

CHAPTER 22

NON-IONIZING RADIATION

2201. Discussion

The term non-ionizing refers to forms of radiation, which do not have sufficient energy to cause ionization of atoms or molecules. Typically, examples include the electromagnetic emissions radiated by lasers, radiofrequency (RF), and microwave sources.

2202. Policy

The Department of the Navy (DON) policy is to preserve and maintain the health of its personnel by adopting practices that eliminate or control potentially hazardous radiation exposures. This policy encompasses:

- a. Limiting personnel exposures to levels that are within permissible exposure guidelines
- b. Identifying, attenuating or controlling through engineering design, administrative actions or protective equipment, hazardous exposure levels and other dangers associated with non-ionizing radiation sources
- c. Controlling areas in which harmful exposure to unprotected personnel could occur
- d. Ensuring personnel are aware of potential exposures in their work places and duty assignments and the control measures imposed to limit their exposures to levels that are within the permissible guidelines
- e. Investigating and documenting overexposure incidents.

2203. Applicability

All Navy activities employing sources of non-ionizing radiation which may affect the safety and health of personnel shall observe radiation protection requirements, exposure standards and safety guidelines. Provisions of this chapter do not apply to exposures administered to patients undergoing medical diagnostic or therapeutic procedures.

2204. Laser Radiation

Lasers are designed to operate at various wavelengths in the ultraviolet, visible and infrared portions of the electromagnetic spectrum, and are used in various military, industrial, medical and scientific applications. While mechanisms for biological damage from lasers are similar to effects produced from absorption of energy from conventional light sources, lasers are of special concern because of their potential to project hazardous levels of energy over great distances. Exposure to lasers can result in permanent and disabling eye injury.

2205. Laser Radiation Policy

Chief, Bureau of Medicine and Surgery (BUMED) is the administrative lead agent for laser safety within the DON. Responsibilities for setting forth DON policy and guidance in the identification and control of laser radiation hazards are set forth in reference 22-1.

2206. Laser Permissible Exposure Limits (PELs)

a. Laser PELs, also referred to as threshold limit values (TLVs) and maximum permissible exposure (MPE) limits, are published in references 22-2 and 22-3 respectively. For laser exposures that are within the PEL, no adverse biological effects are expected to occur even under repeated or long-term exposure conditions. Only trained and technically qualified personnel shall apply these exposure limits in determining laser safe viewing conditions, since an improperly conducted laser hazard evaluation may pose serious risks to a person's eyes.

b. Laser exposure limits are set to protect tissue from damage and are not the equivalent of comfortable viewing levels. Operators of lasers need to be aware of secondary laser safety concerns. For example, intrabeam viewing of visible wavelength lasers, even at or below the permitted safe level, will still be perceived as an intense light source capable of producing disabling glare or visual after-images. These temporary visual effects can interfere with performing critical tasks such as operating vehicles or aircraft. Similarly, intrabeam viewing of lasers at or below the permitted exposure limits can still damage or "saturate" night vision viewing devices because of the high amplification of incident light levels provided by the devices. Wearing of laser protective eyewear can also lead to other safety concerns, such as the potential for blocking or filtering out the color of some warning or alarm indicator lights.

2207. Laser Classification, Labeling, Technical Assistance and Exposure Incidents

a. The Navy has adopted a system for categorizing the hazards of lasers, which provides a practical means for determining safety requirements appropriate for different types of lasers. These categories range from a Class I laser that is safe to view under all conditions, to the Class IV laser which can cause eye damage under most viewing conditions. Appendix 22-A provides information on laser classification, types of laser warning signs and labels, technical assistance and exposure incidents.

b. For most lasers used in medical, laboratory, research and industrial applications, use of the classification system precludes the necessity for performing any laser measurements or calculations. Reference 22-4 requires manufacturers to classify and label their laser systems. Laser measurements or laser safety calculations will usually be required only for lasers operating on outdoor ranges or in open areas when it is necessary to define a laser nominal hazard zone (NHZ).

2208. Military Exempt Lasers

Lasers or laser systems designated for combat, combat training or classified in the interest of national security may be exempted from compliance with some or all of the provisions of reference 22-4. To obtain military exemption status, the contractor must have written authorization from the military contracting activity, and the laser product must be certified to conform with requirements in reference 22-5 and have been approved by the Navy Laser Safety

Review Board (LSRB). Commands shall maintain a current inventory of all military exempt lasers for submission to the administrative lead agent as requested. Commands wishing to dispose of lasers shall obtain approval from BUMED following guidance in references 22-1 and paragraph 2205.

2209. Laser Safety Review Board (LSRB)

Military laser systems are reviewed by the LSRB during their development to ensure that adequate safety criteria have been incorporated. LSRB review is required at appropriate stages of development and prior to introduction of prototype or production units into the fleet for testing or initial use. An important function of the Navy Laser Safety Program is a determination of the nominal ocular hazard distance (NOHD) or safe viewing range, for each operational laser system used in the Navy. LSRB review also applies to Class IIIb and Class IV commercial lasers and laser systems that are not intended solely for laboratory or medical use. Reference 22-6 contains general guidance for materials necessary and procedures followed by the LSRB review.

2210. Laser Safety Hazard Control Program

Commands operating Class III or IV commercial or military exempt lasers shall establish a laser safety program and designate a laser system safety officer (LSSO) per reference 22-6. The laser safety program shall include an inventory of all commercial Class IIIb, Class IV and all classes of military exempt lasers that are assigned to the command lasers for submission to the administrative lead agent as requested.

