

Radiation Safety Plan

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I. INTRODUCTION

The Nuclear Regulatory Commission (NRC) has published specific policies and procedures applicable to radioisotope usage in the Code of Federal Regulations 10 CFR Parts 0 to 199. The Commonwealth of Virginia (Commonwealth) via the Virginia Department of Health issues a regulatory publication entitled, "Radiation Protection Regulations." In order to comply with 12VAC5-480 as applicable to VIMS/SMS, this Radiation Safety Plan has been established for personnel, students, or visitors using radioisotopes on the VIMS/SMS campus or aboard research vessels.

This program sets forth policies, procedures, equipment, and work practices that when properly implemented, support the goal of safe and secure use of radioisotopes according to the guidelines established by the Commonwealth and NRC.

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A. Scope

This program covers all employees, students, contractors, and visitors who may become directly or indirectly involved with or exposed to any radioactive material (RAM). These activities may include, but are not limited to, the receipt, packaging, storage, transport, use, disposal, and emergency response involving RAM and any materials or substances which may have been exposed to or contaminated with RAM.

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B. Responsibilities

1. Dean/Director

The Dean/Director has overall responsibility for the safe and secure use of RAM at VIMS/SMS and exercises this responsibility through the campus Radiation Safety Officer.

2. Next Level Supervisors

The Associate Dean of Research and Advisory Services, Associate Dean of the School of Marine Science, Department Chairs, and Principal Investigators of radioisotope research laboratories are responsible for supporting the execution of this program within the scope of their respective duties. It should be noted that although Laboratory Supervisors/Managers may be responsible for the day to day supervision of RAM in radioisotope research laboratories, the Principal Investigator(s) are expected to actively oversee and supervise the use of RAM within their respective laboratories. All Principal Investigators with laboratories conducting research using radioisotopes must have adequate training and experience and should be named in Section 12 of VIMS/SMS's state and federal licensure.

3. Radiation Safety Officer (RSO)

The RSO is appointed by the Dean/Director and must be specified on the VIMS/SMS state and federal licenses. The RSO is charged with the execution and oversight of this program to include the following specific actions:

Prepare and maintain currency of the VIMS/SMS Radiation Safety Program. Annually review program content and implementation.

Approve valid Purchase Order Requests for RAM to support research/education at VIMS/SMS.

Maintain Commonwealth and NRC RAM Licenses and prepare/submit all requests for amendments as required.

Maintain inventory of radioisotopes in use at VIMS/SMS based on input from researchers, to insure license type and quantities are not exceeded.

Maintain RAM waste management, storage, and disposal program and arrange for the proper handling and shipment of RAM waste during disposal operations.

Maintain required records and reports to ensure compliance with Commonwealth and NRC regulations.

Offer a class consisting of lecture, demonstration, and written examination which is sufficient to qualify personnel in the use of RAM within the parameters and constraints established by federal and state licensure.

Conduct unannounced inspections of RAM research laboratories as often as deemed necessary. Notify Principal Investigator(s) of respective laboratories regarding results of inspections and any corrective actions required. Conduct follow-up inspections to assure that corrective actions have been accomplished and initiate Disciplinary Action if required.

Develop/implement procedures for routine and emergency operations involving RAM.

Conduct investigations of accidents and incidents involving RAM and issue necessary reports.

Conduct annual audit of the Radiation Safety Program and implement corrective action as required. Determine if and initiate Disciplinary Action as required.

Perform other duties as required by the Commonwealth or NRC and this program to promote the safe and secure use of RAM on the VIMS/SMS campus or aboard VIMS/SMS research vessels.

4. Senior Authorized Researcher (SAR)

SAR personnel will act in the temporary absence of, or in assistance to, the RSO in the execution of this program. A SAR shall be designated by the RSO to carry on typical daily duties normally performed by the RSO should (s)he be off campus and unavailable. These duties may include authorization of Purchase Orders for RAM, response to and clean-up of a spill of RAM, or the receipt of RAM shipped via

commercial means. Should the RSO be absent it will be the duty of the Chief Operations Officer to designate a SAR if required.

5. Radiation Safety Committee

A Radiation Safety Committee will be designated by the Dean/Director. The Committee will consist of a Chairman and members from the research community. The Committee will meet at the call of the Chairman or RSO. The Committee will provide overall guidance and support to the VIMS/SMS community as necessary to support the safe and secure use of RAM. Furthermore, members may be called upon to act in the absence of or assist as necessary, the RSO in the performance of duties necessary to insure the proper use, disposal, and emergency response to incidents involving RAM.

