NAVPGSCOL INSTRUCTION 6055.11

Subj: RADIO FREQUENCY SAFETY PROGRAM FOR NAVAL POSTGRADUATE SCHOOL

Ref: (a) OPNAVINST 5100.23
(b) DoD Instruction 6055.11 of 19 Aug 09
(c) NAVSEA OP 3565/NAVAIR 16-1-529/NAVALEX 0631-LP-530-6120
(d) ANSI/IEEE C95.1/3

1. Purpose. To establish Radio Frequency (RF) protection requirements, exposure standards and safety guidelines at Naval Postgraduate School (NPS). This instruction incorporates references (a) through (d), and the Office of the Surgeon General's (OTSG) Policy Letter 86-01.0, (surveillance of microwave/radio frequency radiation (RFR) workers). The safety criterion applies to all RFR workers and systems at NPS.

2. Discussion. RF exposure at NPS is primarily associated with operation and utilization of various radars and communication systems. In the controlled environments where free space transmissions occur, RF energy may generate fields that could potentially pose a risk to human health. Control of these environments is necessary in order to reduce the risk. Control measures include conspicuous posting, use of physical barriers such as fences and access control measures such as locks and entry restrictions to authorized personnel who have received the required RF safety training.

3. Responsibilities.

   a. The President is responsible for compliance with Navy directives and federal regulations and is responsible for assigning, in writing, a Radio Frequency Safety Officer (RFSO) with direct access to the President on all matters pertaining to radio frequency radiation (RFR) safety.

   b. The Radio Frequency Safety Officer:

      (1) Shall be appointed by the President.

      (2) Shall act authoritatively for and has direct access to the President on all matters pertaining to RFR safety.

      (3) Has permission to suspend, restrict, and terminate the operation of an RF source for any reason of non-compliance or violation of RF safety.
(4) Must have the required training/experience as set forth in reference (a).

(5) Shall establish policy for all phases of hazardous RFR generating systems acquisition, installation, operation, and maintenance.

(6) Ensure general awareness training is provided to all personnel who work with RFR sources or who work in areas where the potential may exist for exposure above the permissible exposure limits (PEL). PEL’s for controlled and uncontrolled environments are listed in reference (a), appendix 22-B.

(7) Perform or cause to occur required hazard surveys on systems that produce RFR and evaluate the exposure levels.

(8) Maintain a current inventory of controlled RFR sources, and personnel authorized to operate them.

(9) Maintain a repository consisting of surveys, calculations, reports, technical manuals, and other publications for standard or non-standard RFR systems to support operation of RFR systems at NPS.

(10) Investigate all alleged or actual RFR overexposure incidents, provide required incident reports, and make recommendations to prevent future occurrences.

(11) Conduct compliance inspections periodically at frequencies specified in references (a) through (d) in order to ensure control measures are adequate to safeguard human health, protect equipment, and the environment.

(12) Specify control measures necessary to operate hazardous sources of RFR energy on the NPS campus or any of its satellite locations.

c. The Assistant Radio frequency Safety Officer:

(1) Assist the RFSO in the performance of his/her responsibilities.

(2) In the absence of the RFSO, he/she shall assume the duties and responsibilities of the RFSO.

(3) In the absence of the assigned RFSO shall act authoritatively for and has direct access to the President on all matters pertaining to RFR safety.

(4) Assist in the investigation of RFR mishaps when requested by the RFSO.
(5) Upon request, support the Department Radio Frequency Supervisor (DRS)/RFSO in conducting new RFR system inspections; Make recommendations as appropriate.

d. Department Radio Frequency Supervisor. A DRS shall be appointed by each Department operating potentially hazardous RF systems. The DRS shall be appointed by his/her Department Chairman, and a copy of the appointing correspondence shall be provided to the RFSO. The DRS must have training and experience in RFR generation, wave propagation along transmission lines and in free space, antenna and radiation patterns, electric and magnetic field relationships, and RFR power density calculations. The DRS, also, must have knowledge of the indirect and direct biological effects of RFR, to include specific absorption rates, standards, limits, control procedures and other isolation techniques. No department shall operate hazardous RF operations without an appointed DRS. Responsibilities of the DRS included, but are not limited to:

(1) Review all departmental requests for RFR source operations.

(2) Plan for RFR device activity with special emphasis on the safe operation of the system.

(3) Recommend the necessary protective devices to be used in the activation of the RFR source.