NOTE:

Some commercially available laser pointers are categorized as Class IIIa lasers with output levels that are not considered safe for all viewing conditions. A formal laser safety program is not required for Class IIIa laser pointers; however, the user needs to recognize that care must be exercised to control its accessibility (kept out of the hands of children or others who are unaware of the hazardous nature of lasers), and to avoid directing the pointer at those in the audience. Class II laser pointers do not pose a hazard during normal viewing, and their use is not restricted.

2211. Medical Surveillance Procedures

Enrollment in a laser radiation medical surveillance program is limited to those personnel who are clearly at risk from exposure to laser radiation. The nature of such risks is associated with accidental injuries resulting from excessive exposure to laser levels and not as a result of chronic exposures. The command LSSO determines which personnel should be enrolled in the surveillance program using the following guidance:

- a. Laser workers requiring medical surveillance are those individuals who routinely work with Class IIIb or Class IV lasers under conditions where there is a likely potential for accidental exposures to excessive levels. These workers require a pre-placement and termination laser eye examination per reference 22-7.

- b. The following personnel generally require medical surveillance:
- (1) Research and development (R&D) and laboratory personnel who routinely work with unenclosed Class III and Class IV laser beams
 - (2) Maintenance personnel who routinely repair or align Class III or Class IV laser systems
 - (3) Operators (personnel behind the laser) and down-range personnel who routinely work with Class III or Class IV engineering laser transits, geodimeters and alignment laser devices
 - (4) Operators who routinely work with Class IIIb and Class IV industrial lasers where access to an unenclosed beam path is possible.
- c. Other laser workers or personnel where the potential for accidental exposure is deemed very unlikely generally do not require medical surveillance. For example:
- (1) Personnel who work with Class I or Class II lasers, or with laser systems containing Class III or Class IV lasers when there is little or no potential for exposure to the open laser beam
 - (2) Visitors or other personnel involved infrequently in laser testing, demonstrations or training when the LSSO has ensured such personnel will be protected from exposure to levels of laser radiation greater than the PEL
 - (3) Supervisory, clerical and custodial personnel working in laser areas where laser safety procedures preclude their exposure to levels of laser radiation above the PEL
 - (4) Operators of fielded military laser systems when operations are conducted on established laser ranges, or as part of training operations where prescribed laser safety procedures are enforced
 - (5) Personnel involved in "force on force" laser training exercises where appropriate protection is established, either in the form of administrative controls or procedures, or where laser protective eyewear is provided.

2212. Laser Safety Training

a. Commands shall provide LSSO laser safety training through the completion of a Laser System Safety Officer Course approved by BUMED and the Lead Navy Technical Laboratory at the Naval Surface Warfare Center, Dahlgren Division. There are four categories of LSSOs, administrative laser safety officer (ALSO), technical laser safety officer (TLSO), laser safety specialist (LSS), and range laser safety specialist (RLSS). Re-testing at the LSSO's highest certification level is required to maintain certification for all categories of LSSO every 4 years. If the LSSO fails the re-certification examination, the LSSO will have to be re-certified by attending the appropriate course. Commanding officers should determine which category of LSSO is appropriate for their command considering their mission, types of lasers being used,

and size of the laser safety program. Laser safety-training requirements at medical treatment facilities for the medical LSSO and designated medical personnel are contained in reference 22-8.

- (1) An ALSO is qualified to:
 - (a) Establish and manage a unit level laser safety program.
 - (b) Approve, disapprove, or submit for safety approval to higher authority all local laser uses, both portable and fixed.
 - (c) Instruct employees and supervisors on the safe use of lasers.
 - (d) Supervise laser operations and maintenance.
 - (e) Manage laser incident investigations as appropriate. Technical assistance of a LSS or a RLSS is required.
 - (f) Maintain a laser medical surveillance program.
 - (g) Maintain an inventory of military-exempt and class IIIb and class IV lasers.
 - (h) Post laser warning signs and devices.
 - (i) Ensure that laser operators have the appropriate knowledge to safely operate their specific lasers (supervisor safety briefs, factory training school, instructional materials, etc.)
 - (j) Provide safety briefs/pre-mission briefs to laser range users.
 - (k) Prior to use of a laser range, ensure/confirm that warning signs have been posted, the area is clear of specular reflectors, personnel have required LEP, and all other safety conditions for range laser use outlined in the range regulations or range standard operating procedures (SOPs) are met.
 - (l) Perform laser eye protection inspections.
- (2) A TLSO is qualified to:
 - (a) Understand the calculations and measurements of laser safety parameters such as nominal ocular hazard distances (NOHDs) and required optical densities for laser eyewear.
 - (b) Train ALSOs using the administrative lead agent (ALA) approved course curriculum (Qualifications of TLSOs as instructions requires ALA/lead Navy technical laboratory (LNTL) approval).
 - (c) Understand classification of lasers and laser systems.

(d) Perform the duties of a laboratory, installation, base, research facility, or RLSO that includes establishing and managing a base or installation laser range safety program; approving/disapproving the use of laser systems and laser operations on their range that fall within the guidelines of the range certification; and performing annual range safety compliance inspections; and ensuring laser ranges under their cognizance are certified/re-certified by RLSS at least every three years or when changes to the range fall outside the current certification.

(e) Ensure range regulations/SOPs are provided to commands requesting unsafe of the laser range.

(f) Review training plan (to include laser type(s) and proposed employment tactics) of each command requesting access to the laser range certification.