6. Laboratory Supervisors/Managers

Laboratory Supervisors/Managers who work in radioisotope research labs should be qualified to work with and have had previous experience with RAM. These personnel may be called upon by laboratory researchers to provide guidance and assistance during research evolutions as well as act in first response to radiological accidents. Furthermore, Lab Supervisors/Managers are often required to submit radioisotope inventory, waste, and shipment/receipt information for the respective laboratory.

7. Radioisotope Researchers/Students

All researchers/students must complete a formal course of instruction prior to using RAM at VIMS/SMS. A Radiation Safety Class is offered at periodically at VIMS/SMS at no cost to VIMS/SMS employees/students. Similar classes from other universities or research institutes as well as practical experience gained using radioisotopes in research settings may well satisfy the above requirement. To obtain credit for classes and past experience submit appropriate documentation to the RSO for review. This information may be presented to the Radiation Safety Committee for additional review prior to a decision being made. A signatory Compliance Statement in regard to the content and understanding of the VIMS/SMS Radiation Safety Plan will be required of all Principal Investigators, staff, and students using radioisotopes for research (Appendix A).

8. Personnel Frequenting Radioisotope Research Labs Not Qualified to Conduct Research with Radioisotopes

Personnel, students, or volunteers who frequent and or perform non-radioisotope research in a portion of a designated radioisotope research lab must attend a short Radioactive Material Awareness class conducted by the RSO on a periodic basis. Requests for the class shall be forwarded to the RSO in the Office of Safety and Environmental Programs.

In regard to special circumstances such as Governor's School students or mentor programs in which the participants are Minors, a Statement of Permission form (Appendix B), is required in addition to attending a Radioactive Material Awareness class. The Statement of Permission form must be completed and signed by the parent or legal guardian of the Minor and submitted to the RSO.

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II. PROCEDURES

A. General RAM Safety Precautions

Safety, personal hygiene, and general operating procedures in a radioisotope research lab are similar to those practiced in any laboratory in which hazardous materials are used for research. Therefore, sections of the VIMS/SMS Chemical Hygiene Plan pertaining to general safety principles, housekeeping, maintenance, and laboratory facilities should be reviewed by all users and where appropriate, integrated into radioisotope safety procedures.

Equipment used with RAM shall be kept separate from other equipment and appropriately labeled. Once used with RAM, equipment shall not be used for non-radioactive work unless appropriate safety and protective methods are employed. Furthermore, equipment used in RAM research shall not be disposed of as nonradioactive material until it has been determined to be free of radioactive contamination. Appropriate survey methods and documentation are required and the

removal or defacing of all radioactive symbols or labels is required. Typically, the release of RAM research equipment as nonradioactive shall be conducted or supervised by the RSO. A storage cabinet or drawers shall be labeled for the storage of glassware and tools used in RAM research.

Each laboratory conducting research with radioisotopes may acquire and maintain a hand-held radiation/contamination survey instrument for use by personnel of that lab. This instrument shall be calibrated at least annually for the radioisotopes used within the respective labs and a calibration label affixed to the instrument for inspection. Where a survey instrument is ineffective due to use of low energy or low specific activity isotopes (ex. H-3), area and equipment wipe surveys shall be performed and analyzed using liquid scintillation instrumentation. In laboratories which use moderate to high energy beta emitters and/or gamma emitters, a hand-held contamination survey instrument shall be available.

Personal protective equipment (PPE) shall be employed by all personnel working with or handling RAM. As a minimum, lab coats and double gloves shall be worn while conducting research with RAM. The type of gloves worn shall be compatible with the chemicals being used by the researcher. Should question arise in regard to suitable gloves consult a glove compatibility table, contact the glove manufacturer, or contact the RSO.

Safety glasses or goggles shall be worn when a risk of splash to the eyes exists or when conducting research evolutions that may result in a bursting container or explosive force. Consider all aspects of the experimental protocol and when in doubt wear protective eyewear!

Lab coats worn while conducting research using RAM shall be used only in the respective RAM laboratory or while transporting RAM between approved locations. When not in use, lab coats shall be maintained within the confines of the RAM research lab. Lab coats shall be hung individually on a coat hook or hangers. Lab coats shall not be hung one on top of another such that the outer surface of one coat contacts the inner surface of another.

