



DEPARTMENT OF THE NAVY
UNITED STATES NAVAL ACADEMY
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USNAINST 5104.2

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USNA INSTRUCTION 5104.2

From: Superintendent, United States Naval Academy

Subj: USNA RADIOLOGICAL SAFETY PROGRAM (RSP)

Ref: (a) USNA INSTRUCTION 5104.1, Radiation Health Program
(b) Radiological Affairs Support Program (RASP) Manual (NAVSEA S0420-AA-RAD-010)
(c) P5055 NAVMED P-5055, Radiation Health Protection Manual
(d) NUREG 1556 Volume 11, Consolidated Guidance about Materials Licenses
(e) Code of Federal Regulations, Title 10 (10 CFR)
(f) SE700-AA-MAN-100/RADIAC, Navy Radiac Program User's Manual

Encl: (1) Definitions
(2) Audit Program Guides for RSO and RSC

1. Purpose. To establish the Radiation Safety Program (RSP) at the United States Naval Academy (USNA). This instruction outlines the policies and procedures for safely managing the radioactive material and machine sources of radiation under the purview of USNA.

2. Cancellation. USNAINST 11080.1 will be canceled following the issuance of the Broad Scope Naval Radioactive Materials Permit (NRMP) and confirmation from the USNA Radiation Safety Officer (RSO). Users will comply with this instruction and USNAINST 11080.1 during the transition period. Where the requirements of the two instructions differ, the more restrictive requirements will govern until the cancellation of USNAINST 11080.1.

3. Scope. This instruction specifies detailed policies and procedures that apply to all ionizing radiation sources utilized by USNA for other than medical or dental purposes. The USNA Radiation Health Program is managed by the Naval Health Clinic and is described in reference (a).

4. Overview. USNA possesses radiological materials and radiation producing machinery used in the education of Midshipmen and in the academic research activities of the faculty. USNA is required to establish controls over regulated sources of ionizing radiation. These sources require issuance of a local license by the Radiation Safety Committee to a "USNA Licensee." USNA Licensees are faculty or staff who serve as the custodian and the principle user or facility manager of the source. Licensees may request additional Authorized Users to operate under their RSC-approved license.

5. Reporting Relationships

a. The Superintendent, as Commanding Officer of USNA, retains overall responsibility for the RSP per reference (b).

b. The Director, Division of Engineering & Weapons (E&W DivDir) is hereby delegated the RSP execution authority.

c. The Radiation Safety Officer (RSO) is appointed by the Superintendent and will report to the E&W DivDir for RSP matters. The RSO has direct access to the Superintendent for urgent RSP matters. Otherwise, routine RSP matters should be directed through the E&W DivDir.

- d. The Director, Division of Mathematics & Science (M&S DivDir) reports to the E&S DivDir for RSP matters.
- e. Assistant Radiation Safety Officers (ARSOs) report to the RSO for RSP matters.
- f. Users report to the RSO for all RSP matters.
- g. All personnel are encouraged to direct questions and concerns to the RSO/ARSO. In the case of an emergent/emergency event whereby the RSO/ARSO is unable to provide an effective response, USNA personnel may contact any responsible party in the reporting structure below.
- h. Figure 1 illustrates the RSP reporting relationships.

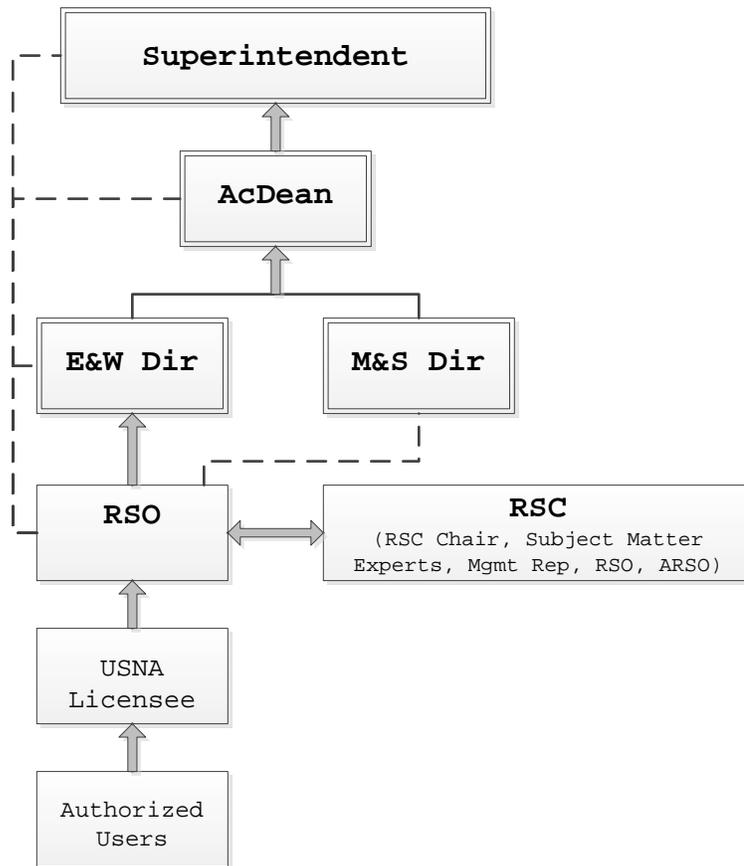


Figure 1 - Reporting Relationships

i. The Academic Dean & Provost, though shown in Figure 1 Reporting Relationship, will only be involved as a figurative representative. Since USNA is considered an educational command where the faculty, staff, and military primary role is to educate Midshipmen, the resource management will require the involvement of the Academic Dean. The Academic Dean & Provost will not be involved in any operational or permit related duties. All NRMP changes or findings will be routed through the E&W DivDir to the Superintendent's office.

6. Radiation Safety Officer (RSO)

a. The RSO is appointed by the Superintendent as the designated representative for managing the RSP.

b. Qualifications. The RSO shall be qualified as a GS-1306 Health Physicist, ideally including:

(1) An academic degree in related physical or biological sciences.

(2) An RASO-approved RSO course certification.

(3) Approximately 5 years of specific experience in radiation protection with the type, quantities, and use of radioactive material to be used under USNA's (Broadscope) Navy Radioactive Materials Permit.

(4) Experience working in an academic and research environment.

c. Responsibilities:

(1) Manage the RSP so as to preserve the radiological health and welfare of the public and USNA's radiation workers within Federal and Navy standards and as low as reasonably achievable (ALARA).

(2) Ensure compliance with Federal and Navy regulations.

(3) Identify radiation safety issues; initiate, recommend, or provide corrective actions; and verify that corrective actions have been implemented and assess their effectiveness.

(4) Ensure all radionuclide acquisitions are authorized under the institution's Navy and Federal licenses and the user's license.

(5) Maintain a centralized program for the receipt and inspection of radioactive shipments, and keep an inventory record of the radioactive materials on hand.

(6) Ensure radiation safety survey and testing equipment is calibrated at the required frequency.

(7) Evaluate the effectiveness of the RSP through routine inspections and surveys.

(8) Implement and maintain a personal monitoring program including bio-analysis testing and establishment of action levels which, if exceeded, shall initiate an investigation to determine the cause.

(9) Investigate all incidents involving radioactive materials including unauthorized removal and/or theft, spills and accidental releases, unauthorized receipt, medical events, and any activities which are not being conducted in full compliance with Federal, Navy, and Local regulations. Implement corrective actions as necessary.

(10) Maintain records and reports required by Navy and Federal regulatory agencies and prepare reports and program audits for the RSC.

(11) Prepare and present radiation safety training sessions for personnel handling radioactive material or frequenting areas where ionizing radiation is present.

(12) Manage a program for the processing, packaging, and disposal of radioactive waste.

(13) Implement any recommendations of the RSC.

d. Radiation Safety Office: Those tasked to perform in the roles of the RSO are referred to as the Radiation Safety Office.

(1) The Radiation Safety Officer is primarily supported by the Assistant Radiation Safety Officers (ARSO) who has completed the NAVSEADET-RASO Radiation Safety Officer training course. The ARSO will assist the RSO in performance of the RSO duties.

(2) The RSO is permitted to qualify additional personal to assist in completing specific RSO roles. Those qualified will be trained in the standard as radiation workers, however dependent on job duties may not need to comply with the Radiation Health Program. The RSO shall maintain oversight of those qualified personal.

7. USNA Radiation Safety Committee (RSC)

a. Purpose. The RSC is the principle advisory group to the RSO. The RSC shall review and approve all proposed uses of radioactive material and other sources of ionizing radiation consistent with the ALARA philosophy; perform routine audits of RSP effectiveness; and review and act on all incidents involving radioactive material and reported items of non-compliance with Federal, Navy, and Local command regulatory requirements. The RSC may establish committees to expedite the review of license applications, enforcement issues, and policy development.

b. Membership. The Superintendent appoints the RSC members. The RSO, with the advisement of the RSC (RSC) Chair will recommend via the Management Representative a minimum of four (4) members to the Superintendent for appointment to the Committee. The term of appointment shall normally be for three years or projected rotation date for active duty members. The composition of the RSC shall meet the membership requirements set forth in references (b) and (e). The membership shall include, but not be limited to the following: a Chairperson; a Management Representative; individuals who represent each type of use of ionizing radiation for which the command has authorization and who through training or experience possess special competence in the areas of radiation protection and/or risk assessment; the RSO; at least one ARSO; and subject matter experts from departments possessing sources/equipment capable of generating ionizing radiation. Should a member of the RSC require replacement, the RSO and Chair, under advisement of the Committee, shall forward a membership nomination and change memorandum to the Superintendent.

(1) The Chair must have practical experience in a variety of material and machine sources of ionizing radiation and management of a RSP.

Additionally, the Chair must have knowledge of radiation safety issues, good leadership abilities, the authority and credibility by virtue of their position within the facility, and a desire to serve as Chair of the RSC. The RSO may not serve as Chair of the RSC.

(2) The Management Representative will be a senior officer or equivalent senior civilian staff member who provides support for the RSP and

due consideration of the legal interests of USNA. The Management Representative shall have sufficient experience with radiation sources to effectively communicate between the RSC and the USNA senior leadership. The Management Representative will not normally be an authorized user.

(3) Other members should include a representative from the Nucleonics Lab, a representative from the Accelerator Laboratory, and a representative from the analytical equipment research groups machine source (e.g. scanning electron microscopes, X-Ray diffractometers).

c. Responsibilities. The RSC responsibilities, specified in reference (b) and reference (d) Chapter 8.7.2, include:

(1) Review and approve, in advance of procurement, proposed uses of sources of ionizing radiation.

(2) Review and approve program and procedure changes for new or modified uses of sources of ionizing radiation in accordance with criteria developed prior to implementation.

(3) Advise on all RSP operations.

(4) Review personnel doses and the ALARA program.

(5) Review radiological incidents.

(6) Perform periodic audits and surveillances. These RSC audits and surveillances are in addition to the RSO audits and surveillances required by reference (b).

(7) Take appropriate actions when noncompliance is identified, including analysis of the cause, corrective actions, and actions to prevent recurrence.

(8) Delegate authority to approve procurement, transfer, or disposal of radiation sources that are defined as routine.

(9) Qualify individuals as authorized users.

(10) Establish a security plan that will be reviewed and updated annually. Distribute the security plan to the Superintendent, RSC members, department heads, supervisors and custodians of radioactive material and radiation sources

(11) Conduct a full review of the RSP program annually. This review includes reviewing compliance of authorized users, examining the RSO's periodic audits and findings, discussing the results of the annual report and the effectiveness of corrective actions in order to deter future problems and violations.

(12) The Chair of the Committee is responsible for the Committee's function, including:

(a) Calling meetings of the RSC at least quarterly, specifically following the major mid-year and end-of-year Radiation Safety Office audits of the complete program.

(b) Calling meetings of the RSC following quarterly audits when issues within the program are detected.

(c) Calling licensee meetings of the RSC when a new or modified usage proposal is submitted.

(d) Calling education and training meetings of the RSC to evaluate the experience and training of new users.

(13) RSC meetings will normally be attended by all members of the committee. However, if fewer members than comprise the full committee are able to attend, a quorum is established with the majority of members present consisting of the committee chairperson (or his/her designee), the RSO, the management representative (or his/her alternate), and a representative from each area of use from which specific issues will be discussed.

(14) The RSC shall meet at least quarterly, and as often as needed to ensure the RSP is operating in compliance with the license, established procedures and regulations.

(15) Minutes of the quarterly meetings of the RSC are prepared by the RSO to document the proceedings and safety evaluations of principal users (referred as USNA Licensees') of radioactive material. The minutes should include date of meeting, the members present and absent to demonstrate a quorum was present, a summary of discussions, recommendations, the results of votes, and review of new users, uses, and programs changes. The minutes should also include information related to the ALARA program reviews and the annual audit review. The RSO shall maintain records of the RSC meetings and provide a copy to the Superintendent.

(16) The criterion for approving research authorizations and users will include adequacy of the facility and equipment; personnel monitoring and survey equipment; required surveys, operating, handling, and emergency procedures; and the experience and training of proposed users of greater than exempt quantities of radioactive material. Information that will be provided by prospective USNA Licensee for each evaluation includes a USNA Application for Authorization to Use Radioactive Material (RMA), completed USNA Training and Experience of Authorized Radioisotope Users form for each user listed on the RMA request, and a proposed Safety Standard Operating Procedure (SOP). Information that will be provided by the RSO/ARSO for each evaluation includes a pre-use inspection for adequacy of proposed facilities and equipment, assurance that appropriate personnel monitoring and survey equipment are available, and regulatory guidance provided by Federal, U.S. Navy and national consensus standards.

(17) Radioactive materials are to be used by or under the direct supervision of individuals designated by the RSC. The RSC reviews and approves all procedures implemented by the RSO and Principal Users for controlling/maintaining inventories, procurement, individual possession limits, total possession limit, and transfer of radioactive material within/outside of USNA.

d. Conduct of Business

(1) The RSC shall review and approve or disapprove all proposed uses of radioactive material at USNA; develop, approve and audit programs required to ensure the radiological health and welfare of DoD personnel and the general

public; and ensure compliance with pertinent Federal, Navy, and Local regulatory requirements. In fulfilling these responsibilities, the Committee shall:

(a) Review on the basis of safety, and with regard to Navy and Federal standards for training and experience, all applications for a license for radioactive material.

(b) Evaluate the adequacy of facilities and equipment for specific radionuclide applications.

(c) Review annually, with the assistance of the RSO, a summary of the occupational radiation dose records of all personnel, giving attention to individuals or group of workers whose occupational exposure appears excessive.

(d) Establish a program to ensure that all persons whose duties may require them to work in or frequent areas where radioactive materials or other radiation sources are used (including midshipmen, faculty/staff, fire/security, housekeeping) are appropriately instructed as required in reference (e).

(e) Review, at least annually, the Radiation Safety Office's summary report of the entire RSP to determine that all activities are being conducted safely, in accordance with the NRC and RASO regulations and the conditions of the licenses, and consistent with the ALARA program and philosophy. The review must include an examination of records, reports from the RSO, results of RASO inspections, written safety procedures, and the adequacy of the management control system.

(f) Recommend remedial action to correct any deficiencies identified in the RSP; working with radioactive material; and all incidents involving radioactive material with respect to the cause and the corrective actions taken.

(g) The RSC may combine multiple committee meeting agendas under one unified meeting umbrella.

(2) The RSC may establish working groups or subcommittees, as needed, to prepare documents or preliminary evaluations for consideration by the whole RSC. The two standing subcommittees are the Licensing Subcommittee and the Education and Training Subcommittee.

(a) USNA Licensing Subcommittee: The composition of the Licensing Subcommittee shall include licensees representing the various non-human use procedures authorized by the Department of Defense's Naval Radioactive Material Permit (NRMP), and who, through training or experience, possess sufficient expertise in radiological safety and regulatory guidelines to allow thorough review of license applications. This subcommittee shall meet as needed based upon changes in licensee's programs, or if a renewal is requested. The Licensing Subcommittee shall review all non-human use license applications and all radiation incidents and reports of safety violations and submit recommendations regarding the appropriate course of action. In fulfilling this responsibility, the Licensing Subcommittee shall:

1. Review the qualifications of each non-human use license applicant with regards to Federal, Navy, and Local standards for training and experience.

2. Evaluate the adequacy of the facilities and equipment of each applicant with regard to the handling procedures described in the application.

3. Review each incident involving radioactive material; ascertain whether the incident resulted from an infraction of Federal, Navy, or Local safety regulations, and order corrective measures or initiate enforcement actions where appropriate.

