety or reliability) when the item is employed in the RF environment delineated in MIL-STD-464 (series).

NOTE

Percussion-initiated ordnance has no HERO requirements.

HERO Survey. Analysis, supported by measurements, which results in a description of the radio frequency environment at specific ordnance handling, loading, storage and transportation sites. The radio frequency environment is characterized in terms of its impact on susceptible ordnance systems and operations.

HERO SUSCEPTIBLE ORDNANCE. Any ordnance containing electrically initiated devices (EID) proven by test or analysis to be adversely affected by RF energy to the point that the safety and/or reliability of the system is in jeopardy when the system is employed in the RF environment delineated in MIL-STD-464 (series).

HERO UNSAFE ORDNANCE -

a. Any electrically initiated ordnance item, including those having a HERO SAFE ORDNANCE or HERO SUSCEPTIBLE ORDNANCE classification, whose inadvertent initiation or detonation causes an immediate catastrophic event that has the potential to either destroy equipment or injure personnel, is defined as HERO UNSAFE ORDNANCE; when its internal wiring is physically exposed; when tests are being conducted on the item that result in additional electrical connections to the item; when EIDs having exposed wire leads are present, handled, or loaded in any but the tested condition; when the item is being assembled or disassembled; or when such ordnance items are damaged causing exposure of internal wiring or components or destroying engineered HERO protective devices.

b. Ordnance items containing EIDs, whose inadvertent initiation or detonation causes an immediate catastrophic event that has the potential to either destroy equipment or to injure personnel, which have not been classified as HERO SAFE or SUSCEPTIBLE by either test or design analysis are HERO UNSAFE ORDNANCE and are subject to the restrictions of chapter 2, figure 2-2. Items that fall into this classification may be exempted from being classified as HERO UNSAFE ORDNANCE as the result of HERO tests conducted to determine specific susceptibility.

Igniter. An electrical, chemical, explosive, or mechanical device used to initiate combustion.

Initiator. See Igniter.

Loading/Unloading. The operation of installing an ordnance item or attaching it to its launcher from the time it is physically being installed or attached until after the operation has been completed, and all electrical connections have been made, access doors closed, safety pins installed, and sway braces tightened. Loading includes the act of removing shorting bars, clips, and dust covers. The term unloading also includes the above process. This definition of loading includes any operation specified as loading by the technical manual describing the item.

Maximum Allowable Environment (MAE). The highest radiated field-strength levels to which ordnance can be exposed without exceeding EID HERO margins.

Near Field. The region (or regions) adjacent to the region in which the field of an antenna is focused (that is, just outside the Fraunhofer region). For most radar antennas, the near field is that free space whose distance is less than $2d^2/l$ where d is the largest linear dimension of the antenna. For communication antennas, the near field is considered to extend to approximately one wavelength (l) from the antenna.

No HERO Requirement. Any ordnance that does not contain an EID.

Power Density. The power flow per unit area, usually expressed in units of mW/cm^2. Average power density is the quantity relating to the heating properties of EMR and, hence, to personnel and other hazards, while peak power density becomes important in the study of the effects of electromagnetic fields on electrically initiated explosive devices and on fuel hazards.

Presence. The unattended existence of a system in an RF field (no personnel in direct contact or indirect contact with it); i.e., a weapon on the deck, on a bomb cart, loaded on an aircraft, loaded in a launcher, etc.

Primer. A sensitive initiator that responds to percussion, friction, electric impulse, or other action to set off an explosive or combustible element.

Racking. As used herein refers to the ordnance operation of mechanically attaching a weapon to a launcher or rack on an aircraft. It does not include electrical connection to the aircraft.

Radar. A device for transmitting electromagnetic signals and receiving echoes from objects of interest (targets) within its volume of coverage. Presence of a target is revealed by detection of its echo. Additional information about a target provided by radar includes distance (range), direction, rate of change of range, description, or classification of the target. The name is derived from the initial letters of the expression Radio Direction and Ranging. As used in this manual, radar includes countermeasures, navigational, and other similar types of equipment.

RADHAZ Manual. Common name for NAVSEA OP 3565.

Radiation Hazards (RADHAZ). Radio frequency electromagnetic fields of sufficient intensity to produce harmful biological effects in humans, cause spark ignition of volatile combustibles, or actuate EEDs.

Radio Frequency (RF). A frequency useful for radio and radar transmission, 10 kHz to 300 GHz.

RF Environment. An electromagnetic field. The magnitude of electromagnetic fields at communication frequencies (100 kHz to 1.0 GHz) is referred to in terms of vertical E-field strength in units of V/m, and the magnitude of electromagnetic fields at radar frequencies (100 MHz to 100 GHz) is referred to in terms of the average power density in units of mW/cm^2.

Reliability Consequence. The inadvertent actuation of an EID that does not result in a safety consequence, but degrades system performance or renders the ordnance item either ineffective or unusable. An example is the RF initiation of a detonator in a fuze whose safe and arm (S&A) device is mechanically out-of-line with the explosive train. Another example of an EID with a reliability consequence is an electrically initiated match in a thermal battery. When this electrically initiated match is activated, it simply initiates the chemical process to stimulate the battery. Dudding is considered to be a reliability consequence.