(4) Provide departmental RFR source users technical assistance/advice upon request.

(5) Inspect and evaluate any unsafe conditions which radio frequency levels to the general public may exceed the PEL for occupied areas.

(6) Provide initial RFR safety briefings to all users within their department. A copy of the training reports shall be forwarded to the RFSO. A file of all training efforts shall be locally maintained.

(7) Provide detailed procedures for the control of RFR sources within their department, which can emit power density levels in excess of PELs; these procedures should address specific steps to control the movement of personnel so that no one is intentionally exposed to RFR levels in excess of PELs. A copy of these procedures shall be forwarded to the RFSO for review and final approval prior to operation.

(8) Mark and maintain in accordance with references (a) through (d) all controlled areas with appropriate control measures such as warning signs, barricades, lights, alarms, safety switches, etc.; as a general rule, warning signs constitute adequate marking for systems that cannot exceed 5X PELs.
(9) Report all RFR incidents and mishaps immediately, to the RFSO, and any infractions or irregularities with respect to safe operations.

(10) Assist in the investigation of mishaps if requested.

(11) Maintain a comprehensive inventory of all department RFR sources by manufacturer, model #, serial #, NPS #, BLDG. Room #, power density; provide a current inventory to the RFSO.

(12) Maintain a current list of all departmental RFR source users (military/civilian, student/faculty/staff); provide a copy of the list to the RFSO.

(13) Provide supervision on projects where multiple transmitting RF devices, mixed or broadband fields at various frequencies, are emitting simultaneous in free-space, and/or, if the possibility exists for the fractional PELs to exceed the sum of unity.

e. RFR System Users. Anyone authorized by the department to utilize RFR sources at NPS. All authorized users require training in accordance with references (a) through (d) prior to being involved in the operation of hazardous RFR sources.

(1) RFR Hazard Training. All occupational RFR workers will receive RFR hazard training. Personnel will take annual refresher training to re-emphasize training objectives. All training will be documented and copies provided to the RFSO.

4. Standard Operating Procedure (SOP) Safety Criteria. Written and approved SOPs shall be used in the operation of hazardous RFR sources on the NPS campus. Copies of the approved SOPs shall be kept by the DRS and forwarded to the RFSO. These SOPs will specify all RFR control measures relative to the equipment and precautions discussed in reference (c), to assure no one is intentionally exposed to levels in excess of PELs. The following are minimum considerations and constituents of an SOP. ALL controlled RF sources must have an associated SOP approved by the source custodian, and RFSO and acknowledged by the DRS. All users of the equipment will acknowledge the contents of the SOP in writing.

a. Keep all controlled levels of RFR away from areas that could be or need to be occupied by personnel. Keep personnel away from areas that do or could have controlled levels of RFR present in them.

b. All unnecessary free-space transmission which can emit power density levels greater than PEL are prohibited. Where it is necessary to radiate, restrict the level and zone of the radiation by means of attenuators, couplers, dummy loads, interlocks, mechanical stops, signs on control panels, special markings on positive indicators, etc.
c. If RFR levels exceed 5X-PEL threshold, positive controls like temporary barricades, fences, visual surveillance and control, dummy-loaded outputs, etc. will be required.

d. If RFR levels are expected to be less than 5X-PEL, interlocked engineering controls, operational restrictions, signs, warning devices, briefings, etc. are required.

e. Individuals to be contacted in the event of a suspected RFR overexposure, or an RFR source or related safety feature malfunction could produce levels in excess of PELs shall be included in the SOP. The list of such persons, with phone numbers, shall be posted at the controlled area. The RFSO, DRS, or the Safety Office, at a minimum will be included in this list.

f. Emergency stop procedures for the specific RF systems shall be noticeably posted at all times.

g. High voltage sources shall be posted, shielded, and interlocked/locked to prevent access to energized components.

h. Special electromagnetic radiation hazard surveys are required every five years and will require advanced planning.

i. Personnel not involved in RFR operations, will not be allowed in a controlled area, unless specifically authorized by the DRS/RFSO.

j. RFR sources shall be secured when not in operation so as to avoid unauthorized use.

k. Use of interlocks shall be considered at controlled space entrance points and on equipment if other less restrictive means to provide adequate access control during operation. If installed, RFR safety related interlocks, switches, warning devices, etc. shall be tested routinely.

l. Posted Warning Signs

(1) Post the standard RFR warning signs along all access routes into radiation zones where power density levels can exceed PEL. Barricades (rope/tape/fence) and/or warning lights/alarms may be necessary to isolate any radiation zone where the power density can exceed 5X-PEL. Post the standard RFR warning sign along such barricades to warn personnel of the overexposure potential.