(b) Education and Training Subcommittee: The composition of the Education and Training Subcommittee shall include licensees and ionizing radiation users representing the various areas or departments authorized for ionizing radiation activities, and who, through training and experience, possess sufficient expertise in radiological safety to evaluate educational programs designed to instruct all persons whose duties may require them to work in or frequent areas where radioactive materials or other radiation sources are used (e.g. visiting faculty, midshipmen, security, laboratory staff, housekeeping). The Education and Training Committee shall review the training and education efforts of the RSO and submit recommendations to the full Committee regarding training needs at the USNA. In fulfilling this responsibility, the Education and Training Committee shall:

1. Review the training programs presented by the Radiation Safety Office.

2. Determine their adequacy.

3. Assist the Radiation Safety Office in developing programs for faculty, staff and Midshipmen.

8. Applications for Local USNA Licenses to Use Radioactive Material or Machine Sources

a. General Information

(1) USNA has been issued a license from the U.S. Navy RSC (under NAVSEA 4N) via the Radiological Affairs Safety Office (RASO) for reactor-produced, accelerator-produced, and naturally occurring radionuclides along with machine sources of radiation. Under the provisions of the license, the issuing agencies do not accept applications from researchers for individual licenses, but instead require that the individuals apply for authorization from the USNA RSC to work under the institution's broad scope license. Thus, the USNA RSC acts as local responsible authority, answerable to RASO, the U.S. Navy RSC, and the United States Nuclear Regulatory Commission (USNRC).

(2) In acting on a license application, the RSC shall require the same training, experience, and facilities requirements as are employed by the NRC and RASO.

b. Application Procedures for a Local USNA License

(1) A completed non-human use application must be submitted for acquisition of a new license, renewal of a license about to expire, or for an amendment of existing license where significant changes in the authorized activities are requested. When an amendment request involves only minor

changes in the licensed activity, application may be made in the form of a memorandum detailing the requested changes.

(2) Application forms for a non-human use license are available (hard copy, or digital copy) from the Radiation Safety Office and must be filed there in duplicate, type written, and signed by the applicant. During review of the application, the RSC may require further information before deciding whether to issue a license. In this case, all additional information provided by the applicant shall be incorporated as part of the original application.

(3) Applications submitted to the Radiation Safety Office shall receive an initial review for clarity and completeness and are then presented to RSC for review during its next meeting. Following approval by the RSC, the applicant may begin licensed activities.

(4) All applications shall include draft standard operating procedures (SOP) for individual sources of ionizing radiation (Radioactive Material or Equipment).

(a) All draft instructions must be provided to the RSC for review and approval by the RSC prior to being approved by the applicable Division Director.

(b) The SOP shall be codified under the Engineering & Weapons Division or Math & Science Division local 5104.x series instruction.

(5) Following its review of a non-human use application, the Licensing Subcommittee will recommend approval provided the following criteria are met:

(a) The applicant has a staff or faculty appointment to USNA.

(b) The radionuclide(s), possession limit(s), and proposed use(s) contained in the application are authorized under the institution's Navy and Federal licenses.

(c) The applicant has provided sufficient information to justify the choice of radionuclide(s), possession limit(s), and proposed use(s) described in the application.

(d) The applicant possesses adequate training (provided by the Radiation Safety Office) and experience to use the requested radionuclide(s) in such a manner as to protect health and minimize the danger to DoD personal and property.

(e) The applicant has attended the required portions of the radiation safety training program presented by the Radiation Safety Office.

(f) The applicant's laboratory facilities have been deemed adequate by the Radiation Safety Office for the radioactive material(s) requested, and the applicant possesses sufficient safety devices and monitoring equipment to protect health and minimize the danger to DoD personal.

(6) No use of radioactive materials or machine sources is permitted until the use is approved by the RSC. Only routine uses are approved on an interim basis by the Chairperson of the Licensing Subcommittee. The RSC has established the following criteria for "routine" uses that can be given interim approval:

(a) Sealed exempt sources - new uses and/or users of self-shielded source possessed by USNA that can be considered routine.

(7) Acquiring new sources in shielded devices requires RSC approval both for safety and to consider future disposal problems and costs that may be associated with some sources. Use of unshielded sources (or acquiring same) requires RSC approval.

(8) Local USNA licenses are valid for a period of five (5) years after which time a new application must be completed and submitted for renewal of the license.

(9) The RSC may at any time after a license has been approved, require modifications from the licensee to enable it to determine that deficiencies have been corrected or to decide whether a license should be modified, suspended, or revoked. All changes and representations made by the licensee shall be incorporated into the original license application.

(10) Authorization for use of machine sources of ionizing radiation requires submission of an "Application for Authorization to Use Machine Source." The Licensing Subcommittee shall recommend approval of an application provided the applicant has justified his/her need to have access to the unit and has received the radiation safety orientation program provided by the Radiation Safety Office.

(11) Local USNA licenses are valid for activities performed at USNA only. Authorizations may not be transferred to other institutions, nor shall a license obtained at another institution be honored at the USNA. A licensee is required to comply with all pertinent Navy and Federal regulations and Local policies until such time that their radioactive material license is officially terminated. Termination of a license shall be approved if the following conditions are met.

(a) The licensee submits a letter of intent to terminate use of radioactive materials to the RSO.

(b) A "Radioactive Material Disposition" form, accounting for all radioactive material received by the licensee, is completed and submitted to the Radiation Safety Office.

(c) All radioactive material in the possession of the licensee is surrendered to the Radiation Safety Office, or is physically transferred, with the approval of the RSO, to an individual licensed to possess the material.

(d) The license's laboratory/equipment has been surveyed by the Radiation Safety Office for contamination. All contamination shall be removed prior to release in an unrestricted area.

(e) The letter of release shall be sent to the licensee and the departmental chairperson.

c. Authorized Uses of Radioactive Material and Machine Sources

(1) Radioactive materials and Machine Sources obtained under a local USNA license shall only be used for research and development and teaching purposes.

(2) The licensee shall limit the use of radioactive materials and Machine Sources to only those purposes authorized in his/her license and in such a manner as to maintain compliance with the conditions specified in the license.

(3) Radioactive material and Machine Sources shall not be used in or on humans and shall not be used for in-vitro tests for the purpose of obtaining diagnostic medical information for use in the treatment of human subjects.

(4) Radioactive material and Machine Sources shall only be used by the licensee and those individuals under his/her supervision who are designated authorized users. In order to qualify as an authorized user, individuals must meet the following conditions.

(a) Individuals must be a USNA faculty, staff, or midshipmen.

(b) Individuals shall have been designated as an authorized user on the licensee's license application or an amendment request.

(c) Individuals shall have attended the training program provided by the Radiation Safety Office.

(d) Individuals shall have received on job training from the licensee covering the specific procedures and attendant hazards associated with the work to be performed.

d. Exposure Limit Requirements

(1) The local policies set forth in this section have been established to restrict the use of radioactive material in such a manner as to maintain the radiation exposure to USNA personnel and the general public As Low As Reasonably Achievable (ALARA), to minimize the danger to property and the environment, and to ensure compliance with all applicable Navy and Federal regulatory codes.

(2) Each user of ionizing radiation, whether a licensee or an individual working under the authority of a licensee, shall ensure that they do not possess or handle radioactive materials unless all applicable provisions of this chapter are met.

(3) A Restricted Area (synonymous with a Radiation Area in reference (b)) must have signs indicating it is a Radiation Area. A Restricted/Radiation Area is defined as any location in which there is a likelihood of an individual receiving radiation at the following levels:

(a) Receiving a 2 millirem/hr (0.02 mSv/hr) (external) whole body deep dose of continuous exposure at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

(b) Receiving a 100 millirem (1 mSv) total effective dose equivalent (TEDE) of one year of continuous exposure. Occupancy factors are permitted to be applied for such scenarios.

(c) Exposure to radioactive material in concentrations in excess of the limits delineated in reference (e) Appendix B to 20.1001-2402 of 10 CFR Part 20 and any limitations set forth in reference (b) RAD-010.

(4) An unrestricted area is any location in which there is no reasonable likelihood of an individual being exposed to the limits identified in sub-paragraph 3 of this section.

(5) Each licensee shall take appropriate steps to limit the access to the restricted area under their supervision so that only authorized individuals, using a personal radiation monitoring device (when required), may enter.

(6) Areas used for shipping, receiving, or transporting radioactive material packaged in accordance with Navy and Federal DOT regulations are exempt from the requirements for a restricted area. These areas must not be used for long term storage of radioactive material.

e. Permissible Limits of Radiation Exposure

(1) General Public. Radioactive material shall be stored and handled in a manner so that no member of the general public receives a total effective dose equivalent (radiation dose) in excess of 0.1 rem (1mSv) per year resulting from the sum of the (external) whole body dose equivalent and the (internal) committed effective dose equivalent. This limit shall apply if a licensee allows access to a restricted area by a member of the general public.

(2) Radiation Workers. Radioactive materials shall be stored and handled in a manner so that no individual occupationally exposed receives a radiation dose in excess of the following rem limits, where rem is defined as the RAD dose multiplied by a quality factor. The quality factor for beta particles of energies below 0.05 keV is 1.7; the quality factor for all other beta particles, gamma rays, and x-rays is 1.0.

(3) The annual dose limit shall be the more limiting of the following:

(a) Radioactive material and/or other sources of radiation shall not be used in such a manner as to cause an adult to receive in excess of the more restrictive of the radiation doses listed in Table 1 below (excerpt from reference (c) P-5055).

TABLE 1 - Occupational Dose Limits

Total Effective Dose Equivalent (Whole Body)	3.000 rem/qtr
Total Effective Dose Equivalent (Whole Body)	5.000 rem/year
Shallow Dose Equivalent (Extremities)	50.000 rem/year
Shallow Dose Equivalent (Skin)	50.000 rem/year
Eye Dose Equivalent (Eyes)	15.000 rem/year
Sum of Deep Dose Equivalent and Committed Dose Equivalent for any organ or tissue other than the lens of the eye (Organ Dose)	50.000 rem/year

(b) USNA shall comply with any administrative control limits (ACL) as described by reference (b) RAD-010 section 2.3.1.

(c) ACL limits are currently 10% of the values listed in the above table.

(d) For radiation workers whose prior or current year exposure is unknown, the annual limits shall be reduced by one-quarter for each quarter of the current year for which records of exposure are unavailable or incomplete. For example, if new employees are hired in June and state that they were exposed at their previous job earlier in the year but records are unavailable, then the annual exposure limits for the new employees must be reduced by one-quarter for the first and second quarters of the year, i.e., reduced from 5 rem (0.05 Sv) to 2.5 rem (0.025 Sv), from 50 rem (0.5 Sv) to 25 rem (0.25 Sv) for shallow dose, 15 rem (0.15 Sv) to 7.5 rem (0.075 Sv) for eye dose and from 50 rem (0.5 Sv) to 25 rem (0.25 Sv) for the sum of deep dose equivalent and committed dose equivalent for any organ or tissue other than the lens of the eye (excerpt from reference (c), P-5055).

(e) Non-radiation Workers. Radioactive material and/or other sources of ionizing radiation exposure shall not be used in such a manner as to cause any non-radiation worker to exceed a total effective dose equivalent of 500 mrem (5 mSv) per year considering occupancy factors and source usage. It must be locally documented that due to limited source usage, occupancy or transient situations the individual's total effective dose equivalent is not expected to exceed 500 mrem (5 mSv) per year.

(f) Embryo/Fetus. Once a woman monitored for occupational exposure notifies her command in writing of her pregnancy and the estimated date of conception, exposure to the embryo/fetus shall not exceed 500 mrem (5 mSv) for the term of the pregnancy and should not exceed 50 mrem (0.5 mSv) per month in any month for the remainder of the pregnancy.

1. The dose to the embryo/fetus shall be taken as the sum of the deep dose equivalent to the declared pregnant woman and the dose to the embryo/fetus from radionuclides in the embryo/fetus and declared pregnant woman.

2. If the dose to the embryo/fetus is found to have exceeded 500 mrem (5 mSv) or is within 50 mrem (0.5 mSv) of this dose by the time the woman declares the pregnancy, the activity shall be deemed to be in compliance with the limit if the additional dose to embryo/fetus does not exceed 50 mrem (0.5 mSv) during the remainder of the pregnancy.

(g) Minors. No individual under 18 years of age shall receive an occupational exposure to ionizing radiation in excess of 10 percent of the annual total effective dose equivalent limit for radiation workers.

(h) Emergency Exposure. In an emergency, it may be necessary for emergency workers to exceed occupational dose limits in Table 1 to save life or valuable property. In such situations, the probable risk of high exposure to the rescuer must be weighed against the expected benefits. In emergency situations:

1. That require personnel to search for and remove injured personnel or that require entry to prevent conditions that would probably injure numbers of people, reasoned judgment is permitted; no upper dose limit is specified. In all cases, exposures should be kept as low as practicable by using rotation of workers and other standard methods to minimize exposure.

2. Workers used in such activities should be limited to non-pregnant volunteers who are aware of the risks associated with the projected dose.

3. Where it is desirable to enter a hazardous area to protect facilities, eliminate further escape of contamination, or to control fires, the planned total effective dose equivalent should not exceed 10 rem (0.1 Sv). Workers used in such activities should be limited to non-pregnant volunteers. This limit may be increased only with written RASO/NRC approval.

(4) Additional Exposure Limit Restrictions

(a) The quarterly whole body external deep dose component of the annual effective dose equivalent limit listed in section 8.e.3.a, above, shall not exceed 0.3 rem (0.003 Sv).

(b) If an individual receives an exposure which exceeds the 3 rem (0.02 Sv) quarterly limit, but does not exceed the 5 rem (0.05 Sv) annual limit, then the licensee shall limit further exposure to the individual such that the 5 rem (0.05 Sv) annual limit is not exceeded.

(c) If an individual receives a dose that exceeds the annual 5 rem (0.05 Sv) dose limit, the licensee shall not assign that person to any task in which there is a likelihood of any additional occupational exposure.

(d) The licensee shall not assign an individual to a task which is expected to result in any of the following situations.

1. Ingestion of radioactive material in excess of 10 percent of the Allowable Limit of Intake (ALI).

2. Exposure to airborne concentrations of radioactive material in excess of 10 percent of the Derived Air Concentration (DAC).

3. Exposure to concentrations of radioactive material in excess of 10 percent of the Maximum Permissible Average Concentrations (MPAC) in Air and Water.

4. Minors and declared pregnant women likely to receive, in one (1) year, a committed effective dose equivalent in excess of 0.05 rem (0.5 mSv).

(e) The following restrictions shall apply to the radiation exposure to declared pregnant employees.

1. The pregnant employee shall notify her supervisor of the pregnancy. The supervisor shall in turn notify the RSO.

2. The licensee shall make efforts to avoid substantial variation above a uniform monthly exposure rate to declared pregnant women so as to satisfy the 0.5 rem (5 mSv) limit.

3. The RSO shall determine whether there is a likelihood of the embryo/ fetus receiving the 0.5 rem (5 mSv) limit. If this possibility exists, then the individual shall be assigned tasks which require significantly less or no radiation exposure. At her request, the employee may continue to be assigned the same tasks; however, the frequency of TLD exchanges shall be increased to twice a month. If the TLD readings indicate

that the 0.5 rem limit may be exceeded, the employee shall be removed from her presently assigned tasks and assigned responsibilities which involve significantly less or no radiation exposure.

4. The dose to the embryo/fetus shall be taken as the sum of the deep dose equivalent to the declared pregnant woman and the dose to the embryo/fetus from radionuclides in the embryo/fetus and radionuclides in the declared pregnant woman.

5. Radioactive material shall be stored and handled in a manner such that no minor or declared pregnant woman shall be exposed to a radiation dose in excess of 10% of the annual dose limits specified in section 8.e.3.a.

f. Personal Monitoring Requirements

(1) Personal and area monitoring dosimetry devices will be distributed, and maintained by Naval Health Clinic (NHC) Annapolis. NHC Annapolis is responsible for distribution, collection, and sending used dosimetry to the local processing facility, and receiving and distributing reports to the RSO. The Radiation Safety Office will assist the Radiological Health Technician in performance of these duties.

(2) TLD monitoring of whole body radiation doses shall be issued by the Radiation Safety Office with assistance from the Radiologic Health Technician to individuals with the potential of receiving radiation exposure in excess of general public exposure limits.

(3) Individuals assigned to handle non-exempt sources of penetrating radiation shall be issued finger (ring) monitors to determine the absorbed dose to the hands.

(4) The Radiation Safety Office shall provide auxiliary monitoring devices, including direct reading dosimeters, to any individual where the absorbed dose to a body part may not be adequately defined by the readings obtained with a TLD or finger monitor.

(5) Other individuals who are exposed to radiation on an occasional basis, such as security personnel who deliver packages, secretarial staff, short term visitors, or those who perform routine maintenance/service will not normally be issued exposure monitors.

(6) TLDs and finger monitors shall be exchanged on a 12-week basis.

(7) It is the responsibility of each licensee to ensure that individuals under their supervision are provided with personal monitors according to the requirements for operation of their facility. Each individual who is issued a personal monitor shall ensure that:

(a) A personal monitor intended to measure whole body exposure is worn on the trunk of the body (e.g. on the collar, chest pocket, or belt).

(b) A finger monitor is worn on the tip of the finger (under the protective glove) on the hand most frequently used to handle radioactive material.