Safety Consequence. The inadvertent actuation of an EID that creates an immediate catastrophic event that has the potential to either destroy equipment or to injure personnel, such as the firing of an inline rocket motor igniter by RF energy.

Shield (Electromagnetic). A housing, screen, or other object, usually conducting, that substantially reduces the magnitude of E- or magnetic (H)-fields on one side thereof, upon devices or circuits on the other side.

Stockpile-to-Safe Separation Sequence (S4). The progressive stages (phases) that begin at the time the ordnance is manufactured and continue until it is expended or reaches a safe distance from the launch vehicle/platform/system. This progression is sometimes referred to as the S4 and may consist of up to the following six distinct stages:

a. Transportation/storage. The phase in which the ordnance is packaged, containerized, or otherwise prepared for shipping or stored in an authorized magazine area. This includes transporting the ordnance.

b. Assembly/disassembly. The phase involving all operations required for ordnance build-up and/or breakdown and typically involves personnel.

c. Staged. The phase in which the ordnance has been prepared for loading and is re-positioned in a designated staging area.

d. Handling/loading. The phase in which physical contact is made between the ordnance item and personnel, metal objects or structures during the process of preparing, checking out, performing built-in tests, programming/reprogramming, installing, or attaching the ordnance item to its end-use platform/system, for example, aircraft, launcher, launch vehicle, or personnel. These procedures may involve making and/or breaking electrical connections, opening and closing access panels, removing/installing safety pins, shorting plugs, clips, and dust covers. This configuration also includes all operations required for unloading, that is, removing, disengaging, or repacking the ordnance item.

e. Platform-loaded. The phase in which the ordnance item has been installed on or attached to the host platform/system and all loading procedures have been completed.

f. Immediate post-launch. The phase in which the ordnance item has been launched from its platform/system, but has not reached its safe ordnance separation distance with regard to the actuation of its explosives, pyrotechnics, or propellants.

Susceptibility. The property of an ordnance item which describes its capability to function acceptably when subjected to unwanted electromagnetic energy. The degree of susceptibility is dependent upon the amount of induced energy, the characteristics of the EED and the environment (such as field strength, orientation of weapon system, weapon configuration, etc.).

Susceptibility Radiation Hazards Designator (SRAD) Code. A 14-character alphanumeric code, assigned to ordnance when operating in a North Atlantic Treaty Organization (NATO) environment, to define a level of, and to control, HERO susceptibility. As outlined in Allied Environmental Conditions Publication (AECP)-2, each NATO nation is responsible for determining the SRAD codes for its ordnance and weapon systems containing electrically initiated devices (EID).

Transmitter Radiation Hazards Designator (TRAD) Code. An alphanumeric code, assigned to antenna/transmitter systems to identify the frequency range and the EIRP of the system. Following AECP-2 procedures, the TRAD is compared to the SRAD to identify HERO concerns and to establish SSDs when operating in a NATO environment.

Uncertified Ordnance. Electrically initiated ordnance which has not been analyzed or tested for HERO and is classified as HERO UNSAFE ORDNANCE

Uploading. Loading.

A-3. ABBREVIATIONS.

The abbreviations used in this volume are as follows:

A/m. Amperes per meter

ACN. Advance Change Notice

AECP. Allied Environmental Conditions Publication

AIT. Automatic Identification Technology

AM. Amplitude Modulation or Acquisition Manager

AUR. All-Up Round

BPMS. Business Process Management System

BRAC. Base Realignment and Closure

CAC. Common Access Card

CAD. Cartridge Actuated Device

CALA. Combat Aircraft Loading Area

CAPA. Combat Aircraft Parking Area

CIWS. Close-In Weapon System

CLAWS. Complementary Low-Altitude Weapon System

CO. Commanding Officer

Comm. Commercial

CONOPS. Concept of Operations

CONREP. Connected Replenishment

CSO. Combat System Officer

CW. Continuous Wave

d. Maximum Linear Antenna Dimension

D. Distance (from Antenna)

DAPS. Document Automation and Production Service dB. Decibel

dBd. Decibel relative to ½-wave dipole antenna

dBi. Decibel relative to isotropic antenna

DC. Duty Cycle

DLA. Defense Logistics Agency

DoD. Department of Defense

DoDIC. Department of Defense Identification Code

DON. Department of the Navy

DOT. Department of Transportation

DSN. Defense Switched Network

E3. Electromagnetic Environmental Effects

E-Field. Electric Field

EID. Electrically Initiated Device

EIRP. Effective Isotropic Radiated Power

EM. Electromagnetic

EMCON. Emission Control

EME. Electromagnetic Environment

EMO. Electronics Material Officer

EMR. Electromagnetic Radiation

EOD. Explosive Ordnance Disposal

ESO. Explosive Safety Officer

E_t. Total Electric Field Strength

EW. Electronic Warfare

f. Frequency

FCC. Federal Communications Commission

FF. Folding Fin

FFAR. Folding Fin Aircraft Rocket

FM. Frequency Modulation

G. Antenna Gain

GEMO. Ground Electronic Maintenance Officer

GHz. Gigahertz

G_t. Transmitter Gain Ratio

HBW. Hot Bridgewire

HERF. Hazards of Electromagnetic Radiation to Fuel

HERO. Hazards of Electromagnetic Radiation to Ordnance

HERP. Hazards of Electromagnetic Radiation to Personnel

HF. High Frequency

H-Field. Magnetic Field

Hz. Hertz

I. Current (Electric)

IA. Installation Activity

ID. Identification

kHz. Kilohertz

KMS. Knowledge Management System

kV. Kilovolt

mA. Milliampere

MAE. Maximum Allowable Environment

MeV. Million Electronvolts

MHz. Megahertz

MIL-HDBK. Military Handbook

MIL-PRF. Military Performance Specification

MIL-STD. Military Standard

mm. Millimeter

ms. Millisecond

mW/cm^2. Milliwatt per Square Centimeter

NALC. Navy Ammunition Logistic Code

NAR. Naval Ammunition Reclassification

NATO. North Atlantic Treaty Organization

NAVAIR, NAVAIRSYSCOM. Naval Air Systems Command

NAVELEX. Naval Electronic Systems Command

NAVFAC, NAVFACENGCOM. Naval Facilities Engineering Systems Command

NAVFACINST. Naval Facilities Engineering Systems Command Instruction

NAVSEA, NAVSEASYSCOM. Naval Sea Systems Command

NAVSEAINST. Naval Sea Systems Command Instruction

NOLSC. Naval Operational Logistics Support Center

NOSSA. Naval Ordnance Safety and Security Activity

NOSSAINST. Naval Ordnance Safety and Security Activity Instruction

NSN. National Stock Number

NSWC. Naval Surface Warfare Center

NSWC PHD. Naval Surface Warfare Center, Port Hueneme Division

NSWCDD. Naval Surface Warfare Center, Dahlgren Division

OIC. Officer In Charge

OP. Ordnance Publication

OPNAVINST. Chief of Naval Operations (CNO) Instruction

ORDALT. Ordnance Alteration

P_a. Average Power

PCM. Pulse-Code Modulation

PD. Power Density or Power Distribution

PED. Personal Electronic Device

PEP. Peak Envelope Power

PM. Program Manager

P_P. Peak Power

PRF. Pulse-Repetition Frequency

P_t. Transmitter Power

PW. Pulse Width

Pyro. Pyrotechnic

PWD. Public Works Department

PWFD. Personal Wearable Fitness Device

PWMD. Personal Wearable Medical Device

rad. Radiation Absorbed Dose

RADHAZ. Radiation Hazards

rad/min. Radiation absorbed doses per minute

rad/sec. Radiation absorbed doses per second

RF. Radio Frequency

RFID. Radio Frequency Identification

rms. Root Mean Square

RSL. Ready Service Locker

S4. Stockpile-to-Safe Separation Sequence

S&A. Safe and Arm

SATCOM. Satellite Communication

sec. Second

SECNAVINST. Secretary of the Navy Instruction

SHIPALT. Ships Alteration

S/N. Signal-to-Noise

SOP. Standard Operating Procedure

SPAWARSYSCOM. Space and Naval Warfare Systems Command

SRAD. Susceptibility Radiation Hazards Designator

SSD. Safe Separation Distance

STANAG. Standard NATO Agreement

TMDER. Technical Manual Deficiency/Evaluation Report

TNT. Trinitrotoluene

TRAD. Transmitter Radiation Hazards Designator

TRP. Total Radiated Power

UNREP. Underway Replenishment

UXO. Unexploded Ordnance

VERTREP. Vertical Replenishment

V/m. Volts per Meter

V/m-rms. Volts per Meter, Root Mean Square

W. Watt or Average Waveguide Power

WON. Work Order Number

W/m^2. Watt per Square Meter

WLAN. Wireless Local Area Network

A-4. SYMBOLS.

The symbols used in this volume are as follows:

Ω Ohm

@ At

l Wavelength

m Micro (=10-6)

> Greater than

≥ Greater than or equal to

< Less than

≤ Less than or equal to

= Equal to

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APPENDIX B
REFERENCE DOCUMENTS

B-1. NORTH ATLANTIC TREATY ORGANIZATION (NATO)

AECP-2 (D), NATO Naval Radio and Radar Radiation Hazards Manual

B-2. DEPARTMENT OF DEFENSE (DOD)

B-2.1. DOD INSTRUCTIONS (DODINST). Available for download from the Washington Headquarters Services website at https://www.esd.whs.mil/dd/.

DODINST 3222.03, DoD Electromagnetic Environmental Effects (E3) Program

B-2.2. MILITARY HANDBOOKS, STANDARDS, AND OTHER MANUALS. Available for download from Acquisition Streamlining and Standardization Information System (ASSIST) at https://assist.dla.mil.