(g) Perform the same duties as an ALSO.

(3) A LSS is qualified to:

(a) Perform the calculations and measurements of laser safety parameters such as NOHDs and required optical densities for laser eyewear.

(b) Train ALSOs, TLSOs, RLSOs, and LSSs using the ALA-approved course curriculum. (Qualification of instructors requires ALA/LNTL approval).

(c) Classify lasers and laser systems.

(d) Conduct technical aspects of laser incident investigations.

(e) Perform the same tasks as a TLSO.

(4) A RLSS is qualified to:

(a) Conduct laser radiation hazard surveys and evaluations for commanding officer certification.

(b) Perform the calculations and measurements required to certify a laser range.

(c) Train ALSOs and RLSSs using the ALA-approved course curriculum. (Qualification of instructors requires ALA/LNTL approval.)

(d) Conduct technical aspects of laser range incident investigations.

(e) Perform the same tasks as a TLSO.

b. Laser range safety officers, laser maintenance personnel and industrial laser supervisors shall complete a formal command laser safety training course as outlined in reference 22-6.

c. Commands shall provide formal classroom training on the potential hazards associated with accidental exposure to laser radiation to all personnel in areas operating Class IIIb (and Class IIIa with danger logo) or Class IV lasers. In particular, the vulnerability of the eyes to being damaged by lasers shall be emphasized. Commands shall conduct annual refresher training per reference 22-6.

d. For employee training, the following laser safety training videotapes are available from the Norfolk Regional Electronic Media Center: *Laser Hazards and Control*, 804245DN, *Hazards and Control of Military Lasers*, 804246DN, and *Laser Safety in Medical Treatment Facilities*, 803198DN. (See section 0604b). Additional information is available in reference 22-9 on laser operations, hazard distances for Navy laser systems and use of laser protective eyewear.

2213. Other Optical Sources

Broadband optical sources such as germicidal lamps, phototherapy, sun lamps, backlights, arc lights, projector lamps, high intensity discharge lamps and infrared arrays are also used in many medical and industrial applications. These types of light sources may require controls to prevent possible acute effects such as skin burns, photokeratitis, cataracts or retinal burns. Exposure guidance can be found in reference 22-2. Obtain assistance in the evaluation of broadband optical sources, where personnel are considered to be at ocular risk, from an industrial hygienist or radiation health officer.

2214. Radiofrequency (RF) Electromagnetic Fields (EMF)

RF exposure is primarily associated with operation of various radars and communication systems at Navy shore facilities and aboard ships. In addition to personnel concerns, RF fields may generate induced currents or voltages that could cause premature activation of electro-explosive devices in ordnance, equipment interference or sparks and arcs that may ignite flammable materials and fuels.

2215. Radiofrequency Ashore and Afloat

Naval Sea Systems Command (COMNAVSEASYS COM) is the lead agency for coordinating electromagnetic safety programs for Naval ships. Space and Naval Warfare Systems Command (COMSPAWARSYS COM) is the lead agency for coordinating electromagnetic safety programs for shore facilities. Reference 22-10 contains RF hazard (RADHAZ) guidance regarding hazards of RF exposure to personnel, fuels and ordnance.

2216. RF Permissible Exposure Limits (PELs) and Maximum Permissible Exposures (MPEs)

a. Reference 22-10 will be amended to reflect the current RF PELs listed in reference 22-11 for the frequency range of 3 kilohertz to 300 Gigahertz and the current RF MPEs in reference 22-14 for the frequency range of 0 to 3 kilohertz. Those persons conducting RF hazard analysis and evaluations should consult the more extensive technical guidance contained in references 22-11, 22-12, 22-13, and 22-14.

b. Exposure limits are specified for locations that are defined as either controlled or uncontrolled environments. Controlled environments are areas where exposure may be incurred by personnel who are aware of the potential for RF exposure as a result of employment or duties, by individuals who knowingly enter areas where higher RF levels can reasonably be anticipated to exist and by exposure incidental to transient passage through such areas. Uncontrolled environments generally include public areas, living quarters and work places where there is no expectation that higher RF levels should be encountered.

c. The RF exposure limits for controlled environments represent scientifically derived values to limit absorption of RF energy in the body, and to restrict the magnitude of RF currents induced in the body. This means that the amount of energy absorbed is insufficient to produce or cause any adverse effects on health, even under repeated or long-term exposure conditions. The controlled environmental limits are the equivalent of personnel exposure standards for all individuals. In uncontrolled environments where access is not restricted or controlled, lower permissible exposure levels have been adopted as a consensus to maintain lower exposure levels outside of well-defined areas. The limits for uncontrolled environments should not be interpreted as being imposed to lessen any known adverse health effect, and should not be interpreted as being the limit on personnel exposure for non technical employees or for members of the public that enter a controlled environment.

d. For shipboard situations, consider the weather decks, enclosed and open masts and electronic work spaces as controlled environments. For shore stations, consider accessible areas beyond a station's perimeter fence line as uncontrolled environments. Within a station's boundaries, differentiation between controlled and uncontrolled environments will require individual determinations. For both ship and shore situations, incorporate existing physical structures or areas, such as decks, fences, rooftops, etc., in defining the location of boundaries for controlled environments.

e. No special RF exposure limits or additional exposure restrictions are imposed in the case of pregnancy.