(c) They only wear the personal monitor(s) assigned to them by the Radiation Health Technician.

(d) They immediately notify the RSO when a personal monitor is lost or if it is suspected that a monitor has become contaminated or damaged.

(e) They protect the monitors against exposure to high heat or humidity and do not remove the monitors from the USNA.

(f) Monitors shall not be worn by an employee receiving a medical examination or treatment involving ionizing radiation. Personal monitors are issued to determine an individual's occupational exposure only.

g. USNA Acquisition of Radioactive Material and Machine Sources

(1) All acquisitions of radioactive materials, whether through purchase or transfer from another authorized licensee, shall be arranged through the RSO.

(2) All requisitions for purchase of radioactive material must be approved by the RSO/ARSO before the purchasing department issues a purchase order number.

(3) The RSO will approve a purchase requisition provided that:

(a) The requisitioner has an approved instruction which covers the radionuclide(s) and the chemical and physical forms requisitioned; approved individuals will be referred to as licensees.

(b) Acquisition of the radioactive material will not result in the USNA exceeding the possession limits specified in its Naval Radioactive Material Permit (NRMP) and will not result in the licensee exceeding the possession limit specified in their institutional license.

(c) The requisition contains the following information:

1. The shipping instructions specify the licensee's name and the notation "in care of the RSO/ARSO - Rickover 76," and the complete USNA address.

2. The radionuclide, chemical form, and activity to be purchased.

3. The vendor, catalog number and Sealed Source Registry Number (if greater than exempt quantity & sealed).

4. The requested delivery date.

(d) Requisitions for standing orders of radioactive material will be approved by the Radiation Safety Office provided that the requisition indicates an anticipated delivery schedule and number of shipments for each radionuclide, and the licensee confirms that prior shipments are depleted (i.e., have been disposed of) before a new shipment is received.

(e) Acquisition of radioactive material through transfer from another radioactive material licensee either inside or outside the institution will be approved by the RSO provided that the conditions identified in 6(b)1 and 6(b)2 are met. If the radioactive material is to be received from a licensee outside the institution, then the shipping instruction provided to the sender shall conform to those described in 6(b)3(a), above.

(f) Incoming shipments of radioactive material shall be routed directly to the Radiation Safety Office where they will be logged into a master inventory record and inspected for integrity, radiation levels, and proper labeling, before being released to the licensee. Authorized radioactive workers may not directly receive a shipment of radioactive material unless written authorization is received from the RSO. When the licensee has written authorization to directly receive packages, they shall inspect the shipment following the procedures provided by the Radiation Safety Office and notify the Radiation Safety Office that the shipment has been received.

(g) Once under the control of the licensee, radioactive material shall be secured in such a manner as to prevent unauthorized access or accidental exposure to the radioactive material. It shall be locked in a cabinet, refrigerator, freezer, safe, or security box which only individuals authorized to handle the material possess a key. Laboratories containing radioactive material shall be locked when designated user(s) are not present.

(4) Acquisition of Ionizing Radiation Producing Devices (machine sources).

(a) All acquisitions of ionizing radiation production devices, whether through purchase or transfer from another authorized licensee, shall be arranged through the RSO.

(b) All requisitions for purchase of ionizing radiation production devices must be approved by the RSO/ARSO before the purchasing department issues a purchase order number.

(c) The following instruments are examples of ionizing radiation producing devices.

1. Machine X-ray producing equipment:
 - a. X-ray Diffractometers
 - b. X-ray Cabinet (example: Faxitron)
 - c. Industrial X-ray Radiography
 - d. X-ray Fluorescence Analyzers (XRFs)
 - e. X-ray Spectrometer
 - f. Scanning Electron Microscope

(d) The RSO will approve a purchase requisition for machine sources provided that:

1. The requisitioner has submitted a draft SOP proposal which covers the ionizing radiation production device requisitioned; approved individuals will be referred to as a licensee.

2. Acquisition of ionizing radiation production devices do not result in the USNA exceeding the possession limits specified in its Naval Radioactive Material Permit (NRMP).

3. The requisition contains the following information:

a. The shipping instructions specify the authorized investigators name and the complete destination USNA address.

b. The ionizing radiation production device to be purchased.

c. The vendor, catalog number, and item serial # (if available).

d. The requested delivery date.

(e) Requisitions for standing orders of ionizing radiation production devices will not be approved unless approved by the RSC.

(f) Acquisition of ionizing radiation production devices through transfer from another radioactive material licensee either inside or outside the institution will be approved by the RSO provided that the conditions identified in 8.g.3 are met. If the radioactive material is to be received from a licensee outside the institution, then the shipping instruction provided to the sender shall conform to those described in 8.g.3.c, above.

(g) Authorized radioactive workers may not directly operate ionizing radiation production devices unless authorization is received from the RSO. The Radiation Safety Office must first review operating conditions identified in 8.b.9 & 8.c, perform initial radiation surveys, ALARA training, qualify operators as needed, and determine that the device is operating in accordance with reference (b) conditions prior to releasing it for use to authorized licensee.

(h) Once under the control of the licensee, ionizing radiation production device shall be secured in such a manner as to prevent unauthorized access or accidental exposure to non-radiation workers, whereby only the licensee/ authorized users possess a key (either physical or electronic). Laboratories containing ionizing radiation production devices shall be locked when designated user(s) are not present. The Radiation Safety Office will be promptly notified if there is a malfunction, intended disposal, intended transfer/move of device, change in operator/operating conditions, or radiation safety incidents involving the ionizing radiation production device.

h. Disposal of Radioactive Material Requirements

(1) Disposal of radioactive material shall be arranged through the Radiation Safety Office. Unless authorization is obtained to do otherwise, licensees shall transfer all of their radioactive waste to the radioactive waste room located in USNA Rickover 73, where long lived wastes will be processed and packaged in accordance with the requirements of the licensed low level radioactive waste (processing/burial) site, the transport broker, and Navy and Federal DOT regulations. Short lived waste shall be held for decay following the procedure described below.

(2) The Radiation Safety Office shall accept radioactive waste for disposal or interim storage, provided the following conditions are met:

(a) Radioactive waste shall be pre-segregated into the below categories.

1. Dry Solid Material (DSM) - which contains no pourable liquids or biological tissues or fluids of any kind.

2. Large Volume Aqueous Liquids - which consists of containers having a volume in excess of 50 milliliters of aqueous, non-corrosive fluid.

3. Small Volume Aqueous Liquids - which consists of containers having a volume of less than 50 milliliters of aqueous fluid.

4. Scintillation Vials Exempt - which consists of vials containing liquid scintillation fluid with tritium and/or carbon-14 in concentrations less than 0.05 microcuries per milliliter.

5. Scintillation Vials Regulated - which consists of vials containing liquid scintillation fluid with tritium and/or carbon-14 in concentrations greater than 0.05 microcuries per milliliter, or any other radionuclide concentrations greater than background.

(b) Each category of waste is marked with radionuclide, activity content, and licensee's name.

(c) The radiation exposure rate on the surface of the waste package does not exceed 50 mR/hr.

(d) The radioactive waste is accompanied by a signed requisition indicating to which licensee the disposal record will be applied to.

(e) The radioactive waste is brought for processing and packaging during the specified hours of operation of the radioactive waste room.

(f) Storage of radioactive materials for decay shall only be performed at the radioactive waste room under the control of the Radiation Safety Office. Short lived radioactive waste shall be stored for a minimum of ten half-lives and be free of detectable radioactivity, when monitored using a thin window GM survey meter, before it is released as normal trash. However, the Radiation Safety Office is permitted to process radioactive waste in accordance to 10 CFR 20.2005.

(g) The Radiation Safety Office shall accept waste for "Decay in Storage" provided that the following conditions are met:

1. The radionuclide(s) have a half-life of less than 120 days.

2. Each package of radioactive waste has a volume less than 1 cubic foot.

3. Each package of radioactive material contains a maximum of 3 radionuclides.

4. The radiation exposure rate on the surface of the package does not exceed 5 mR/hr.

5. The radioactive material is double bagged and has a permanent label indicating the radionuclide contained the activity, and the licensee's name.

6. All radioactive warning labels must be defaced or removed prior to disposal for decay (no radioactive labels inside the bag).

7. Radioactive waste is brought to the radioactive waste room for storage during the specified hours of operation.

(h) Short lived radioactive waste may not be held for decay in the user's laboratories.

(i) No licensee shall dispose of or allow to be disposed, any radioactive material through release with normal trash.

(j) All disposable items used during radioactive procedures shall be monitored for contamination before disposal as normal trash.

(k) Radioactive warning labels must be removed or defaced prior to their disposal as normal trash.

(l) Radioactive waste storage containers in laboratories shall be conspicuously posted with a radioactive materials warning sign and a worded warning to housekeeping personnel not to remove the waste.

(m) Disposal of radioactive material into the sanitary sewer system shall not be performed. However, the licensee may wash lab ware (glass, plastic ware, etc.) if approved by Radiation Safety Office. The Radiation Safety Office shall provide containers to collect liquid waste.

(n) Liquid radioactive waste shall be picked up by the Radiation Safety Office or delivered by an authorized user to the radioactive waste room provided the below criteria are met.

1. The radioactive compound is readily soluble (or is readily dispersible biological material) in water.

2. The liquid waste is non-toxic.

3. Each radionuclide is maintained in a separate container and separated as short-lived and long-lived liquid waste.

4. All liquid waste containers are labeled with tags provided by the Radiation Safety Office. The tag must list the below information.

a. Name of licensee

b. Isotope

c. Activity (microcuries)

d. Chemical form (on reverse side of tag)

e. Date of pick-up.

(3) The Radiation Safety Office is provided paragraph 8.h.2.n.4 disposal details forty eight (48) hours prior to expected disposal date.

i. Facility Requirements

(1) Radioactive material shall only be used and stored in those areas designated in the licensee's approved radioactive material application.

(2) The RSC shall not approve a radioactive material license application until the Radiation Safety Office has inspected the applicant's laboratory facilities and determined that the below minimum requirements are met.

(a) All work surfaces shall be constructed of smooth, non-porous material (such as stainless steel or non-porous stone) which is resistant to absorption of or reactions with radioactive compounds.

(b) Sinks used for decontamination or disposal of radioactive material shall be lined with a smooth, non-porous material and have drain traps made of glass or other non-porous, non-corrodible material.

(c) If unsealed material is intended to be used, a fume hood shall be present which is located away from windows, doors, and ventilation outlets. All airflow lines shall be directed into the hood with a minimum velocity of 100 linear feet per minute at the face with the sash fully open. The walls of the hood shall be smooth and non-porous, and resistant to absorption of or reaction with, radioactive materials. The floor of the hood shall be sufficiently strong to support lead shielding when required.

(d) There shall be means of securing access to the room whenever no authorized users are present.

(e) Refrigerators, freezers, and cabinets used for storage of radioactive material shall be lockable to prevent unauthorized access.

(f) The radiation exposure rate in unrestricted areas adjacent to the laboratory facility shall be less than 0.5 mR per hour with the proposed radionuclide(s) and activity(s) fully unshielded at the proposed work locations within the lab.

(g) Appropriate shielding to use radioactive materials (Lucite/plexi-glass for beta emitters, lead for gamma emitters) shall be available.

(h) The laboratory shall be equipped with remote handling devices such as pipettes, tongs, etc.

(i) If storing radioactive material in a locked box/safe/cabinet/fridge/freezer, a visible lock shall be present. The containment must either be physically secured or be of sufficient weight to prevent unauthorized movement of the containment vessel.

(3) In addition to the laboratory specifications identified in paragraph 8.i.2 above, the RSC may impose other requirements, before or after a licensee's application is approved, to ensure that health and environmental safety are maintained.

(4) The RSC shall not approve an application for a radioactive material license until the RSO determines that the applicant, at a minimum, possesses the appropriate safety resources and equipment to satisfy the below requirements.

(a) Each licensee shall maintain a supply of disposable

protective gloves and shall provide protective laboratory coats.

(b) Each licensee shall possess remote pipettes for transferring radioactive solutions.

(c) Each licensee shall maintain a supply of waterproof backed absorbent paper to protect large surfaces against contamination and splash trays of adequate size to protect against spills when large volumes of radioactive solutions are handled.

(d) Each licensee authorized to use sources of penetrating photon or high energy beta radiation shall possess remote handling devices of appropriate design and of such diversity as to preclude the necessity of handling unshielded sources with the hands.

(e) Each licensee authorized to use phosphorus-32, or other sources of high energy beta radiation shall possess a Plexiglas (or Lucite, etc.) shield with a minimum thickness of 0.5 inches or 1.25 centimeters, and of a size sufficient to protect the body and head of the worker.

(f) Each licensee authorized to use sources of penetrating photon radiation shall possess lead shields of appropriate design and of such diversity to individually shield each source greater than 10 microcuries, or shall possess lead blocks and/or sheets to construct a "cave" or similar concept to shield sources. Licensees who routinely use millicurie amounts of photon emitters shall possess an "L-block" shield with a lead glass view window to protect the body and head of the worker.

(g) Each licensee authorized to use millicurie quantities of penetrating radiation shall possess a GM survey meter (USNA provided Radiac) having probe with a window sufficiently thin to allow detection of the radiation emitted by the source(s).

(h) Each licensee shall have access to a RASO approved detector (refer to Section 10: Survey instrument types and calibration) for analysis and surveys for gamma emitting radionuclides.

(i) Each licensee authorized to use a volatile form of radioactive material shall possess breathing masks having a filter designed to protect against inhalation of the radioactive compound.

(j) Each licensee shall possess appropriate containers for temporary storage of radioactive waste.

(5) The RSC may at any time require a licensee obtain any further resources and equipment which it deems necessary to ensure the protection of health or the environment.

j. Posting Requirements

(1) All signs and labels used to caution individuals of the presence of radiation or radioactive materials shall have a standard three-bladed radiation symbol in black or purple on a yellow background.

(2) Each room where non-exempt quantities of radioactive materials are used or stored shall be posted with a conspicuous sign bearing a radiation symbol and the words "Caution, Radioactive Materials."

(3) Each room in which there is a location where an individual may receive a whole body dose equivalent of 2 millirem (0.02 mSv) in one hour at a distance of 30 centimeters from a source or a surface through which the radiation penetrates shall be posted with a conspicuous sign bearing a radiation symbol and the words "Caution, Radiation Area."

(4) Each room in which there is a location where an individual may receive a whole body dose equivalent in excess of 100 millirem (1 mSv) in one hour at a distance of 30 centimeters from a source or a surface through which radiation penetrates shall be posted with a conspicuous sign bearing a radiation symbol and the words "Caution, High Radiation Area" or "Danger, High Radiation Area."

(5) Each room in which there is a location where an individual may receive a whole body dose equivalent in excess of 500 rads (5 grays) in one hour at a distance of 100 centimeters from a source or a surface through which radiation penetrates shall be posted with a conspicuous sign bearing a radiation symbol and the words "Grave Danger, Very High Radiation Area."

(6) Each room in which radioactive material could potentially be dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases shall be posted with a conspicuous sign bearing a radiation symbol and the words "Caution, Airborne Radioactive Material."

(7) Each room in which airborne radioactivity exists in concentrations listed below shall be posted with a conspicuous sign bearing a radiation symbol and the words "Caution, Airborne Radioactivity Area" or "Danger, Airborne Radioactivity Area."

(a) In excess of the derived air concentrations (DACs) specified in Appendix B of the 10 CFR 20.

(b) To such a degree that an individual present in an area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6% of the annual limit of intake (ALI) or 12 DAC hours.

(8) Each refrigerator, freezer, cabinet or other device or appliance which contains radioactive material shall have a conspicuous sign bearing a radiation symbol and the words "Caution, Radioactive Materials."

(9) Each container of radioactive material shall have a durable label bearing a radiation symbol and the words "Caution, Radioactive Material" or "Danger, Radioactive Material." In addition, the label will specify the radionuclide present, the date, and the activity present on that date.

(10) Each container used for temporary storage of radioactive waste shall be conspicuously posted with a label bearing a radiation symbol.

(11) Each laboratory bench area routinely used for handling radioactive material shall have a border made of yellow tape having radiation symbols or be posted with a conspicuous sign having a label bearing a radiation symbol and which reads "Caution Radiation Work Area."

(12) Each sink used for decontamination shall be posted with a sign bearing a radiation symbol and the words "Caution, Radioactive Material."

(13) In addition to posting signs and labels to caution individuals

of the presence of radiation and/or radioactive materials, each licensee shall post the following documents and ensure that each individual under his/her supervision knows of their presence.

(a) Copies of forms NRC-3 "Notice to Employees" and notifications as required by the reference (b).

(b) A list of individuals, with telephone numbers, who should be contacted in the event of a radiation incident.

(c) The emergency procedures as described in section 12 should be accessible within the room. This document does not need to be posted. However, the document should be an accessible hardcopy found alongside the operation instructions.