MIL-HDBK-240, Hazards of Electromagnetic Radiation to Ordnance (HERO) Test Guide, Parts 1 through 7

MIL-STD-464, Electromagnetic Environmental Effects Requirements for Systems

MIL-PRF-81705, Barrier Materials, Flexible, Electrostatic Discharge Protective, Heat-Sealable

B-3. OFFICE OF THE SECRETARY OF THE NAVY (SECNAV)

B-3.1. SECNAV MANUALS. Available for download from the Department of the Navy Issuances website at https://www.secnav.navy.mil/doni/default.aspx.

SECNAV M-5510.36, Department of the Navy Information Security Program

B-4. OFFICE OF THE CHIEF OF NAVAL OPERATIONS (OPNAV)

B-4.1. OPNAV INSTRUCTIONS (OPNAVINST). Available for download from the Department of the Navy Issuances website at https://www.secnav.navy.mil/doni/default.aspx.

OPNAVINST 8020.14 (series), U.S. Navy Explosives Safety Management Program Policy Manual

B-5. NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND (NAVFAC)

B-5.1. NAVFAC INSTRUCTIONS (NAVFACINST). Available for download from the NAVFAC Flankspeed site at https://flankspeed.sharepoint-mil.us/sites/NAVFAC-HQ.

NAVFACINST 11010.45 (series), Safety Site Approval Request Process

B-5.2. NAVFAC BUSINESS PROCESS MANAGEMENT DOCUMENTS (BPMS). Available for download at https://flankspeed.sharepoint-mil.us/sites/NAVFACHQAM/SitePages/Site-Approval-Request.aspx

B-6. NAVAL SEA SYSTEMS COMMAND (NAVSEA)

B-6.1. NAVSEA INSTRUCTIONS (NAVSEAINST). Available for download from the NAVSEA Flankspeed site at https://flankspeed.sharepoint-mil.us/sites/NAVSEA_HOME.

NAVSEAINST 8020.6 (series), Department of the Navy Weapon Systems Explosives Safety Review Board

NAVSEAINST 8020.7 (series), Hazards of Electromagnetic Radiation to Ordnance (HERO) Safety Program

B-6.2. TECHNICAL MANUALS. Available for download from the Model Based Product Support (MBPS) site at https://mbps.navseaplm.navy.mil/Windchill/app/

OD30393, Design Principles and Practices for Controlling the Hazards of Electromagnetic Radiation to Ordnance (HERO Design Guide)

SW020-AC-SAF-010, Ammunition, Explosives and Related Hazardous Materials; Transportation and Storage Data

B-7. NAVAL ORDNANCE SAFETY AND SECURITY ACTIVITY (NOSSA)

B-7.1. NOSSA INSTRUCTIONS (NOSSAINST). Available for download from the NOSSA website at https://nossa.dc3n.navy.mil.

NOSSAINST 8020.14 (series), Navy Shore Station Explosives Safety Management Program

NOSSAINST 8020.15 (series), Explosives Safety Review, Oversight, and Verification of Munitions Responses

APPENDIX C
CERTIFICATION PROCESS FOR INTENTIONAL EMITTERS IN BELOW DECK OR OTHER ENCLOSED SPACES

C-1. CERTIFICATION PROCESS.

The following paragraphs describe the Navy's process for Hazards of Electromagnetic Radiation to Ordnance (HERO) evaluation of new or modified intentional emitters, such as Automatic Identification Technology (AIT), Wireless Local Area Networks (WLAN), or other wireless communication and other sensor network equipment (see figure C-1) for installation in below deck or enclosed spaces. Furthermore, it outlines the steps necessary for a fielding activity to request a HERO certification (see figure C-2) for a given concept of operations (CONOPS) or installation. Since mitigation of the HERO risk for these equipment is dependent on proper deployment or installation, certifications will only be provided upon review of a specific deployment or installation plan. This plan needs to consider both the safe separation distances (SSD) and total radiated power (TRP) limits established for a below deck or other enclosed space. The U.S. Navy's HERO program Technical Authority is the Commanding Officer, Naval Ordnance Safety and Security Activity (NOSSA) (N8). Accordingly, NOSSA will provide certification for systems deployed at or near U.S. Navy and U.S. Marine Corps activities.

a. The Program Manager (PM), Acquisition Manager (AM), or Installation Activity (IA) responsible for the equipment shall request a certification from the HERO Technical Authority at NOSSA (N8) via the HERO program Technical Agent at the Naval Surface Warfare Center, Dahlgren Division (NSWCDD), Electromagnetic Measurements & Engineering Branch (B55), and provide the necessary technical data (i.e., operational frequency, effective isotropic radiated power (EIRP), Federal Communications Commission (FCC) Identification (ID)) to NSWCDD (B55). The information package will include a description of the intended system operation, such as network structure of equipment and location, and a description of the radio-frequency (RF) properties and any independent test data that the manufacturer has obtained as a result RF testing. This is a two-step process. First, an engineering evaluation must be conducted to establish criteria that must be met to assure a HERO safe installation. Upon completion of the engineering evaluation, the requisite data will be provided in the form of a report to the requesting activity. That information will be used in developing a HERO-compliant installation plan that will then be submitted to NOSSA for certification. Certifications are provided at the deployed or system level and not for individual equipment.