2217. RF Measurement and Evaluation

a. Facilities shall determine RF levels for all areas in which personnel could receive exposures in excess of the exposure limits. In addition, shore facilities must determine RF field levels where locations of RF emitting antennas may be expected to raise concerns among personnel or generate public inquiries regarding levels of RF emissions beyond the base perimeter. Facilities must use proper RF measurement techniques and application of the RF exposure limits to avoid imposing unnecessary restrictions on operations or establishing overly restrictive protective boundaries. Facilities may obtain assistance in measuring RF emission levels from the activities listed in appendix 22-B.

b. A comprehensive RF hazard evaluation for major platforms, such as warships or communication stations, where multiple RF emitters exist in close proximity to each other, requires considerable technical familiarity with electromagnetic fields. Such surveys may involve determination of boundary locations for protective fences or enclosures, or specifying operational conditions or restrictions necessary for protection of personnel. The activities listed in appendix 22-C may perform these evaluations, which are primarily an engineering type survey.

c. In addition to appendix 22-B, safety or health professionals may make RF measurements or calculations for situations that primarily consist of determining RF exposure levels for a particular area occupied by personnel.

2218. Safety Certification

a. Activities identified in paragraph 2218(c) shall obtain a survey certification from the technical activities listed in appendix 22-B to ensure all RF sources have been evaluated, safe separation distances have been determined, warning signs posted and any other safety measures, such as protective fences, have been defined.

b. To maintain certification, the site shall forward information on new RF sources that are installed to the technical activity listed in appendix 22-B to obtain a theoretical or calculated safety evaluation. The activity with the original site certification shall maintain this provisional certification.

c. All shore facilities having RF emitters must obtain baseline certification. For most facilities, certifications/re-certifications will require an instrumented site survey or desktop analysis. Some activities with only a few low power RF systems may require neither. The certifying agency will determine certification survey/re-certification requirements of the facility. Re-certifications will be scheduled as follows:

(1) Three-Year Resurvey Re-certification. Major NAVNETSPAOPSCOM transmitter facilities are included within this group.

(2) Five-Year Resurvey Re-certification. Sites with large numbers or frequent additions/changes of RF emitters or a site located in populated areas where public exposure to RF emissions may be an environmental concern.

(3) Ten-Year Resurvey Re-certification. Sites having a moderate and stable number of RF microwave emitters.

2219. Warning Signs, Labels and Devices

a. The RF hazard warning signs, labels, devices, exposure incident procedures and technical assistance are shown in appendix 22-B. Appropriate warning statements are added in the lower triangular portion of the sign. Variations are authorized, such as subdued signs for camouflage or to improve visibility under certain lighting conditions, provided the general wording and layout of the sign remain the same.

b. Activities shall post RF hazard warning signs at all access points to areas in which levels exceed the exposure limits for controlled environments.

c. Activities should post RF hazard warning signs in appropriate areas in which the RF levels exceed the exposure limits for uncontrolled environments as determined by cognizant engineering or safety or health professionals.

d. In areas where access to levels greater than 10 times the exposure limits for controlled environments may exist, warning signs alone do not provide sufficient protection. Activities shall provide other warning devices and controls, such as flashing lights, audible signals, barriers or interlocks, as determined by the certification authority, depending upon the potential for exposure.

e. See appendix 22-B for reporting of RF incidents.

2220. Research, Development and Acquisition

a. Activities performing research, development, testing and evaluation (RDT&E) and acquisition of RF systems, including non-developmental items and commercial off-the-shelf items, shall identify RF control requirements by incorporating adequate protection measures or identifying appropriate operational restrictions to maintain personnel exposures within the exposure limit. System safety studies under reference 22-13 shall use the exposure limits given in reference 22-11 to define restrictions necessary to limit personnel exposures.

b. Activities shall include safety information, operational restrictions, and safe exposure distances for systems being fielded in appropriate fielding documents and technical manuals to limit RF exposure of personnel engaged in operation, maintenance and repair of the system.

2221. RF Safety Training

Activities shall provide RF safety training to personnel who routinely work directly with RF equipment or whose work environments contain RF equipment that routinely emits RF levels in excess of the exposure limits for controlled environments. Activities shall conduct training before assignment to such work areas, and shall focus on awareness of the potential hazards of RF fields, established procedures and restrictions to control RF exposures, and personnel responsibility to limit their own exposures. Activities may incorporate RF safety training in periodic safety training programs to satisfy command-training objectives.

2222. Protective Clothing

The Navy does not authorize RF-shielded protective clothing for routine use as a means of protecting personnel. This does not preclude use of other protective equipment, such as electrically insulated gloves and shoes for protection against electrical shock or RF burn, or for insulation from the ground plane.

2223. Low Frequency and Static Electric and Magnetic Fields

a. Electric and magnetic fields exist around power lines, electrical devices and appliances. The intensity of these fields decreases rapidly with distance. While questions have been raised about the possibility of health effects from exposure to electric and magnetic fields at levels that are commonly encountered in homes and most work places, findings issued by various scientific review panels have not confirmed that such fields pose any risk to health.

b. Since the body is a conductor, electric fields induce a charge on the surface of the body that results in current flow inside the body. Time varying magnetic fields, or body

movement in a static magnetic field, induce electric fields and current flow inside the body. For commonly encountered fields near high voltage transmission lines, power distribution systems, office equipment, and household appliances, the magnitude of these induced currents will typically be below levels which are perceptible. Existing guidelines given in reference 22-14 have been established to limit induced current densities in body tissues. This rationale has been used to set a biological endpoint since no other definable risk criterion has been identified for establishing a health standard for electric and magnetic fields.