(14) Each licensee shall, prior to removal or disposal of empty uncontaminated containers to unrestricted areas, remove or deface the radioactive material label or otherwise clearly indicate that the container no longer contains radioactive material.

(15) Posted signs should be consistent with current radiation levels. Signs should be removed or deactivated if there is no measurable radiation risk.

k. Radiation Safety Survey Requirements

(1) Each licensee is responsible for performing routine surveys for contamination in locations under their supervision where unsealed sources of radioactive material are handled. These surveys shall be in the form of wipe tests which shall be taken and counted utilizing a procedure which incorporates the following:

(a) Wipe tests shall be made of all surfaces where radioactive materials are handled, and in other locations which have a risk of becoming contaminated (e.g. sinks, refrigerator or freezer handles, telephones, etc.).

(b) Each wipe test shall cover an area no greater than one square foot, and the number of wipe tests taken per survey shall be sufficient to ensure that any contamination within the work area is detected.

(c) Wipe tests shall be assayed on a calibrated counting instrument in such a way as to detect contamination levels of 200 disintegrations per minute on each sample.

(d) Wipe tests for contamination with alpha, beta, or gamma emitters shall be counted using:

1. Gas proportional counter
2. Liquid scintillation*
3. Gamma counter using a NaI crystal*

4. Approved alpha/beta survey instruments following NAVSEA Radiac Program Office

*Counter for which the counting efficiency (cpm to dpm conversion factor) is known for the radionuclide (either by using reference standard or manufacture

provided), counting configuration, and (counting cocktail used-LSC only).

(e) Wipe tests for contamination with gamma emitters shall be counted using a well type sodium iodide scintillation counting system for which the counting efficiency is known for radionuclide being sampled and the counting source geometry used.

(f) The results of wipe test surveys shall be entered on the form provided by the Radiation Safety Office or Licensee generated form approved by the RSO. Positive results shall be recorded in units of disintegrations per minute.

(g) Wipe test samples which give a count rate in excess of three times the background level shall indicate the presence of contamination.

(h) Contamination surveys described above shall be performed at the following frequency for unsealed radioactive materials greater than exempt quantities.

1. Monthly contamination surveys shall be performed in areas where a total of > 200 microcuries of unsealed radioactive material is used in a week.

2. Quarterly surveys shall be performed in areas where less than 500 microcuries, but more than exempt quantities, of unsealed radioactive material are routinely used.

3. Special contamination surveys shall be performed immediately whenever contamination is suspected.

(i) Spot checks for personal and area contamination should be performed between routine contamination surveys. Spot checks may be performed using a GM survey meter having a probe with a window sufficiently thin to allow detection of the radionuclide(s) being surveyed.

(j) Decontamination procedures shall be initiated immediately whenever a contamination survey or spot check yields positive results. The trigger levels for removable contamination surveys in research laboratories are 200 dpm per 100 cm² for all radionuclides with the exception of alpha emitting radionuclides, which has a trigger level of 20 dpm per 100 cm² above background levels.

(k) Each licensee who "uses" at any one time, quantities > 200 microcuries of unsealed sources of gamma or energetic beta emitting radiation shall perform area surveys of radiation levels in his/her work area and document the results. These surveys shall incorporate the below procedures.

1. Area surveys shall be performed using an energy dependent portable ionization chamber or a GM survey meter which reads in exposure units of mR/hr and which has been calibrated against an RASO approved traceable source.

2. The locations surveyed shall include shield surfaces, storage units, worker locations with source(s) unshielded, the unshielded source surfaces, and adjacent unrestricted areas.

3. The results of ambient radiation level surveys shall be entered in units of mR/hr onto the form provided by the Radiation Safety

Office.

(l) Spot checks of radiation levels should be made at the start of new procedures involving sources of penetrating radiation and whenever significant or unpredictable changes in the radiation exposure rate are possible.

(m) The Radiation Safety Office shall be contacted whenever an area survey reveals a radiation level in which an individual may receive a whole body dose in excess of 5 millirems in one hour. If greater than 5 mrem/hr is anticipated, the user shall request pre-approval to operate from the RSO prior to commencement of operation/use of the device/source.

(n) Surveys for airborne radioactivity shall be undertaken whenever a licensee performs a procedure which may result in the release of radioactive fumes, vapors, or aerosols. Air surveys shall be made under the supervision of the Radiation Safety Office which shall provide the sampling device and the appropriate filters, and shall select the locations from which air samples are taken. The calculations of airborne concentrations, based on air sampling results, shall be made by the Radiation Safety Office.

(o) Licensees authorized to possess sealed sources of beta/gamma radioactivity in amounts greater than 100 microcuries per source shall perform leak tests on these sources at six (6) month intervals. Each leak test sample shall be assayed on a counting system capable of detecting 0.005 microcuries of removable radioactivity. The RSO shall be contacted whenever a leak test yields positive results.

(p) Licensees authorized to possess sealed alpha only sources of radioactivity in amounts greater than 10 uCi per source shall perform leak tests on these sources at three (3) month intervals. Each leak test sample shall be assayed on a counting system capable of detecting 0.005 microcuries of removable radioactivity. The RSO shall be contacted whenever a leak test yields positive results.

(q) Leak check frequencies and exemptions are subject to change respective to reference (e) 10 CFR 39.35 (Leak testing of sealed sources) and reference (b) RAD-010 section 2.19 (Leak Testing of Sealed Radioactive Sources). USNA shall comply with the most conservative of these regulatory guidelines.

1. General Rules of Safety Requirements

(1) Each individual who handles radioactive material is responsible for minimizing the radiation exposure to themselves and other individuals within the work area, and to take appropriate steps to prevent personal contamination and contamination of the environment. To satisfy this requirement, each licensee and authorized user shall ensure that, at a minimum, the following rules are observed in rooms or areas where unsealed sources of radioactive material are handled.

(a) Eating and drinking, or the presence of food or beverages, is forbidden.

(b) The presence of reusable cups or eating implements in open laboratory areas is forbidden.

(c) Smoking, or the presence of tobacco products and smoking

paraphernalia, is forbidden.

(d) Pipetting by mouth is forbidden.

(e) Radioactive materials shall not be handled by individuals with exposed cuts or abrasions.

(f) No individual shall handle unsealed radioactivity unless he/she is wearing protective gloves and a lab coat. When contamination is suspected, protective gloves and lab coats shall be immediately removed.

(g) Handling of radioactive material shall be limited to the smallest area possible. To the extent practical, radioactive work areas shall be delineated using warning tape or warning signs. Each worker is responsible for informing others in the laboratory of the locations where they are using radioactive material.

(h) All items such as glassware, pipettes, forceps, and pens used during procedures involving unsealed radioactivity shall be labeled with radioactive material warning tape.

(i) All surfaces on which work with unsealed radioactivity is conducted shall be covered with waterproof backed absorbent paper. This covering shall be changed when contaminated. Work involving large volumes of radioactive liquid shall be carried out in a splash tray capable of containing the volume being handled.

(j) Vials containing sources of penetrating radiation shall be maintained in a suitable shield to the extent practical.

(k) Unshielded sources of radioactivity shall only be handled using forceps or other device to maintain an adequate distance from the fingers.

(2) When personal or area contamination is suspected, work with unsealed radioactivity shall be stopped as soon as possible so that decontamination procedures may be undertaken.

(3) Immediate notification of the RSO is required in the event of any of the below incidents.

(a) A known or suspected whole body radiation exposure which may result in an absorbed dose equivalent of 5 millirem in one hour.

(b) A spill of radioactive material in excess of 5 microcuries.

(c) Any known or suspected internalization of radioactive material by an individual.

(d) Any known or suspected presence of airborne radioactivity.

(e) Any known or suspected unauthorized release of radioactive material to an unrestricted area, or exposure of a member of the general public.

(f) Any theft or otherwise unauthorized removal of radioactive material.

(4) Minor incidents not falling into the categories identified in the paragraph above shall be reported to the RSO during the course of its next routine inspection or by internal correspondence (email). All incidents will need to be documented at the time of the event inside the respective equipment's radiation safety log.

m. Operating and Emergency Procedures Requirements. The procedures to be undertaken in the event of a spill or other release of radioactivity are provided in paragraph 15. Each licensee shall conspicuously post a copy of the emergency procedures which relate to activities authorized under their license and ensure that personnel working under their supervision are aware of the location of the posting. In addition, the licensee shall ensure that emergency telephone numbers are listed on the space provided on the posting.

9. Annual Program Review (APR) by RSO and RSC

a. Roles of RSO/ARSO/RSC/Licensee

(1) On an annual basis, the RSO, ARSO, SC, and licensee shall initiate an annual program review in compliance with RAD-010 2.10 (Annual Program Reviews). The RSO may consolidate the results into a single report, but must address all the following:

(a) A review of the exposure control processes that are in place to ensure doses are maintained ALARA.

(b) A review of operating and emergency procedures to ensure they are current and in compliance with governing regulations. Include a list of the procedures and any identified discrepancies.

(c) Identification of any improvements to the RSP.

(d) A review of RSP operations with the highest personnel doses to identify opportunities to reduce these exposures.

(e) A review of personnel exposure records that includes the individuals with the five highest annual radiation doses, those individuals with annual doses above 100 mrem (1 mSv), and the cumulative radiation dose total for all radiation workers.

(f) A list of personnel who had their ACL raised and their resulting radiation exposures.

(g) A review of all RSP related training.

(h) A demonstration of compliance with dose limits for individual members of the public.

(i) The results of the annual RDR trend report conducted by the RSO.

(j) A review of all incident and critique reports, associated corrective actions, and the effectiveness of those corrective actions.

(k) A summary of RSP operation surveillances and results.

(l) A review of audit findings, responses, and audit effectiveness.

(2) In order to perform the APR, the RSO will request current Licensees to complete a questioner/review sheet, requesting key details of operational instruction, regulatory compliance, facilities and any proposed recent changes in operations.

(3) The RSO shall determine the adequacy of safety and regulatory compliance of the Licensee's application/operations.

(4) The RSO shall assign RSC subject matter expert(s) to review existing License questioner responses to determine if:

(a) Instructions are clear, concise, and adequately reviewed annually to meet Local, Navy and Federal standards.

(b) Instructions are functional, and current in regards to current USNA facilities.

(c) Operations have not deviated from what was placed in the License without RSO approval or instructional change.

(d) If an RDR was issued to a licensee, corrective actions have been adequately implemented.

(5) The reviewed APR questioner will be returned back to the Licensee, whereby they shall provide a copy for their division manager for review and a duplicate copy shall be maintained by the RSO on file.

(a) All requested changes made by the RSC to the Licensee must be implemented by the Licensee within 60 days of the next revision of the local operation instruction.

(b) RSO and Management representative shall be forwarded a signed digital copy (PDF or equivalent) of the updated instruction in the following document format: xxINSTxxxDATE_OF_LAST_EDIT.PDF

(6) RSC membership shall discuss APR results as part of a combined annual RSC meeting as discussed in paragraph 7.d.2.a - Licensing Meeting & Education and training meeting.

(7) Lab Supervisors and USNA Licensees shall perform their own independent biannual audit verifying:

(a) Procedures and the NRMP are being properly maintained and are current.

(b) Appropriate radiological surveys are being conducted and reviewed in a timely manner.

(c) NRMP commitments are maintained by reconciling physical inventories, leak test records, and other items prescribed by the NRMP.

(d) Required records and reports are properly maintained and issued in a timely manner.

(e) Radioactive material transportation, shipping, receipt, transfer, and disposal records are properly maintained for their respective program.

(f) RSP related training is properly conducted and documented.

(g) Deficiencies identified during previous evaluations, inspections, reviews, audits, and RSP Deficiency Reports (RDRs) have been corrected and that corrective actions are effective.

10. Survey Instrument Types and Calibration

a. Laboratory instruments fall into two general categories: survey devices and experimental equipment. The first group includes portable instruments or devices: thermo-luminescent dosimeters (TLDs) and calibrated portable survey meters (alpha, beta, gamma and neutron). The second includes stationary systems or equipment: neutron detection probes (BF₃ and ³He), rem-meters, gas flow detectors, Geiger-Mueller detection systems, neutron/alpha/gamma spectrometer systems, scalar-timers, analytic balances, a TLD reader and a Far West Tissue Equivalent Proportional Counter instrument called the HAWK. A neutron howitzer is also located in the laboratory.

b. Navy RADIACS

(1) All primary radiation monitoring instruments used for official radiation field records will be chosen from the NAVSEADET RASO approved RADIAC list. These RADIACS are obtained by approval from the NAVSEA RADIAC Program Office (NAVSEA 04RN) and distributed and calibrated by the NAVSEA Calibration Laboratory (WAJ).

(2) USNA has risks from photon, neutron, and alpha radiation which will be monitored using RASO-approved RADIACs. Items in the current RADIAC allowance for USNA are detailed in Table 2 below.

Table 2 - RADIAC Allowance

Model Number	Common Names / Purpose
AN/PDR-70	Neutron, "snoopy"
DT-304/PDR	Beta/Gamma - "Frisker"
DT-680/PDQ	Beta/Gamma
DT-681/PDQ	
DT-685/PDQ	
EPD (orange)	Electronic personal dosimeter
IM-265/PDQ (PDQ-1)	Geiger-Mueller counter
IM-265/PDQ (PDQ-5)	Geiger-Mueller counter
MX-12132/S	Source kit
MX-12133/S	Source kit
IM-231/PD	Ion Chamber
IM-143/PD	Horsehair dosimeter
PP-4265/PD	

c. Non-Navy Instruments

(1) Facilities may require monitoring instruments with capabilities not available from the approved RADIAC list. These may include instruments built into interlock systems, instruments with additional sensitivity, and instruments designed to monitor for specific radioisotopes.

(2) Reference (d) NUREG 1556 Volume 11 Appendix O provides information on the choice of proper radiation detection equipment for various radiological conditions. The table is partially reproduced below.

Table 3 - Typical Survey Instruments

Detector Type	Radiation	Energy Range	Efficiency
Exposure Rate Meters	Gamma, X-ray	uR - R	n/a
Geiger-Mueller	Alpha	All energies (dependent on window)	Moderate
	Beta	All energies (dependent on window)	Moderate
	Gamma	All energies	<1%
NaI Scintillator	Gamma	All energies (dependent on crystal)	Moderate
Plastic Scintillator	Beta	C-14 or higher (dependent on window)	Moderate
Liquid Scintillation Counter	Alpha	All energies	High
	Beta	All energies	High
	Gamma	All energies	Moderate
Gamma Counter (NaI)	Gamma	All energies	High
Gas Proportional	Alpha	All energies	High
	Beta	All energies	Moderate
	Gamma	All energies	<1%

(3) NAVSEADET-RASO shall approve the use of any radiation detection instruments not listed in reference (f) prior to use by a RSP command. Requests for approval of non-standard instruments shall include a detailed description of the instrument and its characteristics, methods, and procedures for calibration, and procedures for use and pre-use checks. USNA shall operate under the calibration frequency provided by the manufacturer unless otherwise noted.

(4) American National Standards Institute (ANSI) publication N323 series provides specific requirements for radiation monitoring instruments. Publications in the series are listed in Table 4 below.

Table 4 - American National Standards Institute Publications

ANSI Document Number	Title
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N323	Test and Calibration
N323A	Portable Survey Instruments
N323B	Near-Background Instruments
N323C	Air Monitoring Instruments
N323D	Installed Instruments

(5) Reference (d) provides advice on procedures for reading scales on instruments. The information is highlighted below.

(a) Model Procedure for Calibrating Survey Instruments. A radioactive sealed source(s) used for calibrating survey instruments will:

1. Approximate a point source
2. Approximate the same energy and type of radiation as the environment in which the calibrated device will be employed
3. For dose rate and exposure rate instruments, the source should be strong enough to give an exposure rate of at least 7.7×10^{-6} coulombs/kilogram/hr (30 mR/hr) at 100 cm [e.g., 3.1 gigabecquerels (85 mCi) of cesium-137 or 7.8×10^2 megabecquerels (21 mCi) of Cobalt-60].
4. The three kinds of scales frequently used on dose or dose rate survey meters are calibrated as follows:
 - a. Linear readout instruments with a single calibration control for all scales shall be adjusted at the point recommended by the manufacturer or at a point within the normal range of use. Instruments with calibration controls for each scale shall be adjusted on each scale. After adjustment, the response of the instrument shall be checked at approximately 20% and 80% of full scale. The instrument's readings shall be within $\pm 15\%$ of the conventionally true values for the lower point and $\pm 10\%$ for the upper point.
 - b. Logarithmic readout instruments, which commonly have a single readout scale spanning several decades, normally have two or more adjustments. The instruments shall be adjusted for each scale according to site specifications or the manufacturer's specifications. After adjustment, calibration shall be checked at a minimum of one point on each decade. Instrument readings shall have a maximum deviation from the conventionally true value of no more than 10% of the full decade value.
 - c. Meters with a digital display device shall be calibrated the same as meters with a linear scale.
 - d. Readings above 2.58×10^{-4} coulomb/kilogram/hr (1 R/hr) need not be calibrated, but such scales should be checked for operation and response to radiation.
 - e. The inverse square and radioactive decay law should be used to correct changes in exposure rate due to changes in distance or source decay.