b. NSWCDD (B55) shall review the request and equipment documentation, and determine the evaluation method (analysis and/or measurement). NSWCDD (B55) shall identify the resources needed to support the evaluation to the requesting manager or activity.

c. The PM, AM, or IA shall provide the necessary resources to NSWCDD (B55) to perform the evaluation.

d. If measurements are required, NSWCDD (B55) shall prepare a test plan for the equipment to be evaluated, and provide a copy to the manager or activity.

e. NSWCDD (B55) shall schedule the measurements based on the availability of the facilities and assets.

f. The equipment PM shall provide all hardware to be evaluated to NSWCDD (B55) at least 10 days prior to the commencement of the measurements.

g. Upon completion of the evaluation, NSWCDD (B55) shall prepare a report detailing the results and conclusions of their assessment and provide a copy to the Commanding Officer, NOSSA (N84) and the PM, AM, or IA.

h. The PM, AM, or IA will generate a detailed description of the proposed system, including equipment locations and methodology used to meet the requirements resulting from the NSWCDD (B55) engineering evaluation. Additionally, this certification request will be required to provide technical characteristics of any co-located in-band system(s) previously deployed in the below decks or enclosed spaces. This data package will be submitted to NOSSA with a request for system certification.

i. The NOSSA HERO PM shall review the assessment report and Certification Request along with supporting data and either approve or reject the request as follows:

(1) If the system has no HERO impact, and meets the requirements set forth in the engineering evaluation, the HERO PM will issue a HERO Certification (Unrestricted) to the PM, AM, or IA, and forward copies of the certification to NSWCDD (B55).

(2) If the system can adversely affect ordnance to the extent that managing HERO shall present undue operational restrictions on the fleet and/or the restrictions placed on the system shall diminish the capability of the equipment's intended usage, the HERO PM will issue a letter rejecting HERO Certification, notifying the PM, AM, or IA of the need to either correct the proposed deployment or request a waiver of the HERO Certification requirements. Should the PM choose to correct the issues or discrepancies, the HERO Certification request shall be reprocessed upon evaluation by NSWCDD (B55).

j. The equipment PM, AM, or IA will do one of the following:

(1) If the equipment is HERO certified (unrestricted), then the PM, AM, or IA may proceed with fleet introduction of the equipment.

(2) If the equipment is HERO certified (with restrictions), then the PM, AM, or IA may proceed with fleet introduction of the equipment ensuring that the proper restrictions, including SSDs and TRP, can be achieved and managed without diminishing the capability of the equipment's' intended usage.

k. If the equipment is not certified, then the PM, AM, or IA either continues to work to make changes to the RF properties (e.g., EIRP or frequency) and have NSWCDD (B55) retest, or request a waiver of the HERO Certification requirements due to a pressing operational necessity.

C-2. EVALUATION PROCESS (see Figure C-1).

NSWCDD (B55) will determine which of the following methods will be used to evaluate the equipment's

HERO SSDs:

a. Analysis using manufacturer data sheet;

b. Analysis of FCC Part 15 test data or test chamber or open air field measurements; or

c. Enclosed space characterizations.

C-2.1. Method (a) will be used for certification when HERO SSDs of 10 feet or greater are operationally feasible and not used in an enclosed space or when the equipment meets the criteria of table 3-1 of this manual. The assigned HERO engineer, when performing analysis of manufacturer data, will compute HERO UNSAFE separation distances using the HERO Safe Separation Distance Calculator available in the RADHAZ Tools on the E3 Team Online KMS or table 3-1 of this manual.

C-2.2. Method (b) will be used if it is determined that method (a) results in operational constraints that are not practical or operationally feasible. If FCC data exists, an analysis of the measured RF emissions will be performed to determine the HERO UNSAFE separation distances using the HERO Safe Separation Distance Calculator available in the RADHAZ Tools on the E3 Team Online KMS or chapter 3 of this manual. If FCC data does not exist, a measurement will be required, whereas the equipment will be exercised such that the unit(s) under test will transmit at the maximum possible output power at the maximum possible duty cycle (DC). Setting this operating condition may involve efforts such as configuring the test setup to intentionally reduce the signal-to-noise (S/N) ratio of the equipment’s communication link. It has been noted that, in some cases, when such worst-case operating conditions are incorporated into the test setup, the measured radiated power can exceed the manufacturer’s published data sheets or the unit’s expected output characteristics. The HERO UNSAFE separation distances will be determined from these measurements using the HERO Safe Separation Distance Calculator or chapter 3 of this manual.