2224. Video Display Terminals

a. Video display terminals (VDTs) are electronic devices that typically involve individuals remaining in close proximity to them for long periods of time. Various forms of electromagnetic energy are associated with VDTs, including static electric fields near the screen, 60 Hz electric and magnetic fields, higher frequency fields around 10 kHz from the beam sweep circuits and low intensity X-rays near some internal components.

b. Some computer manufacturers have chosen to advertise VDTs with low magnetic field emissions for marketing reasons. Other manufacturers have produced various products that are advertised as reducing electromagnetic emissions from VDTs. Extensive measurements have shown that the fields emitted from VDTs are already well below exposure guidelines. There is no requirement or need to periodically measure emissions from VDTs, or to procure add-on screens for shielding electromagnetic emissions from VDTs.

c. VDTs are sensitive to electrical interference, and the displays have been reported to be affected by 60 Hz magnetic fields as low as 10 to 15 milligauss. Such interference poses no health concerns other than annoyance. Correction usually involves relocation of the VDT away from the source of interference or in some cases, adding shielding to nearby power distribution components.

2225. Responsibilities

a. Commander, Naval Sea Systems Command (COMNAVSEASYSCOM) shall:

(1) Serve as the lead agent for RF radiation safety and hazard analysis for the Navy's Electromagnetic Environmental Effects (E3) Program, and as the technical lead agency for laser safety and laser safety hazard analysis in the Navy.

(2) Ensure a capability exists to conduct laser hazard surveys of military laser systems, laser installations and firing ranges.

(3) Sponsor reference 22-10 in providing operating procedures and guidance for electromagnetic hazards to personnel, ordnance and fuel and for RF hazard certification for ships and craft.

b. Commander, Space and Naval Warfare Systems Command (COMSPAWARSCOM) shall:

(1) Serve as the technical lead agency for RF radiation safety and hazard analysis as a component of the Navy's Electromagnetic Environmental Effects (E3) Program for shore facilities.

(2) Provide information to COMNAVSEASYS COM for updating information on the hazards of electromagnetic radiation to personnel and fuels in reference 22-10.

c. Chief, Bureau of Medicine and Surgery (BUMED) shall:

(1) Serve as administrative lead agency for laser safety and laser safety hazard analysis in the Navy.

(2) Will maintain a list of all DON laser systems that have been exempted from Title 21 Code of Federal Regulations and their status.

(3) Provide the secretariat to the LSRB and ensure laser safety design standards, safety documentation and training and laser protective devices are developed for military laser systems.

(4) Ensure laser safety design standards, safety documentation, training standards, and laser eye protection are developed for military laser systems.

(5) Serve as the lead agency for guidance on personnel exposure limits for lasers, RF and other electromagnetic sources.

(6) Provide technical assistance to Navy commands addressing electromagnetic exposures or human health effects issues with local governments or state agencies.

(7) Maintain the Navy repository of laser and RF investigative reports involving personnel injuries from lasers and RF overexposures.

(8) Provide assistance through the Navy Environmental Health Center for laser and RF hazard evaluations at industrial and medical activities.

(9) Sponsor appropriate biological research for addressing the effects of electromagnetic energy on humans.

d. Other Echelon 2 and headquarters commands shall ensure:

(1) Safety requirements are included in procurement activities for the design, operation, maintenance, repair, technical orders, handbooks, manuals and other publications related to lasers and RF systems per references 22-6 and 22-11.

(2) Laser and RF hazard surveys and certifications are obtained for new equipment, installations, laser training ranges or modifications of existing equipment, installations or ranges when required to define laser or RF exposure levels or determine personnel access restrictions.

- e. Commanders, commanding officers, and officers in charge shall:
- (1) Establish a laser safety program per reference 22-6 to protect personnel.
 - (2) Ensure personnel are trained to be familiar with potential laser or RF exposure hazards and appropriate protective measures.
 - (3) Allow laser operation only at installations and ranges that have been certified and approved by an appropriate LSSO as safe for each specific laser and tactic to be used.
 - (4) Obtain safety certification for non-ionizing radiation sources. Update these certifications when new items are added. Also obtain provisional certification whenever new lasers or RF systems are installed, existing RF radiating antennas are modified or relocated or new construction occurs in the vicinity of an RF radiating antenna, when such changes may affect restrictions or boundaries imposed for limiting personnel exposures to RF fields.
 - (5) Ensure laser or RF surveys are conducted by technically competent personnel. Technical activities are listed in appendix 22-A, for laser and 22-B for RF safety.
 - (6) Investigate, document and report results of laser or RF over-exposure incidents per chapter 14 of this document. Refer also to appendix 22-A for laser incidents, 22-B for RF incidents, and references 22-6 and 22-7.
 - (7) Ensure that the use and disposal of military exempt lasers are per reference 22-1.
 - (8) Prepare and retain on-site an annual inventory of all Class IIIb, Class IV, and all classes of military exempt lasers per references 22-1 and 22-6.

Chapter 22

References

- 22-1. SECNAVINST 5100.14D of 18 Oct 05, Military Exempt Lasers
http://neds.daps.dla.mil/Directives/5100_14d.pdf.
- 22-2. American Council of Government Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices (NOTAL) www.acgih.org/.
- 22-3. American National Standards Institute (ANSI) Z136.1-2000, American National Standard for the Safe Use of Lasers, (NOTAL) www.ansi.org/.
- 22-4. 21 CFR 1040 of 1 Apr 2000 Performance Standards for Light-Emitting Products
http://www.access.gpo.gov/nara/cfr/waisidx_01/21cfr1040_01.html.
- 22-5. MIL-STD 1425A, Safety Design Requirements for Military Lasers and Assorted Support Equipment.