(b) Surface Contamination Measurement Instruments

1. Survey meter efficiency must be determined by using radiation sources with similar energies and types of radiation that the survey instrument will be used to measure.

2. If each scale has a calibration potentiometer, the reading shall be adjusted to read the conventionally true value at approximately 80% of full scale, and the reading at approximately 20% of full scale shall be observed. If only one calibration potentiometer is available, the reading shall be adjusted at mid-scale on one of the scales, and readings on the other scales shall be observed. Readings shall be within $\pm 20\%$ of the conventionally true value.

(c) Model Procedures for Calibrating Liquid Scintillation Counters, Gamma Counters, Gas Flow Proportional Counters, and Multichannel Analyzers.

1. A radioactive sealed source used for calibrating instruments shall:

a. Approximate the geometry of the samples to be analyzed.

b. Approximate the same energy and type of radiation as the samples that the calibrated device will be used to measure.

2. Calibration must produce readings within ± 20 percent of the actual values over the range of the instrument.

3. Calibration of liquid scintillation counters will include quench correction.

(d) Calibration Records. Calibration records for all survey instruments should indicate the procedure used and the data obtained. The description of the calibration should include:

1. The owner or user of the instrument.

2. A description of the instrument, including the manufacturer's name, model number, serial number, and type of detector.

3. A description of the calibration source, including the exposure rate at a specified distance or activity on a specified date.

4. For each calibration point, the calculated exposure rate or count rate, the indicated exposure rate or count rate, the deduced correction factor (the calculated exposure rate or count rate divided by the indicated exposure rate or count rate), and the scale selected on the instrument.

5. For instruments with external detectors, the angle between the radiation flux field and the detector (i.e., parallel or perpendicular).

6. For instruments with internal detectors, the angle between radiation flux field and a specified surface of the instrument.

7. For detectors with removable shielding, an indication

whether the shielding was in place or removed during the calibration procedure.

8. The exposure rate or count rate from a check source, if used.

9. The name of the person who performed the calibration and the date it was performed.

10. The following information will be attached to the instrument as a calibration sticker or tag:

a. For exposure rate meters, the source isotope used to calibrate the instrument (with correction factors) for each scale.

b. The efficiency of the instrument, for each isotope the instrument will be used to measure (if efficiency is not calculated before each use).

c. For each scale or decade not calibrated, an indication that the scale or decade was checked only for function but not calibrated.

d. The date of calibration and the next calibration due date.

e. The apparent exposure rate or count rate from the check source, if used.

(e) Survey Record Requirements. Each survey record should include the following:

1. A diagram of the area surveyed.
2. A list of items and equipment surveyed.
3. Specific locations on the survey diagram where wipe test was taken.

4. Ambient radiation levels with appropriate units.

5. Contamination levels with appropriate units.

6. Make and model number of instruments used.

7. Background levels.

8. Name of the person making the evaluation and recording the results and date.

9. Licensees should record contamination levels observed and procedures followed for incidents involving contamination of individuals. The record should include names of individuals involved, description of work activities, calculated dose, probable causes (including root causes), and steps taken to prevent future contaminations.

(f) Leak Test and Inventory Requirements for Sealed Sources

1. Sealed sources shall be tested for leakage and/or

contamination at intervals not to exceed six (6) months or at such intervals as are specified by the certificate of registration referred to in CFR 32.210, not to exceed three (3) years.

2. A physical inventory shall be maintained of all reusable sealed sources. This record shall include:

a. The names of individuals authorized to handle the sources.

b. The number of sources of each strength and any identifying marks or serial numbers.

c. The time and date each source was removed & returned, by whom, and signed confirmation that the number of sources agrees with the inventory listing.

12. Material Receipt and Accountability

a. All acquisitions of radioactive material and ionizing radiation production devices, whether through purchase or transfer from another authorized licensee, shall be arranged through the Radiation Safety Office.

b. USNA Radiation Workers may not directly receive a shipment of radioactive material or a machine source unless written authorization is received from the RSO. Incoming shipments of radioactive material shall be routed directly to the Radiation Safety Office.

(1) Radioactive Material. The shipping instructions shall specify shipment to:

Radiation Safety Officer
Rickover Hall Room 076
590 Holloway Road
US Naval Academy
Annapolis, Maryland 21402

(a) To detect shipments that may have been misdirected, the common receiving areas in Rickover, Michelson, and Chauvenet Halls will be posted with signage as shown below.



or any package with the following HAZMAT markings - UN2910/2911

THIS SIGNAGE MUST BE POSTED IN THE SPECIFIED SHIPPING AND RECEIVING AREAS

(b) Immediately inform the Radiation Safety Office, or responsible Laboratory Director about arriving packages as most packages must

be surveyed within three hours of arrival. During normal working hours, immediately upon receipt of any package known to include radioactive material, visually inspect for any signs of shipping damage such as crushed or punctured containers or signs of dampness. Any obvious damage must be reported to the RSO or ARSO immediately. Do not touch any package suspected of leaking. Request the person delivering the package remain until monitored by the RSO or ARSO.

(c) Outside of normal working hours (e.g., nights, weekends and holidays); deliveries will usually be handled by qualified radiation workers as described in the above procedures. Since certain packages of licensed material will have detectable external radiation, the appropriate recipient (a qualified radiation worker) should be contacted immediately to move the package to a designated storage area where it will be checked for contamination and external radiation level as soon as practical. In any case, the package should be picked up within three hours of receipt. If an appropriate person cannot be contacted, contact the RSO or ARSO.

(d) If the instructions are not clear, or if there are questions regarding receiving packages containing radioactive material, please contact the RSO as identified in USNANOTE 5420.

(e) Shipments are required to be specially packaged so that the exposure to individuals is negligible. Regardless, treat the material in a manner so as to maintain exposures As Low As Reasonably Achievable. The three ways to do this are:

1. Minimize the time near the material.
2. Keep a distance from the material.
3. Use shielding materials. The shipping containers assist with this aspect.

(f) Shipments will be inspected for integrity, radiation levels, and proper labeling. Items will be logged into the master inventory record before being released to the USNA licensee. When the licensee has written authorization to directly receive packages, then they shall be required to inspect the shipment following the procedures provided by the RSO, and to notify the RSO that the shipment has been received.

(g) Once under the control of the licensee, radioactive material shall be secured in such a manner as to prevent unauthorized access or accidental exposure. Radioactive material shall be locked in a cabinet, refrigerator, freezer, safe, or security box of which only individuals authorized to handle the material, possess a key. Laboratories containing radioactive material shall be locked when designated user(s) are not present.

(2) Machine Sources

(a) Authorized radioactive workers may not directly operate ionizing radiation production devices without authorization from the RSO. The RSO must first review operating conditions, perform initial radiation surveys, ALARA training, qualify operators as needed, and determine that the device is operating in accordance with reference (b) conditions prior to releasing it for use to the authorized USNA licensee.

(b) Once under the control of the USNA licensee, ionizing radiation production devices shall be secured in such a manner as to prevent unauthorized access or accidental exposure to non-radiation workers whereby only the licensee/ authorized users possess a key. Laboratories containing ionizing radiation production devices shall be locked when designated user(s) are not present. The RSO will be promptly notified if there is a malfunction, intended disposal, intended transfer/move of device, change in operator/operating conditions, or a radiation safety incident involving the ionizing radiation production device.

(3) Accountability. All exempt and non-exempt sources of radioactive material and machine sources of radiation will be entered into the USNA Master Inventory. The USNA Master Inventory is maintained by the Radiation Safety Office. Each source will be assigned a custodian, a person responsible for knowing the location of the source and performing any necessary paperwork or notifications to the Radiation Safety Office.

13. The USNA Training Program

a. Training Overview. Training requirements and classifications for USNA organization personnel are specified in reference (b) RAD-010 Section 2.8. Those requirements are duplicated in USNA's NRC Form-313 Application for Materials License Item 8. The training classifications include:

(1) Command Management/Leadership. This class applies to the USNA Superintendent. Per reference (b) RAD-010, Section 2.8.2, the Superintendent is required to complete the annual RASP Leadership Course (S-NKO-0001) available at the NAVSEADET RASO Navy Knowledge Online website. Copies of training completion certificates are to be forwarded to the RSO for record retention. The Superintendent may designate other supporting management to complete this course.

(2) RSC Membership. RSC membership shall be provided radiation worker training along with supplemental training on additional responsibilities that RSC members are required to perform. The supplemental responsibility training shall be provided on an annual basis.

(3) RSO and ARSOs. RSO/ARSO shall receive training commensurate to meet or exceed the requirements required by NAVSEADET RASO, NRC, and DOT. USNA shall provide adequate time and resources to maintain RSO/ARSO continuing education and certifications.

(4) Radiation Workers. This class includes personnel who conceivably could obtain a measureable job-function dose using standard RASO-approved dosimeter in routine work or during a radiological incident. Faculty, laboratory technicians, and postdocs are most commonly assigned to this classification. Training shall include:

(a) Training commensurate to reference (b) RAD-010, 2.8.4.

(b) Additional topics, including:

1. Radiation physics
2. Various radioactive decay
3. Radiation biology

4. ALARA principles

(5) Contamination Workers. This class includes the subset of Radiation Workers who conceivably could encounter fixed or removable contamination (in contrast to just irradiation) as part of their normal laboratory work.

(6) Non-Radiation Workers. Students, faculty, staff, and visitors who use equipment and material sources in laboratories regulated by the USNA RSP but would not obtain a measurable job-function dose are placed in this classification. This class also includes emergency personnel, firefighters, medical, and security personnel.

(7) Members of the General Public and Other Organizational Personnel Working in Proximity to RSP Controlled Areas. This classification could include other technical staff, students working in a laboratory but not using equipment or material sources, and staff involved in purchasing or receiving machines.

(8) Radioactive Material Shipper Training. This class includes the Radiation Safety Office, who package and certify shipping of radioactive materials and certain RASO-required radiacs and check sources. The USNA Shipping and Receiving department maintains their own 49 CFR required certifications and documentation.

b. USNA RSP implements training internally rather than contracting with outside businesses. USNA faculty and staff generally have a greater in-depth understanding and experience with radioactive materials and machine sources than what is available from commercial training companies. For purchases of new machine sources, initial training on the maintenance and basic operation of the machine is required from the vendor as part of the installation service.

c. The USNA RSO and the USNA RSC have the responsibility for reviewing and approving the adequacy of all training. The Radiation Safety Office will hold required periodic training sessions and designate speakers for all training sessions.

d. Radiation safety training shall ensure that personnel are aware of radiation safety fundamentals and requirements, procedures to maintain radiation exposure ALARA, and procedures to reduce potential for exposure to radioactive contamination (if applicable). Occupationally exposed workers shall receive initial training before beginning work with or around RSP radiation sources. The duration of the initial training shall be determined by the RSO and modified as needed based on changes required by the RSC.

14. Compliance and Enforcement

a. The operative compliance philosophy is to know the requirements and proactively meet them; find and effectively fix issues internally; and when outside inspectors reveal deficiencies, take ownership and fix them. Key tools in ensuring compliance include effective surveys; internal audits; program, procedure, and instruction reviews; and surveillances. The program should identify single point failures and install an appropriate scheduling and administrative tickler system to prevent personnel oversights from causing an infraction. The program is expected to conduct thorough root cause analysis and develop effective corrective actions that will prevent

recurrence of the same or similar events.

b. All individuals are expected to report any conditions or activities which they feel may present a risk to human health or the environment, or which may not be in full compliance with Federal, Navy, or Local regulations. Reports should preferably be made to the RSO or, commensurate with the perceived risk or severity of consequences any member of the RSC or chain of command, up to and including the Superintendent or members of the Superintendent's staff.

c. The Radiation Safety Office shall immediately initiate an investigation in response to any complaint or report of the misuse of radioactive material, of an unanticipated radiation exposure or, of an activity which is not in full regulatory compliance.

d. The Radiation Safety Office shall prepare a written Radiological Deficiency Report (RDR) when an inspection or investigation determines that a USNA licensee's activities violate governmental and/or local regulatory policies. A copy of this RDR entry shall be forwarded and discussed with the Licensee and reviewed by the USNA RSC.

e. The enforcement actions taken by the RSC shall be based on the Severity Categories established by the NRC and RASO in reference (b) (RAD-010 Section 4.6). The severity categories are briefly summarized in Table 5 below.

Table 5 - Severity Categories

Level	Description
I	Actual loss of safety or security. It is frequently associated with severe or potentially severe injury.
II	Same as Level-I except injuries are not as severe. It is frequently associated with harm or the potential to cause harm to individuals.
III	Realistic potential for the loss of safety or security. Often associated with systematic failure to meet safety program requirements.
IV	Issues with more than minor safety or environmental significance. Often associated with non-systematic failure to meet safety program requirements.
V	Issues with more minor safety, health, or environmental significance. Often associated with inadequate documentation requirements.

f. Guidance for actions.

(1) Any violation falling into Severity Category I, II, III, or IV (3) shall result in immediate suspension of the user's license. Consideration for

reinstating the license shall not be undertaken until a full investigation by the RSC is complete and all required corrective measures are in place.

(2) Any violation falling into Severity Category IV (1, 2, 4), or V, shall result in written notification to the licensee by the RSO, and notification of the RSC of this action. A subsequent occurrence of the violation shall result in the issuance of a written order by the RSO requiring remedial actions be put in place within two (2) weeks. A licensee must respond in writing to a written compliance order. The response shall detail the corrective actions undertaken and shall be countersigned by the licensee's department chairman. Failure to respond to a written compliance order or the occurrence of a subsequent violation shall result in the RSC taking action to suspend, modify, or revoke the licensee's authorization to use radioactive material. Licensees who are cited for numerous violations, which are not repeat violations, shall be subject to the same notification/suspension process described in this paragraph.

(3) In addition to the enforcement policies described in above, the RSC maintains the authority to suspend, modify, or revoke any license when the

actions of the authorized user(s) present an unacceptable health risk to personal health or property, or jeopardizes the DoD's Navy or Federal radioactive material licenses.

(4) The accumulation of three Notice of Violations within 12 consecutive calendar months will result in automatic probation for the licensee. An Additional Notice of Violation will result in suspension of licensure action by the RSC. The Radiation Safety Office reserves the right to order an immediate suspension of operations.

15. USNA Requirements for Operating and Emergency Procedures

a. General Requirements. Reference (b) provides guidance for operating and emergency procedures. These requirements are duplicated below.

(1) Commands with RSP radiation sources shall develop and maintain operating and emergency procedures for the safe use of radioactive material and radiation producing machines and devices.

(2) Command operating and emergency procedures shall be developed and written by the command's subject matter expert and users and operators of the radioactive material or radiation producing machines and devices.

(3) The operating and emergency procedures shall be reviewed and approved by the command RSO.

(4) The operating and emergency procedures shall be a command level instruction or part of a command endorsed RSP instruction.

(5) Each revision to an operating and emergency procedure shall be subject to the same approval process as the original.

(6) If the command possesses an NRMP, revisions or changes shall be submitted as a NRMP amendment request per Section 3.2.3 of ref b.

(7) Operating procedures shall not be a reprint of the manufacturer's operating manual. They shall incorporate the specific procedures and processes required by the command to safely use the device.

b. Specific Requirements

(1) Be specific regarding each RSP operation, each piece of equipment, and facility/location. Use of portable equipment at multiple temporary sites outside a permanent facility constitutes one location.

(2) Specify requirements for the use of primary and secondary dosimeters as required.

(3) Specify requirements for engineered controls and equipment.

(4) Specify contamination controls to be used when working with unsealed radioactive material.

(5) Specify requirements for radiation protection surveys necessary to ensure RSP operations are conducted safely, to include any special instrumentation and airborne monitoring for radioactivity.

(6) Specify requirements for checking safety features such as lights, alarms, and interlocks.

(7) Specify the personal qualifications required to perform the operation, and if applicable, internal monitoring required when working with unsealed radioactive material.

(8) Specify and provide representative examples of all logs, records, and forms required to support each operation.

(9) Include or reference another document that has current and accurate information on persons to be notified in the event of a radiological incident, and specify the method of notification.

(10) Specify procedures to use in case of a radiological incident, including shutting down the affected equipment and securing the area.

(11) Specify that the RSO or ARSO shall be able to respond to an on-site radiological incident within the time required for normal commuting (<2 hours) to the command for RSP operations to take place.

c. Operating Procedures for Machine Sources

(1) Operating procedures for a specific machine shall not be a reprint of the manufacturer's operating manual. The procedures must be adapted for USNA and conform to reference (b) and local guidance. Procedures vary greatly by machine; however they must be reviewed and approved by the RSO and the USNA RSC.