C-2.3. Method (c) will be used in conjunction with method (b) when intentional emitters are to be located in enclosed electrically-reflective spaces and must be assessed for TRP. This is due to the effect of multipath and/or multiple in-band sources deployed within such spaces. This condition exists in both ship and shore facilities, and must also take into account the TRP of other co-located in-band systems. Accordingly, it is necessary to conduct a characterization of such spaces/facilities to determine the power level that is allowable without exceeding the electric field limits of figure 2-2 of this manual.

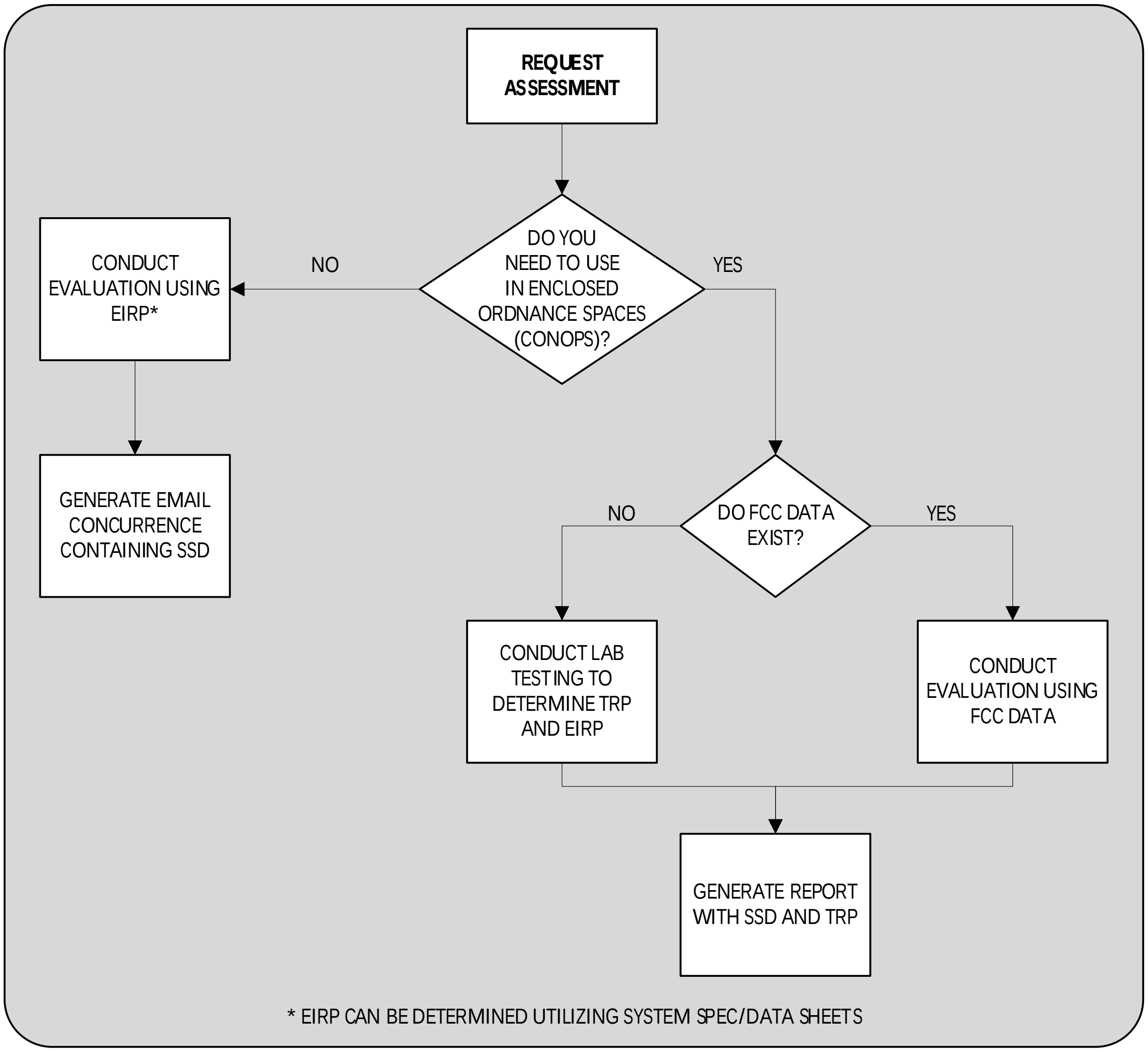

Figure C-1. HERO Equipment Evaluation Process

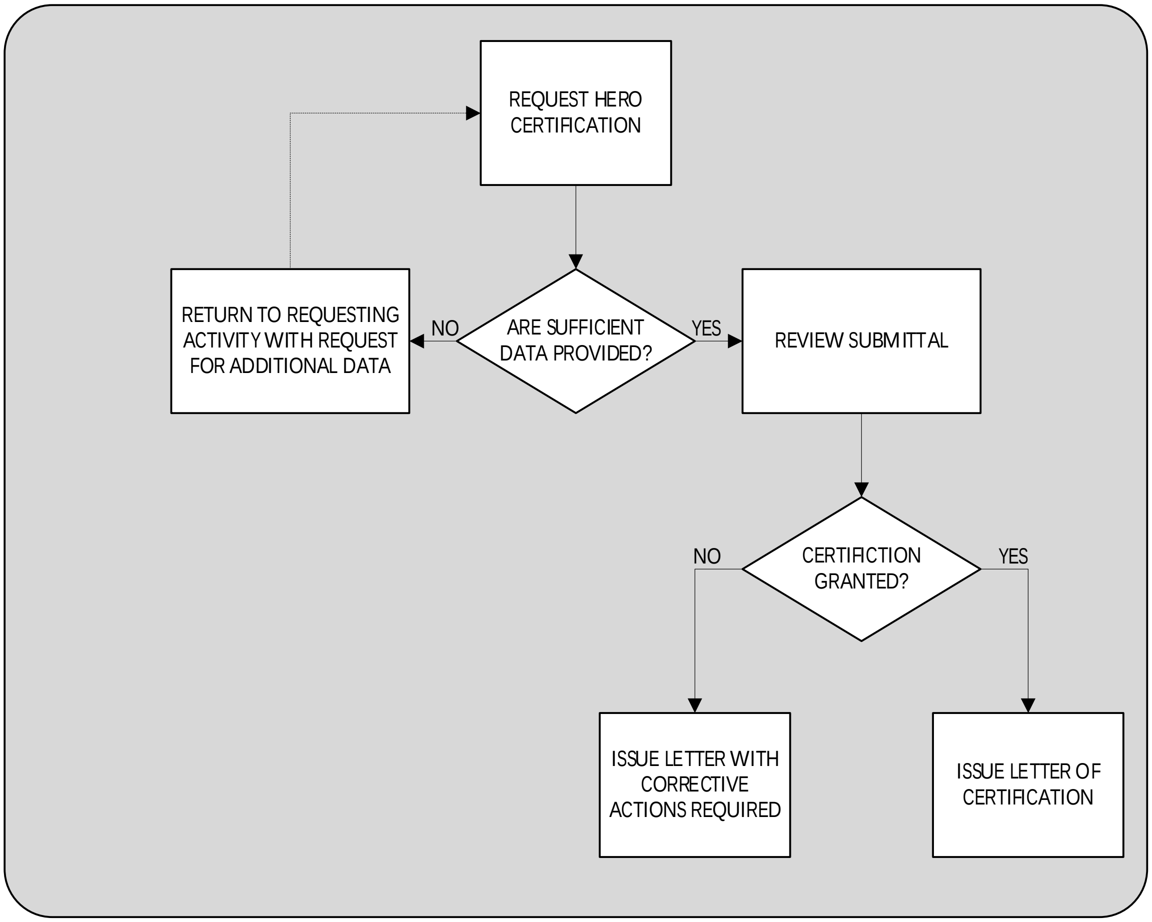

Figure C-2. System HERO Certification Process

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APPENDIX D
NATO OPERATIONAL PROCEDURE & GUIDANCE FOR TWO APPROACHING PLATFORMS

D-1. OPERATIONAL GUIDANCE.

The procedure defined in this appendix is an example of the procedures to be used to cover all U.S. and North Atlantic Treaty Organization (NATO) military platform configurations.

a. As a part of pre-flight procedures, the aircraft pilots will have a record of the platform Susceptibility Radiation Hazard (RADHAZ) Designator (SRAD) code (1) for the weapon/stores configuration for the specific mission, established using the SRAD allocation procedure defined in paragraph 4-1.2. Upon approaching a foreign ship, the pilot shall pass the corresponding SRAD code during the request for permission to close.

b. Ships participating in NATO operations shall establish their Transmitter RADHAZ Designator (TRAD) code using the procedure outlined in paragraph 4-1.3.

c. To receive an aircraft and to ensure its safe recovery, the ship compares SRAD and TRAD. The ship's crew place SRAD and TRAD in a table with the SRAD on the first line and TRAD on the second line:

(1) When the indexes of TRAD are lower than or equal to those of SRAD, the minimum distance to observe between the aircraft and the transmitters is 3 meters. In all other cases, for each radio/radar radiation hazards frequency range, the ship determines the minimum distance between the aircraft and the transmitters, consulting table 4-2, and places these distances on the third line of the table as shown in table D-1.

Table D-1. Operational Distance Examples

Example E-1									
SRAD (1)	**R3**	**T4**	**U2**	**V5**	**WA5**	**WB5**	**YA2**	**YB2**	**Z4**
TRAD	R1	T2	U2	V4	(2)	(2)	YA13	Y13	Z4
Safety distances in meters	3	3	3	3	(2)	(2)	50	50	3
Example E-2									
SRAD (1)	**R2**	**T0**	**U2**	**V4**	**WA3**	**WB3**	**YA5**	**YB5**	**Z4**
TRAD	(2)	T2	U3	V8	WA3	WB3	YA16	Y16	(2)
Safety distances in meters	(2)	40	3	10	3	3	90	90	(2)

Notes

1. The SRAD code of each materiel must be determined by each Nation.

2. No transmitter in this frequency range.

(2) If the safety distance derived is greater than the distance between any of the transmitting antennas and the landing area, suitable steps are to be taken by the ship to switch off the transmitter in the frequency range of concern, or, if that is not possible, to reduce power output (thereby decreasing minimum safe distances) or sector scan, where applicable, to eliminate electromagnetic radiation (EMR) in the landing areas. In the event that maintenance of the calculated safety distances impacts recovery of the aircraft, all transmitters creating the RADHAZ condition are to be switched off, or permission to land denied.

d. A procedural flow chart (figure D-1) is given below to outline the different steps of the procedure. An example of how to use the procedure is given in chapter 4.