When lab coats become soiled from general use they should be bagged and taken to Room 113 in the Facilities Management Building for laundering in machines designated for that purpose. Each laboratory should provide necessary detergents and bleach for this purpose as well as elect an individual to launder the collective number of lab coats. If a lab coat is known to be contaminated with RAM, notify the RSO for special handling and laundering procedures. Do not take lab coats home for laundering in personal machines.

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B. Requests for Approval of Projects Requiring the Use of Radioisotopes or Designation of a New Radioisotope Research Laboratory

The RSO, in consultation with the Radiation Safety Committee, will evaluate the radiological safety aspects of all proposed activities using RAM. Therefore, each researcher shall present, in writing, a copy of the proposed experimental activity in which the radioisotope will be used. As a minimum, this request shall include all items contained on the Request for Radioisotope Approval and Use (RRAU) form (Appendix C). This form is provided as an outline and additional information should be attached as enclosures when necessary to thoroughly describe the anticipated project. All requests must be forwarded and approved by the appropriate Principal Investigator who also must be named on the federal and state RAM license. Approval of a project is contingent upon the availability of adequate laboratory facilities, safety equipment, qualifications of the researcher, a waste minimization plan, and adequate waste disposal capability. Each request should then be forwarded to the RSO a minimum of thirty days prior to the submission of a grant proposal or the initiation of a new experimental protocol. Furthermore, should the radioisotope of interest not be currently listed on the VIMS/SMS licensure or the amount requested exceed the licenses limits an amendment to the licenses may be required. Amendments may require a two to six-month period for review and approval/disapproval by state and regulatory agencies.

C. Procurement of Radioactive Material

1. Purchase Orders

All purchase orders for RAM must be submitted through the RSO or a designated SAR who is authorized to act in the RSO's absence. This submittal process is mandatory and the request should provide pertinent information including the Purchase Order number, the quantity of RAM being purchased, and an authorization signature by the Principal Investigator or Department Head. The RSO is responsible for maintaining the campus inventory of RAM and Purchasing Agents shall not process a Purchase Order or request for RAM without first having the approval of the RSO affixed to the order.

2. Receipt of RAM

All RAM must be picked up from the Shipping and Receiving Department by qualified personnel who have received adequate training in the handling and storage of RAM. Packages containing RAM must be picked up and inspected within 3 hours of delivery to VIMS/SMS and it is the responsibility of the researcher who placed the order to be present on campus to receive the shipment or designate an alternate qualified individual.

3. Inspection and Documentation of RAM Packages

Each package shall be visually inspected for damage to outer shipping container and signs of a possible contamination event including crushed, wet, or moist condition of the packaging. Should these conditions exist the package shall not be removed from the Shipping and Receiving Department. Immediately notify the RSO or the designated alternate and secure the area.

If visual inspection indicates a satisfactory package, remove the package to the appropriate RAM research lab prior to opening and inspecting package contents. Obtain a copy of the RAM Receipt/Inspection Report (Appendix D), which must be completed and the original forwarded to the RSO. The lab shall maintain a copy of the completed form for its records as well. Place the package on a designated RAM work surface and don appropriate PPE, as a minimum a lab coat and disposable gloves.

Perform a radiation survey 1 meter from and at the surface of the package. Should the 1-meter reading exceed 10 m^r/hr. or the surface reading exceed 200 m^r/hr., stop the procedure immediately, secure the package, and notify the RSO or the designated alternate. Furthermore, if the RAM that you ordered is not of sufficient energy or specific activity to yield a surface radiation reading, but an indication above natural background radiation is present on the survey meter, notify the RSO immediately.

Perform a wipe survey on the outer container prior to opening. Open the outer container, following the manufacturer's instructions if supplied and remove the packing slip. Perform wipe survey on the inner container and open to verify contents. Perform wipe survey on inner final source container. Conduct appropriate counting procedure of wipes and record results. Should contamination levels equal or exceed three times background levels notify the RSO or designated alternate prior to using the RAM.

Monitor any packing materials for radiation and contamination to determine proper disposal action. If surveys indicate radiation/contamination then the packing material must be disposed of as RAM waste. If surveys indicate background radiation/contamination levels, document the results, remove and or totally deface any symbols or labels indicating RAM, and dispose of in regular trash. Submit a RAM Receipt/Inspection Report with a copy of the original Purchase Order, to the RSO within 48 hours.