- 22-6 OPNAVINST 5100.27A/MCO 5104.1B, of 22 Sep 02, Navy Laser Hazards Control Program http://neds.daps.dla.mil/Directives/5100_27a.pdf.
- 22-7. BUMEDINST 6470.23, of 18 Aug 99, Medical Management of Non-Ionizing Radiation Casualties.
- 22-8. BUMEDINST 6470.19, of 24 Aug 90, Laser Safety for Medical Facilities.
- 22-9. E0410-BA-GYD-010, Technical Manual, Laser Safety.
- 22-10. NAVSEA OP 3565/NAVAIR 16-1-529/NAVELEX 0967-LP-624-6010, Volume I, Technical Manual, Electromagnetic Radiation Hazards (Hazards to Personnel, Fuel and Other Flammable Material and Volume II, Technical Manual, Electromagnetic Radiation Hazards (Hazards to Ordnance).
- 22-11. DOD Instruction 6055.11, of 21 Feb 95, Protection of DOD Personnel from Exposure to Radiofrequency Radiation and Military Exempt Lasers
http://www.dtic.mil/whs/directives/corres/pdf/i605511wch1_022195/i605511p.pdf.
- 22-12. Institute of Electrical and Electronics Engineers, IEEE Std.C95.1, 1999 Edition (Incorporating IEEE Std C95.1-1991 and IEEE Std C95.1a-1998, IEEE Standard for Safety Levels with Respect to Human Exposure to Radiofrequency Electromagnetic Fields 3kHz to 3GHz, (NOTAL) <http://www.ieee.org/portal/index.jsp>.
- 22-13. Institute of Electrical and Electronics Engineers, IEEE Standard Recommended Practice for Measurement of Potentially Hazardous Electromagnetic Fields, RF and Microwave, IEEE C95.3-1991 (NOTAL) <http://www.ieee.org/portal/index.jsp>.
- 22-14. Institute of Electrical and Electronics Engineers, IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0-3 kHz, IEEE C95.6-2000 (NOTAL) <http://www.ieee.org/portal/index.jsp>.

Appendix 22-A

Laser Classification, Labeling, Warning Signs, Technical Assistance and Exposure Incidents

CLASS I LASERS

Lasers which by inherent design normally cannot emit radiation levels in excess of the permissible exposure limits. Not hazardous under almost all operational or viewing condition. No controls required.

CLASS II LASERS

Low-powered lasers and laser systems that emit less than 1mW visible continuous wave (CW) radiation. Not considered hazardous for momentary exposure. These lasers carry a CAUTION label.

CLASS III LASERS

Lasers which do not present a diffuse reflection hazard.

Class IIIa

Low-powered laser systems that emit 1 to 5 mW visible CW radiation. Lasers or laser systems of less than 2.5 mW/cm² are not considered to be hazardous for momentary (0.25 seconds) unintentional exposures unless the beam is viewed with magnifying optics. These lasers carry a CAUTION label. Lasers that exceed 2.5 mW/cm² carry a DANGER label and should not be directly viewed even momentarily.

Class IIIb

Medium-powered lasers or laser systems considered to be hazardous when the direct or specularly reflected beam is viewed without protection. Special care is required to prevent intrabeam viewing and to control specular reflections from mirror-like surfaces. These lasers carry a DANGER label and require the use of protective eyewear.

CLASS IV LASERS

High-powered lasers or laser systems that can be hazardous to the eye from intrabeam viewing, specular reflections or diffuse reflections. They may also be hazardous to the skin or ignite flammable materials. These lasers carry a DANGER label. Strict controls are required, including use of protective eyewear and door interlocks.

Example of a Class II Laser Warning Label



Example of label for Class II and Class IIIa LASER

Example of a Class IV Laser Warning Label



Example of label for Class IIIb and Class IV LASER DEVICES.

Laser safety-warning signs for posting at laser facilities and at laser ranges are stocked at the Naval Inventory Control Point, Naval Publication and Forms Branch, 700 Robbins Ave., Philadelphia, PA 19111-5098. For Information concerning these forms contact: commercial (215)(697-2626), or DSN (442-2626). Order on MILSTRIP via Defense Automated Addressing Systems. The following signs are available:

Sign Contents: "DANGER, LASER, KNOCK BEFORE ENTERING"
Type: Laminated 10 inches high by 14 inches wide
Form No.: 0118-LF-114-8900

Sign Contents: "DANGER, LASER RANGE IN USE, DO NOT ENTER"
Type: Laminated 18 inches high by 24 inches wide
Form No.: 0118-LF-020-1100

Laser Exposure Incidents

a. If eye damage from laser exposure is suspected or observed, and in all cases of exposure to levels in excess of five times the laser exposure limits of this chapter, the cognizant activity shall ensure the individual receives a medical examination by an ophthalmologist or optometrist as soon as possible. While laser injuries associated with military operations have been rare, limited experience indicates that the extent of eye damage from an accidental laser

exposure may not be readily or initially apparent to either the individual or to local medical personnel. Since early medical intervention may lessen the severity of the damage or subsequent retinal scarring from the laser injury, efforts should be made to have the individual promptly seen by an ophthalmologist or at the ophthalmology department of a hospital **on a walk-in emergency basis.**

b. Commands shall investigate and document all suspected laser incidents or mishaps involving personnel exposure to excessive laser energy in accordance with chapter 14 of this manual. The command exercising operational control of the laser has the primary lead for conducting the laser exposure investigation and for ensuring the appropriate report is filed.

c. Commands are required to report exposure incidents (as outlined in subparagraph g) and investigate exposure levels for the following situations:

(1) Personnel injury has been sustained or physical symptoms are experienced by the individual(s), which are believed to be associated with laser exposure.