(2) Post the standard RFR warning sign permanently in any work area where controlled sources are regularly operated. The warning message should inform personnel that RFR sources are operated in the area. This requirement is optional in those work areas where free-space radiation is not permitted.

m. Protective Equipment.
1. Protective equipment, such as electrically insulated gloves, shoes and safety matting, for protection against electrical shock and RFR burn or insulation from the ground plane are authorized and recommended when necessary.

2. RFR shielded protective clothing is not authorized for routine use in protecting personnel from hazardous levels of RFR. Protective clothing is to be used only as a last resort and under procedures approved by the RFSO.


1. Control techniques to reduce unnecessary personnel exposure will generally fall into one of two categories:

(a) Limiting the tracers of the radiated beam so it does not radiate into occupied areas, or

(b) Limiting the access of personal into areas where hazardous power densities exist.

2. Where operation allows, antenna position should be restricted in order to minimize the extent of exposure areas, thereby reducing unnecessary hazards. These permissible restrictions can be implemented through sector-banking; that is, installation of cut-off devices in the electrical or mechanical components of a system which will automatically terminate transmission when the antenna is pointed in a pre-determined direction; or by instructing operating personnel not to transmit in certain azimuths and/or elevation by means of an enforced SOP.

3. During test or maintenance procedures requiring free-space radiation, the use of appropriate antenna positioning restrictions are necessary if power densities exceed the PELs.

4. The use of barriers, interlocks, and warning signs as appropriate (see discussion above) shall be utilized to prevent ingress by personnel into denied occupancy areas.

5. In situations where operations would be unduly restricted by implementation of the above methods, suitable attenuation of power density levels may be accomplished in the irradiation areas by shielding. An attenuation chart for various materials at different frequencies is provided below.
ATTENUATION FACTORS (SHEILDING)

<table>
<thead>
<tr>
<th>Materials</th>
<th>1-3 GHz</th>
<th>3-5 GHz</th>
<th>5-7 GHz</th>
<th>7-8 GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 x 60 mesh screening</td>
<td>20 dB</td>
<td>25 dB</td>
<td>22 dB</td>
<td>20 dB</td>
</tr>
<tr>
<td>32 x 32 mesh screening</td>
<td>18 dB</td>
<td>22 dB</td>
<td>22 dB</td>
<td>18 dB</td>
</tr>
<tr>
<td>16 x 16 mesh screening</td>
<td>18 dB</td>
<td>20 dB</td>
<td>20 dB</td>
<td>22 dB</td>
</tr>
<tr>
<td>1/4&quot; mesh (hardware cloth)</td>
<td>18 dB</td>
<td>15 dB</td>
<td>12 dB</td>
<td>10 dB</td>
</tr>
<tr>
<td>Window Glass</td>
<td>2 dB</td>
<td>2 dB</td>
<td>3 dB</td>
<td>3.5 dB</td>
</tr>
<tr>
<td>3/4&quot; Pine Sheathing</td>
<td>2 dB</td>
<td>2 dB</td>
<td>2 dB</td>
<td>3.5 dB</td>
</tr>
<tr>
<td>8&quot; Concrete Block</td>
<td>20 dB</td>
<td>22 dB</td>
<td>26 dB</td>
<td>30 dB</td>
</tr>
</tbody>
</table>

o. An Operation Risk Management (ORM) supplement included as an enclosure to the baseline SOP. Appropriate ORM forms are available on the NPS RF website.

6. **Approved RFR Systems.** No hazardous RFR system shall be used at NPS until completion of a site certification by the appropriate technical center in accordance with references (a) through (d).

7. **Site Certification and Measurement Surveys.**

   a. For site certification contact Space and Naval Warfare Systems Activity Pacific (SPAWARSYSACT PAC) (Attn: Code J9132), Building 992, 675 Lehua Avenue, Pearl City, HI 96782-3356, DSN: (315)471-0620, Comm: (808)461-0620. To maintain certification, the RF source user shall forward information on new RF sources installed to the technical activities listed in reference (a), appendix 22-C to obtain a theoretical or calculated safety evaluation. The original baseline certification shall include this provisional certification. Resurvey/recertification frequency shall be as specified/scheduled by the certifying agency.

   b. RFR hazard Surveys shall be evaluated by one of the technical activities listed in reference (a) appendix 22-C.

   c. Safety & Health professionals may only make RF measurements or calculation for situations that primarily consist of determining RF exposure levels for a particular area of occupied personnel.