4. Storage of RAM

All RAM must be stored in an approved, secure storage area to prevent access to material by unauthorized personnel. RAM storage areas, including but not limited to, cabinets, drawers, and refrigerator/freezers must be properly labeled with the appropriate RAM hazard warning sign and located in areas not generally accessible to unauthorized personnel. In addition, all RAM stock and stock solutions must be secured from unauthorized use or removal by a lock and key type mechanism or under the constant surveillance of a person qualified to use, handle, and store RAM. A Radioisotope Inventory Control form (Appendix E), will be supplied for use to all RAM research labs for posting at or near the RAM storage area. The information requested on this sheet shall be completed by the researcher for each type and quantity of RAM maintained for research. As RAM is used for research or disposed of as waste, the

appropriate column of the form shall be filled in, thus keeping a running inventory of each radioisotope maintained by the research lab. These Control forms shall be maintained as part of the permanent records of each RAM research lab.

Radiation levels must not exceed 200.0 mr/hr. on the surface of any RAM container and shall not exceed 0.6 mr/hr. constant in the nearest occupied area.

RAM which may result in the emission of radioactive gas or vapors should be stored in gas tight containers and kept in areas with satisfactory ventilation such as a fume hood.

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D. General Safety Rules for RAM Researchers

A copy of the General Safety Rules for RAM Researchers (Appendix F), shall be posted in a conspicuous location in labs where radioisotopes are used or stored. All RAM researchers should become familiar with these and other rules, regulations, and notices posted within all RAM research labs.

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E. Emergency Procedures

A copy of Emergency Procedures (Appendix G), shall be posted with other pertinent rules regulations, and notices in RAM research labs. These procedures serve as a general guideline should there be an accident involving radioactive material.

As a first response to an accident involving RAM a simple procedure represented by the acronym SWIM is helpful in gaining control of the situation and in minimizing further consequences. SWIM represents the following:

S Stop the spill. Upright container if involved and lay adsorbent paper over spill area. Prevent spill from running into floor drains, sumps, or outside of lab to other adjoining locations. **Take necessary precautions to prevent contaminating yourself (ex. Don gloves, lab coat, and safety eyewear) before becoming involved.**

W Warn other personnel to stay out of the area. Call the RSO or the designated alternate. If unable to locate, call the front desk of Watermen's Hall and have the RSO located.

I Isolate the area. Prevent other personnel from entering the area without warning by closing doors, erecting a simple barrier, or by posting a guard. Do not allow persons who were in the vicinity of the spill to exit the area without first being cleared by the RSO.

M Minimize exposure. This may be accomplished by methods as simple as moving a sufficient distance from the RAM or by placing a shield of sufficient material (ex. door), between you and the source to attenuate the radiation.

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F. Occupational Exposure to Ionizing Radiation

Individuals receiving occupational exposure to ionizing radiation are subject to the limits published in 12 VAC5-480 as applicable. This publication is available for review in the Office of Safety and Environmental Programs. No individual is permitted to receive Occupational Exposure on an annual basis in excess of the following established limits. An annual limit, which is the more limiting of:

A total effective dose equivalent equal to 5.0 Rem (0.05 Sv); or

A sum of the deep dose equivalent and a committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 Rem (0.5 Sv).

The annual limits to the lens of the eye, skin, and to the extremities, which are:

- An eye dose equivalent to the lens of the eye of 15 Rem (0.15 Sv)
- A shallow dose equivalent of 50 Rem (0.5 Sv) to the skin or to any extremity.

However, the type and quantity of RAM used at VIMS/SMS is unlikely to result in an exposure approaching the above annual limits. Therefore, an exposure level of 10% of the above limits will be established at VIMS/SMS in an effort to maintain personnel exposures to "as low as reasonably achievable" (ALARA).

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G. RAM Survey Methods and Requirements

As RAM is not detectable by human sense organs, survey methods using appropriate detection methods and equipment for the radioisotope(s) of concern are the primary method of insuring that RAM is not spread beyond properly controlled research and storage areas. The basic methods of detection at VIMS/SMS include wipe surveys as well as scan and static surveys using hand held instruments to detect the presence of RAM. As with any method of detection there are limiting factors in regard to sensitivity and accuracy. It is the responsibility of the person performing the survey to employ the correct method for the radioisotope(s) in question.