(2) Inadvertent exposure occurred to members of the general public or to other non-involved personnel as a result of naval operations, which have exceeded the PEL.

(3) Exposure circumstances or the severity of the incident or mishap are such that inquires from news media are anticipated, or are deemed to be of interest to the chain-of-command.

d. Commands shall refer personnel reporting physical symptoms or suspected of having been exposed to levels in excess of the PEL for a medical evaluation or follow-up.

e. Commands shall make initial notification for the occurrence of a laser incident by telephone, fax, message or e-mail to the appropriate technical assistance point listed in this appendix with copy to the Bureau of Medicine and Surgery (M3F7). Discussions following this initial notification can determine whether a more extensive investigation will be necessary and whether a site visit should be scheduled to assist in making laser measurements or an exposure evaluation. Central to the command's investigation will be a determination of the degree of laser exposure incurred since such incidents often involve emotional concerns or health worries, which cannot be easily addressed when measurement data is not available. Performing laser measurement assessments are often beyond the technical capabilities of the local command or the nearby medical facility.

f. In cases where it is necessary to reconstruct events or reestablish equipment configuration for conducting a laser exposure assessment, the accuracy of the recreation is crucial to the validity of the subsequent measurements. The command's investigating officer should apply particular attention to obtaining written statements from those involved giving detailed descriptions of the sequence of events, exposure times and equipment set-ups, as well as obtaining appropriate charts, diagrams or photographs indicating the locations of exposed personnel.

g. The command shall submit a final report on the laser incident to the Commander, Naval Safety Center, and to the Bureau of Medicine and Surgery (M3F7), with copies to appropriate headquarters and systems commands within 30 days of the incident. The

command shall also include in the report to BUMED pertinent medical records, retinal photographs and identification data for personnel who were exposed.

Laser Technical Assistance

Interested parties may obtain technical assistance and advice regarding laser safety as follows:

a. For laser operations at medical activities, contact the Navy Environmental Health Center, (NEHC), 620 John Paul Jones Circle, Suite 1100, Portsmouth, VA 23708-2103, DSN 377-0700, commercial (757) 953-0700, fax (757) 953-0685.

b. For all laser operations, other than medical, military exemption of lasers, and certification surveys of laser firing ranges, contact the following activities: (Funding for services shall be provided by the requesting command).

Laser System Evaluation and Range Surveys:

Naval Surface Warfare Center Dahlgren Division, G-72, 17320 Dahlgren RD Dahlgren, VA 22448, DSN 249-1060/1149/2442, commercial (540) 653-1060/1149/2442, fax (540) 653-8453 <http://www.navylasersafety.com/>.

Laser Range Surveys:

Naval Surface Warfare Center Corona Division (Code SE-41), 2300 Fifth St, Norco, CA 92860 mailing address P.O. Box 5000 Corona, CA 92878-5000, DSN 933-4090, commercial (909) 273-4090 or fax (909) 273-5089.

c. For laser bio-effects and medical research issues, or assistance in evaluating laser-induced injuries, contact the Naval Health Research Center-Detachment Energy Bioeffects Laboratory, Brooks City Base 8315 Navy Road, Brooks AFB, TX 78235-5365, DSN 240-4699/6552, commercial (210) 536-4699/6552, fax (210) 536-6439.

d. For guidance on laser exposure limits and health issues, contact the Non-Ionizing Radiation Health Branch, Bureau of Medicine and Surgery (M3F7), 2300 E Street NW, Washington DC 20372-5300, DSN 762-3448/3444, commercial (202) 762-3448/3444, fax (202) 762-0931.

Appendix 22-B

RFR Hazard Warning Sign, Labels, Exposure Incidents and Technical Assistance

Sign Title: Radiofrequency Hazard Warning - Keep Moving
Form No.: 101/5
Type: 5-inch Label
NSN: 7690-01-377-5893
Superseded NSN: 0967-LF-183-8010

Sign Title: Radiofrequency Hazard Warning - Keep Moving
Form No.: 101/12
Type: 12-inch Label
NSN: 7690-01-377-5894
Superseded NSN: 0967-LP-183-8010

Sign Title: Radiofrequency Hazard Warning - Beyond This Point
Form No.: 102/5
Type: 5-inch Label
NSN: 7690-01-377-5895
Superseded NSN: 0967-LP-153-8010

Sign Title: Radiofrequency Hazard Warning - Beyond This Point
Form No.: 102/12
Type: 12-inch Label
NSN: 7690-01-377-5082
Superseded NSN: 0967-LP-153-8010

Sign Title: Radiofrequency Hazard Warning - Burn Hazard
Form No.: 103/5
Type: 5-inch Label
NSN: 7690-01-377-5896
Superseded NSN: 0967-LP-315-2010

Sign Title: Radiofrequency Hazard Warning - Burn Hazard
Form No.: 103/12
Type: 12-inch Label
NSN: 7690-01-377-5898
Superseded NSN: 0967-LP-315-2010