(2) In case of an emergency involving actual or potential exposure, the machine must be shut down as quickly as possible. The standard shutdown procedure is preferred; however the nature of the emergency may require immediate removal of power either via the keyed master switch or removal of all electrical power via circuit breakers.

(3) The Radiation Safety Office must be immediately notified for situations involving actual or potential exposures.

d. Operating Procedures for Radioactive Materials

(1) Small Spills of non-volatile radioactive liquids.

(a) Stop the spill & warn others of the risk, and secure the area.

(b) Contact the USNA Licensee and notify the RSO/ARSO of the event.

(c) Obtain protective shoe covers and don two pairs of protective gloves.

(d) Avoid personal contamination and spreading of the spill. Use a Geiger counter or make wipe tests to determine the extent of the affected area. Mark the perimeter of the spill and cover with absorbent paper.

(e) Place saturated paper in double plastic trash bags. Continue covering the spill with absorbent paper until all free liquid has been absorbed.

(f) Remove residual radioactivity with detergent and water (use commercial decontaminant when available). Clean a small area at a time using a minimum amount of liquid. Work your way toward the center of the spill. Use Geiger counter or liquid scintillation counter to check paper towels used. Place contaminated towels directly into the plastic waste bags.

(g) The spill is considered clean when radioactivity can no longer be detected in the affected area and when the measurements made of the paper towels reveal that there is no longer any removable activity.

(h) When decontamination is finished, place shoe covers and gloves into the plastic waste bag, seal it, and label with a radioactive material warning sticker.

(i) The RSO or a designee shall confirm that decontamination is complete, monitor individuals for personal contamination, and contact the Radiation Health Officer and Radiation Health Mate to determine if bioassay monitoring of individuals involved is merited.

(2) Large spills of non-volatile radioactive liquids

(a) Stop the spill & warn others of the risk, and secure the area.

(b) Contact the USNA Licensee and notify the RSO/ARSO of the event.

(c) Don two pairs of protective gloves. While avoiding personal contamination, prolonged exposure, or spreading of the spill, cover the effective area and a two foot perimeter with absorbent paper and move away.

(d) From a safe distance, stand guard to prevent anyone from entering the affected area. Do not leave until the RSO or a designee arrives to check you for personal contamination.

(e) Do not attempt to clean the spill until a member of the RSO arrives to monitor radiation levels, supervise decontamination procedures,

and contact the Radiation Health Officer and Radiation Health Mate to determine if bioassay monitoring of individuals involved is merited.

(3) Skin Contamination

(a) Alert the nearest person to contact the Radiation Safety Office.

(b) Immediately begin decontamination. Using mild soap and water, wash the affected area two or three times, but no more. Be careful not to spread localized contamination. Strenuous scrubbing will abrade the skin, leading to increased penetration of the contaminant. Alternate options for small skin contamination include using tape presses. Do not use strong alkaline detergents or organic solvents, simple washing should be adequate to remove most of the contamination. If residual radioactivity remains on the hands, donning protective gloves to induce sweating will help flush out skin pores; however, the gloves must be removed and the hands washed immediately after profuse sweating begins or else contamination will penetrate the dilated pores. More severe decontamination procedures should only be undertaken under the supervision of the RSO/ARSO.

(c) If hair becomes contaminated, immediately begin washing with soap and water. Avoid spreading contamination to other parts of the head.

(d) If contamination of the eyes occurs, flush with copious amounts of isotonic solution (if available), otherwise, use water. Be sure to roll back the eyelid as far as possible. If residual contamination remains, further decontamination shall require medical supervision.

(e) If contamination of nose or mouth occurs, immediately flush with copious amounts of water. Be careful not to ingest the rinse.

(f) If contamination of a small wound occurs, stimulate bleeding and flush with sterile water, then follow standard first aid procedures. If contamination of a large wound occurs, control the bleeding and seek medical attention. Decontamination may be undertaken when the situation is medically under control.

(4) Contamination of Clothing

(a) Contact the Radiation Safety Office to obtain disposable paper surgical scrubs. When these arrive, change out of effected clothing being careful not to contaminate your skin. Place effected clothing in plastic bag, label with a radioactive material warning sticker, and transfer to the Radiation Safety Office for decontamination.

(b) If the soles of the shoes become contaminated, contact the Radiation Safety Office to obtain a pair of surgical booties. Do not cause the spread of contamination by moving around in contaminated shoes. Shoe soles are typically decontaminated easily using soap and water; perform this procedure over a sink normally used for radioactive materials.

(c) Use an appropriate RADIAC or make wipe tests to determine when decontamination is complete. Initiate a survey of your work area to determine the source of the contamination.

(5) Release of Airborne or Volatile Radioactivity

30 MAR 2014

(a) Alert everyone in the area of the situation and advise them to evacuate the room and remain in the area outside the room. Have someone contact the Radiation Safety Office.

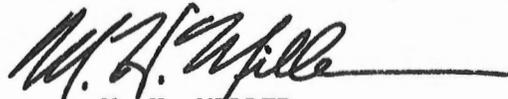
(b) If possible, stop the release of airborne radioactivity from the source, but do not inhale while doing so.

(c) Evacuate the room, closing the door behind you. Stand guard to prevent further entry until the RSO/ARSO arrives.

(d) Personnel who were present in the room should not leave the area until checked for contamination by the Radiation Safety Office. If contamination is obvious, do not wait for the arrival of the RSO/ARSO or a designee but immediately commence personal decontamination at the nearest sink. Be sure to remove shoes and lab coat before doing this so that the spread of contamination is limited.

(e) Make a list of everyone present in the area during the incident. These individuals must receive bioassay testing for internalized radioactivity.

(f) Re-entry and decontamination of the effected room shall only be undertaken under the supervision of the Radiation Safety Office.



M. H. MILLER

Distribution:
Non-Mids (Electronically)
Distribution:
Radiation safety Committee
E&W Div Dir
M&S Div Dir

Definitions

Absorbed Dose – The energy imparted to matter by radiation per unit mass of irradiated material at the place of interest. The unit of absorbed dose are the rad and the gray (Gy). One Gy equals 100 rads.

Accelerator Expert – An individual who has the appropriate combination of education and work experience to make sound judgments regarding specific areas of work to which he or she has been assigned. Minimum qualifications include a Bachelor of Science (BS) in a science or engineering field and 3 years of work experience at accelerator facilities. A higher degree of education can substitute for some working experience. For example, an individual authorized to design and/or certify interlocked access control systems must have education, experience, and training that is commensurate with the tasks assigned. In addition, the individual authorized to design and/or certify the radiation shielding design must have the knowledge and training to undertake an analysis and design of a radiation-shielding system.

Airborne Radioactive Material – Any radioactive material dispersed in air in the form of dusts, fumes, particles, mists, vapors, or gases.

Airborne Radioactivity Area – A room, enclosure, or area in which airborne radioactive materials, composed wholly or partly of licensed material, exist in concentrations: In excess of 10 percent of the derived air concentrations (DACs) specified in appendix B, to 10 CFR 20, or To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

ALARA – Acronym for "As Low As is Reasonably Achievable" means making every reasonable effort to maintain exposures to radiation as far below the dose limits stated in Table 1 as is practical and consistent with the command's mission, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to the Department of Defense's mission in service to the public interest of national security.

Annual Limit on Intake (ALI) – The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rem (0.05 Sv) or a committed dose equivalent of 50 rem (0.5 Sv) to any individual organ or tissue.

Authorized User – An individual that uses radioactive material or operates a machine that generates ionizing radiation, who has had the appropriate training, and is determined by the RSO to be qualified to work with the radioactive material or machine.

Becquerel (Bq) – A unit of radioactivity equal to one disintegration per second.

Byproduct Material – Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or using special nuclear material; The tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface

wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute ``byproduct material`` within this definition; Any discrete source of radium-226 that is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; or Any material that has been made radioactive by use of a particle accelerator and is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; Any discrete source of naturally occurring radioactive material, other than source material, that; a. The Commission, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, determines would pose a threat similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security; and b. Before, on, or after August 8, 2005, is extracted or converted after extraction for use in a commercial, medical, or research activity.

Calibration – To adjust or determine the response or reading of an instrument relative to a series of conventionally true values; or to determine the activity of a radiation source relative to a standard or conventionally true value.

Command – Any Navy or Marine Corps base, facility or activity.

Committed Dose Equivalent – The dose equivalent to an organ or tissue that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

Committed Effective Dose Equivalent – The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues.

Contamination – The presence of radioactive material where it is not wanted.

Contamination Worker – Contamination workers are personnel who receive exposure to ionizing radiation in the course of their employment or duties, and are identified by their command as being occupationally exposed. Normally, these individuals' routine duties require working directly with unsealed radioactive material and have a potential to become contaminated. These individuals normally receive radiation medical examinations. These individuals also normally receive specialized training as part of a specific radiological controls program. USNA qualifies Radiation workers as qualified

contamination workers. Additional training and experience shall be provided under RSO/ARSO's discretion.

Controlled Area – Controlled area means an area, outside of a restricted area but inside the site boundary, access to which can be limited by the licensee for any reason.

Curie – A unit of radioactivity equal to 3.7×10^{10} disintegrations per second or 3.7×10^{10} becquerels or 2.22×10^{12} disintegrations per minute.

Derived Air Concentration Hour (DAC-Hr) – The product of the concentration of radioactive material in air (expressed as a fraction or multiple of the derived

air concentration for each radionuclide) and the time of exposure to that radionuclide, in hours. A licensee may take 2,000 DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of 5 rem (0.05 Sv).

Dose – A generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent (TEDE).

Dose Equivalent – The product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and Sievert (Sv).

Dosimetry (Primary and Secondary) – Individual monitoring equipment designed to be worn or carried by an individual for the purpose of detecting and measuring an individual's exposure to ionizing radiation.

Effective Dose Equivalent – The sum of the products of the dose equivalent to the organ or tissue and the weighting factors applicable to each of the body organs or tissues that are irradiated.

Exposure – The process of being exposed to ionizing radiation or radioactive material.

Facility – The location at which one or more devices or sources of ionizing radiation are installed or located within one building, vehicle, or under one roof and are under the same administrative control.

General Public – Individuals who are not occupationally exposed to ionizing radiation shall be considered members of the general public. Examples would include individuals that live and work outside the perimeter of a command, family members of an employee, or crew members that live on a base but are outside a controlled industrial area, and visitors that do not normally receive occupational exposure.

Gray (Gy) – The SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 Joule/kilogram (100 rads).

High Radiation Area – Any area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 0.1 rem (1.0 mSv) per hour at 30 cm (approximately 1 foot) from the radiation source or 30 centimeters from any surface the radiation penetrates.

Immediate Notification – In reference to contacting RASO, the RSO or ARSO shall make positive contact with someone at NAVSEADET RASO (757-887-4692) as soon as possible after it becomes known to the command of an incident that requires immediate notification.

Interlock – A device or device group arranged to sense a limit, an off-limit condition or improper event sequence that functions to shut down the equipment or prevent its operation. Interlocks are specifically designed to avoid and/or terminate a hazardous radiation condition.

Internal Audit – A documented examination by responsible management individual (i.e., RSO, ARSO, Senior Radiographer, supervisor, foreman, etc.) of the RSP or

any element thereof (training, posting, operations, procedures, records, etc.,) to verify compliance with requirements and established procedures.

Ionization – The process of adding one or more electrons to, or removing one or more electrons from, atoms or molecules, thereby creating ions. High temperatures, electrical discharges, or nuclear radiations can cause ionization.

Ionizing Radiation – Any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter. Ionizing radiation includes the following: gamma rays, x-rays, alpha particles, beta particles, neutrons, protons, and other particles and electromagnetic waves capable of producing ions.

Initial Facility Evaluation – An evaluation of an x-ray radiography facility to determine its classification as an exempt shielded, shielded, or open facility prior to placing a facility into routine operation. A radiation protection survey will provide the basis for the facility evaluation. Facility evaluations will be conducted by NAVSEADDET RASO using data provided by a radiation protection survey performed by the local RSO/ARSO.

Leak Test – A test to determine if a sealed source has lost its integrity and allows leakage of radioactive material through holes or cracks. The test is normally performed by wiping the source with filter paper or absorbent material to determine the presence of radioactive contamination, which indicates leakage.

Licensed Material – Radioactive material that is received, possessed, used or transferred under a general or specific license issued by the Nuclear Regulatory Commission.

Naval Radioactive Materials Permit (NRMP) – Authorization issued by the Naval RSC to a command to receive, possess, use, store, transfer or dispose of radioactive material as specified in Section 3.

Non-Radiation Worker – Workers who receive very low-level radiation exposure incidental to their employment at a command but not as an integral part of their skill, trade or work assignment. Their assigned duties do not involve the direct use of RSP sources of ionizing radiation and they are not authorized to receive, in a year, a dose of radiation greater than 500 mrem (5 mSv) from RSP sources. These individuals may regularly access areas near or adjacent to RSP sources and may periodically be in radiation areas. Examples include: supervisors, management personnel, safety inspectors, radiation health personnel, gas chromatograph operators, maintenance personnel, delivery personnel, messengers, security personnel, firefighters, medical personnel, emergency response personnel and inspectors. Radiation safety training for non-radiation radiation workers should be specific to the areas and hazards that the individual could reasonably encounter.

Occupancy Factor – The factor (≤ 1) for the degree of occupancy (by any one person) of the area in question while the radiation source is emitting radiation.

Principal Activity – Activities authorized by the NRMP which are essential to achieving the purpose(s) for which the NRMP was issued or amended. Storage during which no licensed material is accessed for use or disposal and activities incidental to decontamination or decommissioning are not principal activities.

Qualified Expert – An individual who has the appropriate combination of education

and work experience to make sound judgments regarding specific areas of work to which he/she has been assigned. Minimum qualifications should include a Bachelor of Science (BS) in science or engineering fields and 3 years of work experience at accelerator facilities. Higher degree of education can substitute some working experience. For example, a worker authorized to design and/or certify interlocked access control system must have education, experience and training that is commensurate with the tasks assigned. Radiation Safety Professional is a qualified expert in the areas of radiation safety.

Quarter (Calendar) – A period of time equal to one-fourth of the year (approximately 13 consecutive weeks), providing that the beginning of the first quarter in a year coincides with the starting date of the year and that no day is omitted or duplicated in consecutive quarters.

Quality Assurance Program (QAP) – A program for the systematic monitoring and evaluation of the various aspects of a project, service, operation, or facility to ensure that standards of quality are being met.

Quality Factor - The factor by which the absorbed dose (rad or gray) is to be multiplied to obtain a quantity that expresses, on a common scale for all ionizing radiation, the biological damage (rem or sievert) to an exposed individual. It is used because some types of radiation, such as alpha particles, are more biologically damaging internally than other types.

Quick Scan Radiation Survey – A radiation survey conducted by moving a radiation survey instrument over a specific area anticipated to be the most likely source of leakage at a slow enough movement rate to allow adequate response and noting the highest reading observed.

Rad – The special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs/gram or 0.01 joule/kilogram (0.01 gray). Units of Radiation Dose – Note: For x-ray and gamma rays fields, 1 roentgen (R) is approximately numerically equal to 1 rad, which is also approximately numerically equal to 1 rem.

Radiation Area – An area, accessible to individuals, in which radiation levels exceed 2 mrem/hr (0.02 mSv/hr) at 30 centimeters from the radiation source or from any surface that the radiation penetrates. For the purposes of the RSP, a restricted area, as defined in 10 CFR 20, is considered a radiation area and will meet the definition of a radiation area.

Radiation Producing Machine – Any device or equipment capable of generating ionizing radiation directly or indirectly.

Radiation Protection Survey – An evaluation of the radiation hazards incident to the production, use, release, disposal or presence of radioactive material or other sources of radiation under a specific set of conditions including a physical survey of the location of materials and equipment and measurements of levels of radiation.

RSO – A qualified individual, appointed by the Commander, Commanding Officer, or Officer in Charge who is responsible for the safe conduct and assurance of adequate radiation protection from the use of radioactive material and radiation generating equipment associated with the RSP and in accordance with this manual.

Radiation Worker – Radiation workers are individuals who receive exposure to ionizing radiation in the course of their employment or duties and are identified by their command as being occupationally exposed. Normally, these individuals' routine duties require working directly with sources of ionizing radiation and have a significant potential for exposure. These individuals receive radiation medical examinations. These individuals normally receive specialized training as part of a specific RSP.

Radioactive Contamination Area – Any area, accessible to individuals, where surface contamination levels exceed, or are likely to exceed, the surface contamination values specified in RAD-010 Table 2-2.

Radioactive Material – Any material or combination of materials, which spontaneously emit ionizing radiation.

Radioactive Waste – Any radioactive material that meets all of the following conditions: (1) material no longer needed or usable; (2) material that cannot be returned to the manufacturer; (3) material requires controlled disposal; and (4) material has been declared to be waste by an inventory control point.

Radiographic Exposure Device – Any instrument containing a sealed source fastened or contained therein, in which the sealed source or shielding thereof, may be moved or otherwise changed from a shielded to unshielded position for purposes of making a radiographic exposure.