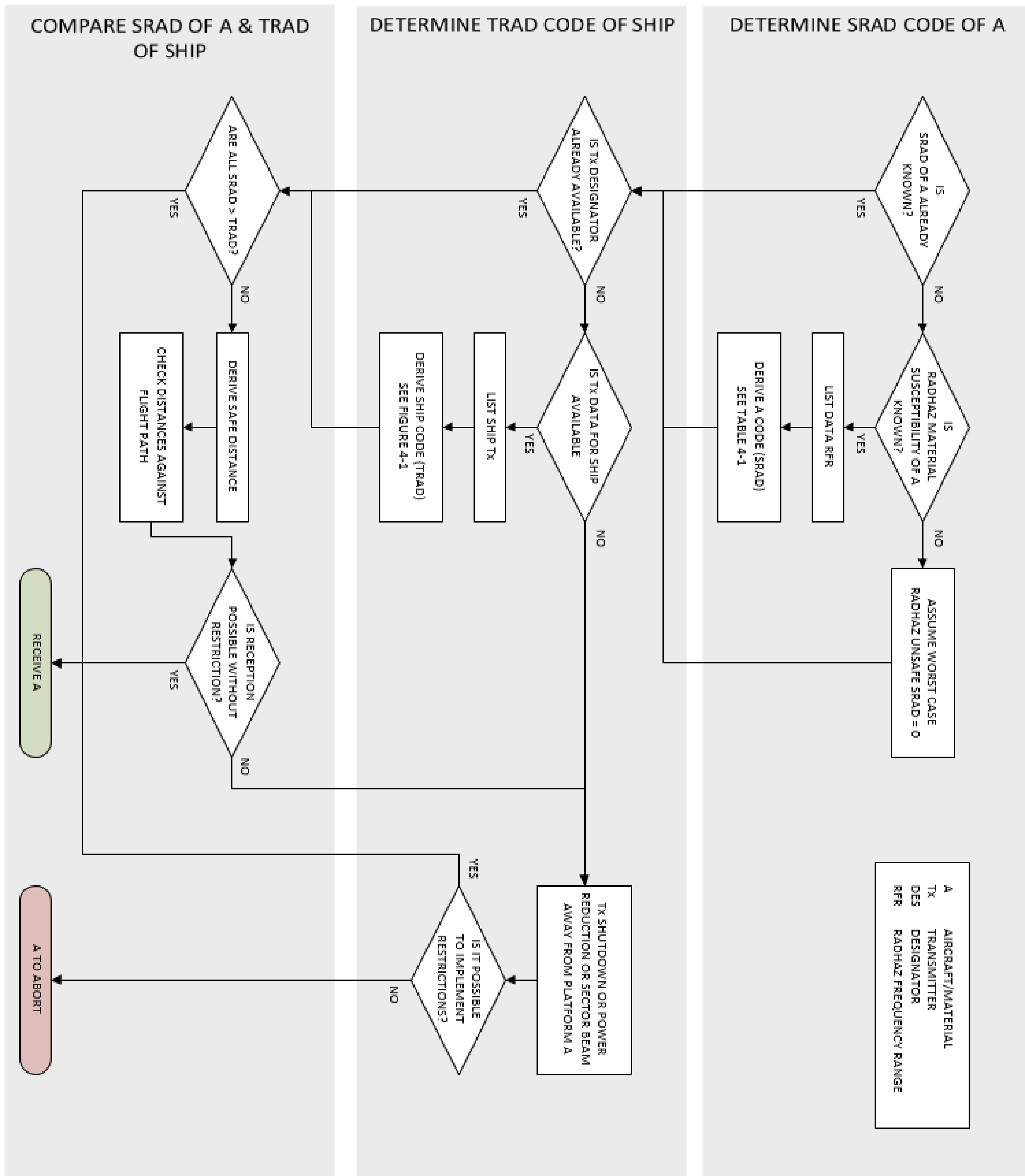

Figure D-1. Procedural Flow Chart

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Ref: NAVSEAINST 4160.3 NAVSEA S0005-AA-PRO-010/TMMP

NAVSEA/SPAWAR TECHNICAL MANUAL DEFICIENCY/EVALUATION REPORT (TMDER)

INSTRUCTIONS: Continue on 8 ½" x 11" page if additional space is needed.

1. Use this report to indicate deficiencies, problems and recommendations relating to publications.
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