Sign Title: Radiofrequency Hazard Warning - Fuel Operations
Form No.: 104/5
Type: 5-inch Label
NSN: 7690-01-377-5899
Superseded NSN: 0967-LP-315-1010

Sign Title: Radiofrequency Hazard Warning - Fuel Operations
Form No. 104/12
Type: 12-inch Label
NSN: 7690-01-377-5900
Superseded NSN: 0967-LP-315-1010

Sign Title: Radiofrequency Hazard Warning - Blank
Form No.: 105/5
Type: 5-inch Label
NSN: 7690-01-377-5374
Superseded NSN: 0967-LP-350-1010 and 0967-LP-096-3010

Reporting of RF Exposure Incidents

a. Commands shall investigate and document all suspected RF incidents or mishaps involving personnel exposure to excessive RF levels, in accordance with reference 22-6 of this manual. The command exercising operational control of the RF source has the primary lead for conducting the RF exposure investigation and for ensuring the appropriate report is filed.

b. Commands are required to report exposure incidents and investigate exposure levels for the following situations:

(1) Personnel injury has been sustained or physical symptoms are experienced by the individual(s) that are believed to be associated with RF exposure.

(2) Personnel exposure has been determined to have exceeded the appropriate PEL in terms of power density by a factor of five or more. (For exposure determinations, provisions for time averaging and spatial averaging can be used in conjunction with transmitter duty factors and antenna rotation or scanning rates to establish maximum likely exposure levels.)

(3) Inadvertent exposure occurred to members of the general public or to other non-involved personnel as a result of naval operations that have exceeded the appropriate PEL.

(4) Exposure circumstances or the severity of the incident or mishap are such that inquires from news media are anticipated, or are deemed to be of interest to the chain of command.

c. Commands shall refer personnel reporting physical symptoms, or suspected of having been exposed to levels in excess of five times the PEL, for a medical evaluation or follow-up. Since medical evaluations following RF exposure have been infrequently required and physical signs of injury are usually not manifested, medical personnel should be advised to refer to reference 22-7 for information on RF biological effects.

d. Commands shall make initial notification for the occurrence of an RF incident by telephone, fax, message or e-mail to the appropriate technical assistance point listed in this appendix with copy to the Bureau of Medicine and Surgery (M3F7). Discussions following this

initial notification can determine whether a more extensive investigation will be necessary and whether a site visit should be scheduled to assist in making RF measurements or an exposure evaluation. Central to the command's investigation will be a determination of the degree of RF exposure incurred since such incidents often involve emotional or health concerns which cannot be easily addressed when measurement data is not available. Performing RF measurement assessments are often beyond the technical capabilities of the local command or the nearby medical facility.

e. In cases where it is necessary to reconstruct events or reestablish equipment configuration for conducting an RF exposure assessment, the accuracy of the recreation is crucial to the validity of the subsequent RF measurements. The command's investigating officer should apply particular attention to obtaining written statements from those involved giving detailed descriptions of the sequence of events, exposure times and equipment set-ups, as well as obtaining appropriate charts, diagrams or photographs indicating the locations of exposed personnel.

f. The command shall submit a final report on the RF incident to the Commander, Naval Safety Center and to the Bureau of Medicine and Surgery (M3F7), with copies to appropriate headquarters and systems commands. The command will also include in the report to BUMED pertinent medical records and identification data for personnel who were exposed. BUMED is tasked with maintaining a permanent repository for RF exposure incidents.

Technical Assistance

a. For RF health hazards, personnel exposures and exposure incidents from industrial and medical RF emitting sources, contact the Navy Environmental Health Center (NEHC), 620 John Paul Jones Circle, Suite 1100, Portsmouth, VA 23708-2103, DSN 377-0700, commercial (757) 953-0700, fax (757) 757-953-0685.

b. For measurement surveys for shipboard RF emitting systems, contact Systems Electromagnetic Effects Branch (Code J-52), Naval Surface Warfare Center Dahlgren Division, 17320 Dahlgren Road, Dahlgren, VA 22448-5100, DSN 249-8594, commercial (540) 653-3487, or (401)- 832-5552, fax (540) 653-7494.

c. For site certification and measurement surveys for shore-based RF emitting systems, contact Space and Naval Warfare Systems Center (SPAWARSYSCEN) Charleston (Attn: Code 323), P.O. Box 190022, North Charleston, SC 29419-9022, DSN 588-4228, or commercial (843) 218-4228. For shore facilities within PACNAVFACENGCOM geographical region, contact Space and Naval Warfare Systems Activity Pacific (SPAWARSYSACT PAC) (Attn: Code 2915), 675 Lehua Avenue, Pearl City, HI 96782-3356, DSN 315-474-7330, commercial (808) 474-7330, fax (808) 474-5511

d. For RF bio-effects and medical research issues, or assistance in evaluating personnel overexposure incidents, contact the Naval Health Research Center-Detachment Directed Energy Bioeffects Laboratory, Brooks City Base, 8315 Navy Road, Brooks City Base TX 78235-5365, DSN 240-4699/6532, commercial (210) 536-4699/6532, fax (210) 536-6439.

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e. For guidance on RF exposure limits and health issues, contact the Non-Ionizing Radiation Health Branch, Bureau of Medicine and Surgery (M3F7), 2300 E Street NW, Washington DC 20372-5300, DSN 762-3448/3444, commercial (202) 762-3448/3444, fax (202) 762-0931.