Radiographer – Any individual who performs radiography or who in attendance at the site, personally supervises radiographic operations, and who is responsible to the Commander, Commanding Officer, or Officer in Charge for assuring compliance with the requirements of this manual and any applicable Naval Radioactive Materials Permit.

Radiographer's Assistant – Any individual who under the direct supervision of a radiographer, uses radiographic exposure devices, sealed sources or related handling tools, or radiation survey instruments in industrial radiography.

Radiographic Operations – All activities associated with the presence of radioactive sources in a radiographic exposure device during use of the device or transport (except when being transported by a common or contract transport), to include surveys to confirm the adequacy of boundaries, setting up equipment and any activity inside radiation area boundaries.

Radiography – The examination of the structure of material by nondestructive methods utilizing sealed sources of radioactive material or radiation producing machines.

Radiological Accident or Emergency – Loss of control of radiation producing machines or radioactive material which presents a hazard to life, health or property, or which may result in any member of the general population exceeding dose limits for ionizing radiation.

Restricted Area – See definition of radiation area.

Rem – The special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rads multiplied by the quality factor (1 rem=0.01 sievert).

Roentgen (R) – A unit of x-ray or gamma exposure determined by measuring the ionization produced in air by x or gamma radiation of energies less than or equal to 3 MeV. It is the sum of the electrical charges of all of the ions of one sign produced in air when all electrons liberated by photons in a volume element of air are completely stopped in the air, divided by the mass of the air in the volume element. One roentgen produces 2.58×10^{-4} coulombs/kilogram of air.

Sievert (Sv) – The SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv=100 rems). Sealed Source – Any byproduct material that is encased in a capsule designed to prevent leakage or escape of the byproduct material.

Senior Radiographer – The qualified individual appointed by the Commanding Officer that is responsible for the day to day radiography operations when the RSO/ARSO is not a qualified radiographer. For commands that do not appoint a Senior Radiographer, the respective requirement will be performed by the RSO/ARSO.

Supplemental Survey – a survey performed by the barrier monitor during subsequent exposures in order to monitor confirmatory survey measurements at the restricted area boundary. If a barrier monitor identifies unexpected readings at the restricted area boundary, the Radiographer in Charge shall be notified.

Source Changer – Any device designed and used for replacement of sealed sources in radiographic exposure devices including those also used for transporting and storage of sealed sources.

Source Material – Source material means: (1) Uranium or thorium, or any combination thereof, in any physical or chemical form or (2) ores which contain by weight one-twentieth of one percent (0.05 percent) or more of: (i) Uranium, (ii) thorium or (iii) any combination thereof. Source material does not include special nuclear material.

Special Nuclear Material – Special nuclear material means: (1) Plutonium, uranium 233, uranium enriched in the isotope 233 or in the isotope 235, and any other material, which the Commission, pursuant to the provisions of section 51 of the Atomic Energy Act, determines to be special nuclear material; or (2) any material artificially enriched by any of the foregoing.

Surveillance – The observation of a person or group for the purpose of assessing the operational performance of the individual or group.

Total Effective Dose Equivalent (TEDE) – The sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Type "A" Package – A package designed to retain the integrity of containment and shielding required by 49 CFR under normal conditions of transport as demonstrated by the tests set forth in 49 CFR 173.465 or 173.466, as appropriate.

Type "B" Package – A package designed to retain the integrity of containment and shielding required by 49 CFR when subjected to the normal conditions of transport and hypothetical accident test conditions set forth in 10 CFR 71.

Unrestricted Area - Any area access to which is not controlled by the command for the purposes of protection of individuals from exposure to radiation or radioactive materials and any area used for residential quarters.

Supplementary Definitions per USNA Standards

Audit - An official inspection of an individual's or organization's accountability by an outside independent body. The audit's objective is to determine the adequacy of USNA's process for overseeing USNA licensee activities and addressing the safety and control of source of ionizing radiation. Similarly, USNA is subject of audit's from outside radiological agencies (examples: NRC & NAVSEA RASO). An official radiological safety audit can be performed by the RSO/ARSO/RSC membership/USNA licensee or any USNA party designated by the RSO or RSC in maintaining radiation safety.

Authorized Users - Individuals who have access to Radioactive material specified on the USNA Naval Radioactive Material Permit (NRMP) or machine sources capable of exposing individuals with >100 mrem/yr or 2 mrem/hr exposure . Such sources shall only be used by the USNA Licensee and those individuals under his/her supervision who are designated as Authorized Users. Authorized Users may or may not be Radiation Workers depending on the hazard associated with their activity. Authorized users must be approved by the RSO/RSC.

CFR - Code of Federal Regulations

Custodian - The term custodian shall apply to any USNA faculty/staff maintaining authority over quantities of NRC licensed material/machine sources or exempt quantity sources. The custodian may also be considered an authorized user and/or radiation worker. The custodian for licensed material can also be considered the USNA Licensee (refereed in application as principle user or facility managers). Custodians will be responsible for the RAD-010 regulatory compliance of their respective sources of ionizing radiation. All non-compliance issues will be addressed directly by the Custodian of the source.

DOE - Department of Energy

Exempt Quantity - Exempt quantities fall into two categories: Radioactive materials with quantities less than listed in 10 CFR 30.18. These radioactive materials are free of NRC restrictions due to their low safety risk. However, all exempt quantity sources must be inventoried and custodians must maintain positive custody once on USNA premises.

Inspection - Refer to audit.

Licensed Quantity - Radioactive material in excess of quantities listed in 10 CFR 30.18. These quantities of radioactive material are a safety risk to the public, and therefore require comprehensive safety precautions. Possession of licensed quantities are maintained by USNA licensee's and overseen by the RSC.

Machine source - Electrically operated sources of ionizing radiation (as described in the RAD-010). Machine sources contain no radioactive material, and can be disabled by removing the power source when not in operation.

NRC - Nuclear Regulatory Commission

Naval Radiological Material Permit (NRMP) - A permit issued by external regulatory agencies (NRC/NAVSEADDET RASO) which dictates the quantities of radioactive material, and operational conditions for the safe use of radioactive materials. This document is maintained under the Superintendent and managed by the RSO.

Principle User - Refer to USNA Licensee

Public - USNA faculty, staff, students, visitors who are expected to receive less than 2 mrem/hr or 100 mrem/yr of radiation exposure.

Radiation Safety Officer (RSO) - Designated by USNA Superintendent, the RSO is responsible for the operation of the Radiation Affairs Safety Program (RASP), including maintaining regulatory compliance. The RSO is responsible for recommending or approving corrective actions, identifying radiation safety problems, initiating action, and ensuring compliance with regulations. The RSO is also responsible for assisting the Radiation Safety Committee in the performance of their duties.

Radiation Workers - Individuals who receive exposure to ionizing radiation in the course of their employment or duties and are identified as potentially able to receive an annual dose in excess of 100 mrem or be exposed at a rate greater than 2 mrem/hr. Normally, these individuals' routine duties require working directly with sources of ionizing radiation and have a significant potential for exposure. These individuals are required to receive radiation medical qualifications provided by the Naval Health Clinic (NHC). These individuals receive specialized training as part of a specific RASP.

Radiation Safety Committee (RSC) - The USNA Radiation Safety Program is directed by the Radiation Safety Committee (RSC) which reports through the E&W Director (USNA management representative). Membership of the RSC includes Authorized Users of the major types of use of radioactive material and ionizing radiation-generating devices (machine sources), along with a representative from USNA management. The RSC meets quarterly to discuss current and future radiological safety standards, and approve new USNA Licensees, Authorized Users, custodians, audit findings, radiological compliance, deficiencies, and day to day radiological safety program operations.

RAM - Radioactive material.

Surveillances - Continual or frequent monitoring and verification of the status of laboratory or equipment operations and the analysis of records to ensure that specified requirements are being fulfilled. Although similar in scope to the definition of audit, surveillances can be more casual and unscheduled in nature. A surveillance may be as simple as a sporadic observation of the operation of a licensable quantity of RAM or machine source. Surveillances can be performed by the RSO/ARSO/RSC membership/USNA licensee or any USNA party with vested interest in maintaining radiation safety.

Survey - An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation (machine sources). When appropriate, such an evaluation includes a physical survey of the location of radioactive material/machine source and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present. An

official radiological safety audit can be performed by the RSO/ARSO or any USNA party qualified by the RSO in performing a safety survey.

USNA Licensee - USNA Licensees are faculty and staff who have submitted a radiation use license application and have been approved as a licensee by the RSC. USNA Licensees are considered the custodian and the principle user or lab/facility manager. Licensees may request additional Authorized Users to operate under their RSC approved license. The Licensee will only be permitted to operate under the conditions of operational instructions approved by the RSC. Any modifications of operations require RSO/RSC approval prior to commencement. All non-compliance issues will be addressed directly by the Licensee/custodian of the source.

Audit Program Guides for RSO and RSC

1. Quarterly Naval Radioactive Material Permit Compliance Audit Guide.

a. EXPIRATION DATE: NRMP ITEM 5

(1) Has the permit expired?

(2) If the permit has expired, is there a "Timely Filed" letter from RASO?

b. RADIOACTIVE MATERIAL LISTING: NRMP ITEMS 6 through 8

(1) Do the lists of radioactive material in Items 6-8 of the permits accurately reflect the licensable radioactive materials that are actually possessed?

(2) Examine safe inventories and conduct a search for licensable RAM which does not appear on the permit by cross-referencing safe inventories with current permit, Table 3 of RAD-010, and 10 CFR 30.71 Schedule B.

c. AUTHORIZED USE: NRMP ITEM 9

(1) Are all radioactive materials being used for the purposes stated in the permits?

d. AUTHORIZED LOCATIONS: NRMP ITEM 11

(1) Are all radioactive materials being used in locations allowed by the permits?

e. AUTHORIZED USERS: NRMP ITEM 12

(1) Are the RSO and the ARSO designated in writing?

(2) Do the RSO and ARSO have designated in writing, direct access to the CO on matters dealing with radiation safety.

(3) Have the RSO and ARSO completed the RSO course, S-4J-0016, or been approved by the Navy RSC as having equivalent training and experience?

(4) Are all radioactive materials stored and used or under the supervision of only the listed personnel.

(5) Does the user list accurately reflect current faculty - i.e. have any of the people listed transferred?

f. LEAK CHECKS: NRMP ITEM 13

(1) Are leak checks conducted as required?

(2) Are records of leak checks maintained for five years?

(3) Are results in units of microcuries?

g. TRANSPORTATION: NRMP ITEM 14

(1) Are shipments of RAM conducted in accordance with the specified NRC and DOD instructions and DOT regulations?

h. SEALED SOURCE INTEGRITY: NRMP ITEM 15

(1) Have any of the sealed sources been opened or sources removed from the source holder?

i. INVENTORY: NRMP ITEM 16

(1) Is a physical inventory conducted every six months?

(2) Are inventory records kept for five years?

j. DOCUMENTATION: NRMP ITEM 17

(1) Is a copy of the NRMP application along with submitted procedures and information maintained on file with the NRMP?

(2) Are all NRMP amendments on file with the NRMP?

(3) Are all the submitted procedures and information on file with the NRMP?

(4) Are current copies of the listed instructions and regulations maintained?

(5) Are the operating and emergency procedures in use the same as those in the NRMP on file?

2. Quarterly Audit Guide for Radiation Control Procedures and Practices.

a. General RADCON procedures and practices.

(1) Supervisors of ionizing radiation programs.

(a) Prepared operating and emergency procedures to ensure compliance with all directives prior to the start of operations involving x-ray devices or licensed RAM?

(2) Radiation workers.

(a) Wear required dosimetry devices?

(b) Promptly report any lost or damaged TLDs? (Inspect for lost or damaged TLDs.)

(c) Observe ALARA?

(d) Is Superintendent's approval required before allowing rad workers to exceed 500 mrem/year?

(e) Do Radiation Workers wear a pocket dosimeter without a BUMED approved thermo-luminescent dosimeter?

(3) Radiation medical examinations.

(a) Do personnel who routinely work with unsealed sources greater than specified limits have Radiation Medical Examinations?

(4) Radiation exposure to the unborn child.

(a) Have all reasonable efforts been made to keep exposure to the unborn child to the lowest practical level?

(5) Postings

(a) Does each space with licensed material have the following postings?

1. A notice which identifies a responsible individual by name to be notified and the location where procedures and regulations concerning 10 CFR 21 can be examined.

2. NRC Form 3 [10 CFR 19]

b. Radioactive material (Exempt items are still subject to the pertinent radiation control provisions in this manual).

(1) Inventory

(a) Do supervisors maintain a current inventory of all radiation sources including location?

(b) Do supervisors ensure all radiation sources are secured against loss or unauthorized use?

(c) Does the RSO maintain an inventory of all RAM authorized by NRMP, all radioactive commodities and all RASP machine sources of ionizing radiation?

1 For RAM, does the inventory list source ID number, radioisotope, chemical and physical form, activity, date of activity determination, location and custodian.

2 For radiation producing machines, does the inventory list machine description, model, serial number, maximum energy (kVp) and filament current (mA) or radiation output, location and custodian?

(d) Are inventories conducted annually?

(e) Are inventories of RAM under NRMP 19-00161-B1NP inventoried every six months?

(2) Are security and fire department personnel provided:

(a) A list of locations of RAM annually and when locations change permanently?

(b) A list of locations of RAM where radiation exposure, contamination or airborne exposure may be produced as a result of fire?

(c) Advanced notification of locations of high radiation areas not under direct supervision of an authorized individual?

(3) Are non-exempt quantities of RAM:

(a) Stored in restricted areas?

1. Access limited to the RSO and designated individuals?

2. Stored in office spaces, food storage areas, or berthing areas?

(d) If in an unrestricted area, under the constant surveillance and immediate control of the RSO or designated individual?

(e) Labeled in accordance with 10 CFR 20; does each container of licensed material bear a durable, clearly visible label containing the information required in 10 CFR 20: Tri-blade, "CAUTION, RADIOACTIVE MATERIAL," or "DANGER, RADIOACTIVE MATERIAL," and sufficient information to permit individuals handling or using the containers, or working in the vicinity thereof, to take precautions to avoid or minimize exposure (information such as radionuclide present, quantity and date of radioactivity, radiation levels, kinds of materials and mass enrichment)?

(4) Are exempt quantities of RAM:

(a) Stored in office spaces, food storage areas, or berthing areas?

(b) Labeled 10 CFR 20: Does each container of exempt material bear a durable, clearly visible label containing the information required in 10 CFR 20; Tri-blade, "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL"?

(5) Does each area or room containing permitted material or general licensed material in use or storage (in amounts exceeding 10 times the Appendix C quantities) posted with a "Caution - Radioactive Materials or Danger - Radioactive Materials" sign? (Exceptions listed in 10 CFR 20.1903) (10 CFR 20.1902)

(6) Leak Testing

(a) Have all sealed sources containing more than 100 μ Ci of beta-gamma emitting material been leak tested in the last six months? Exceptions:

1. H-3 or other gaseous isotopes

2. Radioactive isotopes with half-life less than 30 days

(b) Have all sealed sources containing more than 10 μCi of alpha emitting material been leak tested in the last three months?

(c) Is the leak test capable of measuring 0.005 μCi of radioactivity?

(d) If a leak test equals or exceeds 0.005 μCi of radioactivity, are the proper actions taken?

(e) Are the results recorded in units of μCi ?

(7) Is all radioactive source usage recorded in a log?

(8) Purchasing RAM or machines.

(a) Is approval of the RSO obtained prior to procurement of RAM that contains exempt or licensable quantities of Radioactive materials.

(b) Is approval of the RSO obtained prior to procurement of machines that produce ionizing radiation?

(c) Are supply procedures implemented to ensure RSO approval of procurement of any item containing RAM or any radiation producing machines?

(9) Contracts and contractors.

(a) Do contracts require compliance with NAVSEA S0420-AA-RAD-010 (RAD-010)?

(b) Do contracts require the contractor to provide a copy of their NRC License or Agreement State License or certificate of registration, if required?

(c) For Agreement State Licenses, do contracts require the contractor to provide written notification to the NRC Regional Office by 10 CFR 150?

(10) Nuclear Materials Report for Californium

(a) Does USNA possess more than 0.5 micrograms of Cf-252?

(b) If USNA possesses more than 0.5 micrograms of Cf-252, then USNA must submit a quarterly Nuclear Materials Report, DOE/NRC Form 741 at the end of each quarter.

(c) If currently required, has the Subcritical Reactor Laboratory Director submitted the most recent quarterly statement?

(d) Has a record of the Nuclear Materials Report been maintained?

c. RADCON procedures and practices associated with enclosed beam X-ray diffractometers.

(1) Operators.

(a) Compare the list of qualified operators with the Utilization Log. Are only trained operators allowed to operate the Diffractometer?

(2) Standard Operating Procedures. (SOPs)

(a) Are the SOPs used to operate the Diffractometer approved?