8. **Medical Surveillance.** The most current OTSG eliminates the requirement for RFR Worker medical surveillance. RFR Workers have no vision screening requirement beyond that done routinely in under other occupational health guidelines.

9. **Reporting of RF Exposure Incidents.**

   a. Incidents involving suspected overexposure to RFR must be investigated and documented in accordance with reference (a), chapter 14.
b. Report exposure incidents and investigate exposure levels for the following situations:

(1) Personnel injury has been sustained or physical symptoms are experienced by individual(s) which 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 factor of five or more (>5X-PEL). 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 command operations which have exceeded the appropriate PEL.

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

c. Personnel reporting physical symptoms resulting from suspected exposures of <5X-PEL shall complete the following:

  (1) An appropriate medical examination should be administered. Refer to NAVMEDCOMINST 6470.2 for information in RF biological effects.

  (2) A detailed description of the circumstances surrounding the incident, including measurement of the actual or reconstructed overexposure scenario.

  (3) Recommendations for medical follow up if necessary.

  (4) Recommendations to prevent recurrences of the incident, e.g., engineering or administrative controls.

10. Overexposure Reporting.

   a. For any known or suspected overexposure to RFR, contact the RFSO and/or the Safety Office. Initial notification should be made as soon as possible after the overexposure occurs. Initial report shall be by telephone, fax, message or email to the Commander, Naval Safety Center and to the Bureau of Medicine and Surgery (MED 212), with copies to appropriate headquarters and system commands. The following details are important to the evaluation and shall be included in the final report:

     (1) Date and time of the suspected overexposure.
(2) RF Source (system) involved (description of the source set-up, location of the individual in relation to the source, and the duration of overexposure).

(3) Whether the eyes may have been involved; whether whole or partial body was involved; whether the source was fixed or scanning.

(4) Exposure time and duty being performed during the suspected exposure.

(5) A written statement summarizing the incident from the point of view of the injured person and any witnesses to the incident.

(6) Pertinent medical records.

11. Overexposure Medical Evaluation.

a. It is highly unlikely that overexposure to RFR from conventional systems will result in isolated damage to the eye. However, an appropriate medical evaluation is required for any suspected RFR overexposure. Such an evaluation should be administered within 24 hours. An Immediate Ophthalmic Examination, including a Diagnostic Ocular Examination if the RFR exposure exceeds 5X-PEL, is required for this medical evaluation. The Diagnostic Examination should not be delayed until it has been determined the suspected overexposure could have exceeded the 5X-PEL level.

b. The Immediate Ophthalmic Examination must be performed by an optometrist, ophthalmologist, or physician possessing the necessary skills. The immediate eye exam consists of the following:

(1) Case history, with emphasis on previous eye injury or disease.

(2) Distance visual activity (with correction) in each eye. If corrected distance visual acuity is poorer than 20/20 in either eye, a refraction will be performed to obtain the best corrected acuity.

(3) A Slit Lamp Examination of the eye and cornea and a fundus examination, both with short-duration mydriatic (e.g. tropicamide) unless the use of the dilating agent is contraindicated by medical history and/or professional judgment. The following, as a minimum, are to be recorded:

(a) Presence or absence of opacities in the media.

(b) Sharpness of the outline of the optic nerve head.

(c) Cup-to-disk ratio.
(d) Ratio of the size of the retinal arteries to retinal veins.

(e) Presence or absence of a well-defined macula.

(f) Presence or absence of a foveal reflex.

(g) Any retinal abnormality however small.

(h) A color fundus photograph (preferred method) that includes the optic nerve head and macula which may be used in place of (b) through (g) above.

12. Technical Assistance. Technical assistance in administering the command RFR safety program is available from the following support organizations and commands.

a. Navy Environmental Health Center (NAENVIRHLTHCEN), 2510 Walmer Avenue, Norfolk, VA 22513-2617, DSN: 864-5500, Comm: (757)363-5500, Fax: (757)444-3672.

b. Naval Health Research Center-Detachment Brooks AFB, 8301 Navy Road, Brooks AFB, TX 78235-5365, DSN: 240-4699, Comm: (210)536-4699, Fax: (210)536-6439.


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