(b) Are any Non-Standard or Manufacturer's Operating Procedures used to operate the Diffractometer in writing and approved by the RSO?

(c) Do the SOPs include sample insertion and manipulation, equipment alignment and maintenance?

(d) After adding a new accessory, were procedures reviewed and a survey conducted by the RSO prior to operation?

(e) Is a properly operating IM-231 or other appropriate RADIAC available during operation?

(3) Radiation surveys.

(a) Examine surveys, are radiation levels less than or equal to 0.25 mR/hr?

(b) Are the surveys taken at 5 centimeters from surface?

(c) Are radiation surveys conducted semi-annually?

(d) Are radiation surveys conducted prior to each use?

(4) Warning devices

(a) Is a fail-safe warning light or device labeled "X-RAYS ON" or other similar words located near any switch that energizes the x-ray tube?

(b) Is a fail-safe light or indicator located near the radiation source housing indicate when the x-ray tube is on?

(c) Is a label with the conventional radiation symbol and the words "CAUTION: THIS EQUIPMENT PRODUCES X-RAYS WHEN ENERGIZED-TO BE OPERATED ONLY BY QUALIFIED PERSONNEL" or similar words attached near any switch which energizes an x-ray tube?

(5) Switches and keys

(a) Is there a key-operated power switch which will prevent the production of x-rays when in the "off" position? (A "key" can also be considered password protection)

(b) Are the "on" and "off" positions of the key-operated power switch clearly marked?

(c) Is the key only removable in the "off" position?

(d) Does the Laboratory Manager maintain custody of the power switch key?

(6) Interlocks

(a) Does each x-ray tube-housing equipped with an interlock that shuts off the tube if it is removed from the radiation source housing or if the housing is disassembled?

(b) Is the sample chamber closure interlocked so that no x-ray beam can enter the sample chamber while it is open unless the interlock has been overridden?

(c) Are the interlocks of a fail-safe design?

(d) Was written approval obtained from the RSO prior to safety devices or interlocks being bypassed?

(e) Was such approval for a specific period of time?

(f) When a safety device or interlock was bypassed, was a sign with "SAFETY DEVICE INOPERATIVE" or similar words placed on the housing?

(7) Maintenance

(a) If a procedure may result in increasing the exposure rate in an area, were temporary barriers and warning signs erected and surveys conducted until normal operation was restored? (Look at survey sheets)

(b) After any reassembly following maintenance, was the x-ray system checked by the RSO?

(c) Are Manufacturer's or special alignment procedures used to operate the Diffractometer approved in writing by the RSO?

(d) Was the RSO notified whenever alignment or repair operation was undertaken?

(e) Does the RSO maintain custody of the Interlock Bypass Keys?

(f) Has the Laboratory Manager authorized any repair or alignment of the equipment?

(8) Postings.

(a) Is the room posted with the radiation symbol and a CAUTION XRAY EQUIPMENT sign?

d. 5SDH Pelletron Accelerator

(1) Security

(a) Are doors to the accelerator room locked whenever the room is unattended?

(b) Is the accelerator charging chain motor enabled by a keyed switch?

(c) Is the accelerator charging chain motor key removed and secured when the accelerator is not operating?

(2) Warning devices

(a) Does the accelerator room and entrances equipped with lighted warning signs?

(b) Are their two lamps of each color on each sign?

(c) Is an explanation of the warning sign posted on each door?

(d) Are entrances to the accelerator room posted with warning signs bearing a radiation symbol and "CAUTION: RESTRICTED AREA"?

(e) Is the accelerator control console posted with a sign bearing radiation symbol and words: "CAUTION: RADIATION. THIS EQUIPMENT PRODUCES RADIATION WHEN ENERGIZED. TO BE OPERATED ONLY BY QUALIFIED PERSONNEL."?

(f) Are movable signs and rope barriers available to mark any radiation areas?

(3) Operation

(a) Is the accelerator operated by only qualified operators?

(b) Is a qualified operator always present in the accelerator room when the accelerator charging chain is running?

(c) Is the charging chain turned off and key removed whenever the accelerator is not attended?

(d) Is the accelerator operated such that the radiation level at all accessible locations in the accelerator room is below 2 mR/hr at all times?

(e) Are targets or samples whose major constituents include Li^7 , Be^9 or B^{11} prohibited unless approved by RSO and properly monitored?

(f) Is a copy of the operating procedures posted at the accelerator console?

(g) Are the Instruction Manuals for the 5SDH Pelletron Accelerator, its ion sources and the RBS vacuum controller kept in the accelerator room?

(h) Is a copy of the shutdown procedures posted at the accelerator console?

(i) Is a list of Qualified Operators posted near the accelerator control console?

(4) Radiation monitoring

(a) Does each operator and frequent user of the accelerator issued a TLD?

(b) Is a gamma ray monitor located near the terminal of the 5SDH accelerator and the control console?

(c) Are the gamma ray monitors part of the warning and interlock system?

(d) Is the operation and calibration of the gamma monitors tested at least every six months?

(5) Radiation warning and interlock system.

(a) Is the warning and interlock systems tested every six months or whenever maintenance has been performed?

e. Sub-critical nuclear reactor

(1) Are personnel dosimetry requirements followed as stated in the NRMPs?

(a) Pocket dosimeters not worn alone.

(b) Required personnel issued TLDs.

1. If working full time in Rx, neutron generator, or accelerator labs.

2. If working in radiation areas or in areas where the personnel can be reasonably expected to receive higher than the allowable dose to members of the general public.

(c) Environmental/area monitoring TLDs posted.

(2) Are gamma and neutron surveys done semi-annually or when posted TLDs indicate a significant increase in average background radiation levels?

(3) Are swipe surveys for beta, gamma and alpha done semi-annually around the reactor?

(a) Does any swipe measure greater than or equal to 185 Bq [0.005 microcuries]/100 cm² beta-gamma or detectable alpha? If so, was the area decontaminated to acceptable levels?

(b) Are radiation and swipe surveys reviewed by RSO?

(4) Are current copies of required documents posted or a notice posted describing the document and stating where it may be examined? (10 CFR

19.11) Documents should include NRMPs, 10 CFR 19, 20 and applicable operating procedures.

(5) Are the following posted?

(a) Form NRC-3 (10 CFR 19.11)

(b) A notice that identifies a responsible person by name to be notified in the event of an emergency.

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(6) During operations, is each radiation area posted with signs as described in 10 CFR 20.203b? (Tri-foil and "CAUTION - RADIATION AREA")

f. Neutron Generators (NG)

(1) Operation

(a) Have all personnel who operate or maintain the NG received training on the NG?

(b) Is a copy of the standard operating procedures posted near the control console?

(c) Is the control panel equipped with a removable key operated power switch?

(d) Are operations permitted when shields are removed or access doors open?

(e) Is RSO approval obtained prior to non-standard accessories being installed or operated?

(f) Is the RSO notified and operations suspended when any unusual operating conditions or deficiencies are noted?

(g) Is the power switch key removed when the NG is not in use?

(2) Labeling and Marking

(a) Is a permanently fixed warning sign with the standard radiation symbol and label with "CAUTION - RADIATION AREA WHEN LIGHT FLASHING" or similar words attached?

(3) Surveys

(a) Are surveys performed after installing new units, after maintenance or repair, after shock or suspected deficiency, when major beam alignment is in progress, or when the NG is modified?

(4) Interlocks

(a) Are safety interlocks tested under actual use conditions?

(b) Are safety devices inspected every six months when in operation?

g. Scanning Electron Microscope (SEM)

(1) Operation

(a) Are all personnel who operate or maintain the SEM adequately trained on the SEM?

(b) Is a copy of the standard operating procedures posted near the control console?

(c) Is the control panel equipped with a removable key operated power switch?

(d) Are operations permitted when shields are removed or cabinet doors open?

(e) Is RSO approval obtained prior to non-standard accessories being installed or operated?

(f) Is the RSO notified and operations suspended when any unusual operating conditions or deficiencies are noted?

(g) Is the software control program secured when SEM not in use?

(2) Labeling and marking

(a) Are all meters, lights, indicators and user controls clearly labeled?

(b) Is a permanently fixed warning sign with the standard radiation symbol and label with "CAUTION - PRODUCES X-RAYS WHEN ON" or similar words attached?

(3) Surveys

(a) Are surveys performed after installing new units, after maintenance or repair, after shock or suspected deficiency, when major beam alignment is in progress, or when the SEM is modified?

(4) Interlocks

(a) Are safety interlocks tested under actual use conditions?

(b) Are safety devices inspected every six months when in operation?

h. Unsealed Radiochemistry laboratory

(1) Operations

(a) Are all laboratory personnel using licensable quantities of radioactive materials specified as Authorized Users on the NRMP?

(b) Do all personnel who utilize radioactive have the proper level of training?

(c) Is a copy of the standard operating procedures readily available?

(d) Are all radioactive materials used in the lab listed on the permit, proper form and within permit limits?

(e) Is appropriate personal protective equipment (gloves, lab coats, etc.) readily available and used when radioisotope work is conducted?

(f) Is an appropriate RADIAC available?

(g) Is appropriate laboratory apparatus available, properly labeled and used for radioisotope work?

(h) Are absorbent paper and trays used for radioisotope work?

(i) Are work surfaces made of impervious materials?

(j) Are radiation levels in unrestricted areas below 2 mR/hr and complying with concepts of ALARA?

(k) Is proper shielding available and used properly?

(l) Is there evidence of food consumption or application of cosmetics in the laboratory area?

(m) Do personnel routinely monitor themselves for contamination?

(n) Are radioisotope use areas kept free of unnecessary equipment and materials?

(o) Is laboratory equipment within the radioactive use area labeled?

(2) Labeling and Marking

(a) Are all radioisotope work areas, including disposal sinks, properly identified and labeled?

(b) Are all containers properly labeled with "Caution Radioactive Material" and other information (isotope, activity, initials, date, etc.)?

(c) Are all waste containers properly labeled?

(3) Waste Management

(a) Are radioactive wastes properly segregated according to physical characteristic and half-life?

(b) Is radioactive waste being held for proper disposal through the RASO disposal program?

(c) Are sanitary sewer discharge records properly maintain and within disposal limits?

(d) Are there any protocols that could result in discharges to the environment?

(4) Records and Surveys.

(a) Are radioactive material accountability records maintained and readily available for review?

(b) Are Monthly Contamination Survey Forms completed at the required interval and records maintained?

(c) Are Radioactive Waste Disposal Form records maintained?

(d) Are Radioisotope Utilization Form records maintained?

(e) Have there been any incidents/spills since the last audit?

3. Semi-Annual Records and Reports Audit Guide

a. General Requirements for Surveys (RAD-010 2.6.10.4)

(1) Dose rate levels and contamination levels, as applicable

(2) Airborne radioactivity level (if Applicable)

(3) Date and time of survey

(4) Instruments used by type and serial number

(5) Calibration date of each instrument used

(6) Name of surveyor

(7) Date of review by and signature of RSO

b. Radiation Protection Surveys

(1) Subcritical Reactor Laboratory

(a) Gamma and neutron - semi-annually

(b) Swipes around reactor - semi-annually

(c) Surveys following a configuration change

(d) Surveys required when working with material activated by the reactor or when working with any other RAM that has been introduced to the laboratory.

(2) Bruker X-Ray Diffractometer

(a) Area surveys every 6 months and after equipment repair or modification.

(b) Quick scan radiation surveys prior to operation.

(3) Philips X-Ray Diffractometer

(a) Area surveys every 6 months and after equipment repair or modification.

(b) Quick scan radiation surveys prior to operation.

(4) 5SDH Pelletron Accelerator

(a) Quick scan daily when used.

(b) Complete survey every 6 months or after maintenance.

(c) Interlock System checked every 6 months when in operation.

(5) Scanning Electron Microscope

(a) Every 6 months, retained 3 years.

(b) Situational surveys when required, retained indefinitely.

(c) All survey measurements that are taken with voltage and beam current for highest output.

(d) Surveys include viewing column area, high voltage power supply, lens column, penetrations into the column, control console and electron beam target area.

(e) Are measurements taken at 5 cm from external surfaces?

c. Audits and inspections

(1) Corrective actions tracked to completion.

(2) Final review of adequacy of corrective actions for inspections.

(3) Records maintained for at least 3 years.

d. RADIAC maintenance and calibration records.

e. Inspections of safety devices

(1) 5SDH Pelletron Accelerator

(a) Operation of gamma monitors every 6 months

(b) Operation of neutron monitors every 6 months

(c) Operation of interlock system

(d) Are semi-annual inspections of safety devices retained for three years?

f. Other records

(1) 5SDH Pelletron Accelerator

(a) Utilization Log

1. Are comments included of interlock shutdowns and indications of hazardous conditions?

2. Are comments made if radiation levels exceed 2 mR/hr on an irradiated target?

(b) Area Radiation Monitors Test Log

(c) Warning and Interlock System Test Log

g. Reports and records of overexposures, accidents, significant incidents and occupational radiation exposure and personnel dosimeter records.

h. Radiation medical examinations and medical records

i. Sealed source leak check results

j. Records of receipt, transfer and inventory of RAM

k. Utilization logs for radioactive sources and X-ray machines

l. Training and qualification records of personnel using ionizing radiation sources.

m. Records and reports required by NRMP.

4. Semi-Annual Receipt, Transfer and Disposal of Radioactive Material Audit Guide.

a. If expecting to receive a package containing quantities of radioactive material in excess of a Type A quantity, see 10 CFR 20.1906, shall make arrangement to receive:

(1) The package when the carrier offers it for delivery

(2) Notification of the arrival of the package at the carrier's terminal and to take possession of the package expeditiously or receive package from approved interim storage area. [10 CFR 20.1906(a)]

b. Monitor the external surfaces of a labeled 3a package for radiation levels unless the package contains quantities of radioactive material that are less than or equal to the Type A quantity. (Note: 3a package labeled with a Radioactive White I, Yellow II, or Yellow III label, 49 CFR 172.403 and 172.436-440.) [10 CFR 20.1906(b)(2)]

c. Monitor the external surfaces of a labeled 3a package for radioactive contamination unless the package contains only radioactive material in the form of a gas or in special form. [10 CFR 20.1906(b)(1)]

d. Monitor all packages known to contain radioactive material for radioactive contamination and radiation levels if there is evidence of degradation of package integrity, such as packages that are crushed, wet, or damaged. [10 CFR 20.1906(b)(3)]

e. Were the external surfaces of the packages monitored for external radiation and contamination near the designated receiving or inspection area?

f. Perform the monitoring required as soon as practical after receipt of the package, but not later than 3 hours after the package is received at the facility if it is received during the normal working hours, or not later than 3 hours from the beginning of the next working day if it is received after working hours. [10 CFR 20.1906(c)]

g. Immediately notify the final delivery carrier and, by telephone and telegram, mailgram, or facsimile, the Administrator of the appropriate NRC Regional Office listed in 10 CFR 20 appendix D when:

(1) Removable radioactive surface contamination exceeds the limits of 10 CFR 71.87(i)

(2) External radiation levels exceed the limits of 10 CFR 71.47.

h. Section 2.8.12 Records (maintained for three years from the date the material is accepted by the carrier).

(1) Verification that the receiving activity is licensed to receive the material.

(2) Copy of documentation identifying the radioactive material.

(3) Copy of the Bill of Lading or manifest for the shipment.

(4) Copy of the acknowledgment of receipt of the material.

(5) Copy of leak test within last 6 months (if applicable)

5. Quarterly Transportation Audit Guide.

a. Procedures (49 CFR 173)

(1) Packages meet classification requirements (excepted or Type A quantities).

(2) Packaging meets General Requirements as listed on checklist and in 49 CFR.

(3) Marking is durable and includes name and address of either consignee or consignor (or both), United Nations Number, and if gross mass exceeds 50 kg.

- (4) Labeling for Type A packages meets requirements.
- (5) Surveys conducted per requirements and for labeling.
- (6) Checklist completed for each shipment per this instruction.

b. RAD-010 Section 2.8.12 Records (maintained for three years from the date the material is accepted by the carrier).

(1) Verification that the receiving activity is licensed to receive the material.

- (2) Copy of documentation identifying the radioactive material.
- (3) Copy of the Bill of Lading or manifest for the shipment.
- (4) Copy of the acknowledgment of receipt of the material.
- (5) Copy of leak test within last 6 months (if applicable)

c. Personnel (49 CFR 172.702 and .704)

(1) Are all USNA personnel involved with transportation trained as HAZMAT employees?

(2) Does the HAZMAT training include general awareness/familiarization which includes?

(a) Recognition and identification of hazardous material?

(3) Does HAZMAT training include safety and function-specific training?

(a) Emergency response information?

(b) Measures to protect the employee from hazards, specifically measures to protect from exposure?

(c) Methods and procedures for avoiding accidents.

(4) Are HAZMAT employees trained within 90 days after employment or change in job function?

(5) Are individuals certifying class 7 HAZMAT authorized in writing by Commanding Officer?