In regard to the frequency and type of survey procedures the following guidelines shall be observed and serve as minimum criteria:

- A wipe and or scan survey shall be performed of the general work area and any potentially contaminated objects or surfaces at the completion of an experimental evolution with RAM. Furthermore, if the procedure is not complete by day's end, the researcher shall perform the appropriate survey and analysis prior to leaving campus for the day.
- Wipe surveys shall be conducted with filter paper, parafilm discs, or similar materials having a surface area of one square inch. Wipes should be conducted over 100 centimeters squared and results listed as disintegrations per minute per 100 centimeters squared (dpm/100 cm.sq.).

- All active RAM laboratories and locations where RAM is stored shall be surveyed monthly as a minimum.
- Areas, surfaces, or objects shall be surveyed in the event of a known or suspected contaminating event and/or a spill of RAM.
- In laboratories where high energy beta or gamma emitters are in use, surveys with a radiation survey meter capable of detecting 0.1 mr/hr. are required.

Records of surveys shall be generated and maintained in laboratory notebooks for a minimum period of three (3) years. An example Survey Report form is included in this text (Appendix H). Laboratories are encouraged to use this survey report.

In keeping with ALARA principles, surface and object contamination levels are to be kept "as low as reasonably achievable" to minimize the spread of contamination.

If a survey of an object or surface equals or exceeds three times the background level counted for that series of samples, the object or surface shall be decontaminated and resurveyed. Notify the RSO or the Office of Safety and Environmental Programs upon discovery and give a detailed account of situation. The RSO may elect to assist in the decontamination and resurvey or allow you to proceed depending upon circumstances. Records must be maintained of wipe results and action taken and the responsible Principal Investigator notified of the event.

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H. RAM Inventory Procedures and Records

A current, complete, and accurate inventory of all RAM shall be maintained by each Principal Investigator using radioisotopes. This is a MANDATORY REQUIREMENT and failure to comply may result in disciplinary action. A Radioisotope Inventory Control sheet (Appendix E), shall be maintained current for each radioisotope present in the laboratory. This form, which identifies all RAM by Type and Form as well as by Purchase Order Number will assist the RSO in ready identification of amounts and type of RAM on hand in a laboratory at any given time. This form will also assist the

laboratory in fulfilling the biannual radioisotope inventory requirement. Units of activity of RAM shall be maintained in microcuries (uCi).

The biannual radioisotope inventory is a report submitted to the RSO to ensure that current license limits for RAM are not exceeded. The RSO will notify the research community approximately 30 days in advance of the due date for this report. In an effort to standardize reporting methods the form Radioisotope Inventory Report to RSO (Appendix I), shall be the required format for all inventory submittals. It is not necessary to account for decay of short-lived isotopes since RAM inventory is kept by purchase order and specific isotope. The RSO will account for radioactive decay of short half-life RAM as necessary. The units of activity shall be maintained in microcuries (uCi).

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I. Laboratory Security

Licensed RAM in an unrestricted area must be secured at all times against unauthorized removal. An unrestricted area is defined as any area to which access is not controlled by the user for purposes of protection of individuals from exposure to radiation and radioactive material. Licensed materials in an unrestricted area and not in secure storage shall be tended under the constant surveillance and immediate control of the user.

The current method of securing RAM at VIMS/SMS is the installation and use of automatic cipher locks on access doors to RAM research laboratories. Cipher locks may be used alone or in conjunction with normal key locks in place on most doors. If the lab is to be left unmanned then all RAM stock and solutions shall be secured by lock and key within a cabinet or refrigerator/freezer in addition to securing all entry doors.

To ensure compliance with this critical requirement, the RSO will make unannounced visits to labs on a random basis to ensure proper security measures are maintained. Violations will be noted and appropriate supervisory personnel notified. Security violations may result in disciplinary action up to and including the removal of all radioactive material from the laboratory and suspension of privileges to conduct research with RAM for the responsible party/laboratory.

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J. Radioactive Waste Management

The generation of radioactive waste shall be minimized by all reasonable methods in the laboratory in an effort to reduce subsequent disposal costs and impact on the environment. Radioactive waste may generally be categorized as solid, liquid, or mixed waste. Mixed waste, which consists of radioactive and hazardous (reactive, toxic, corrosive or ignitable) components, is difficult to dispose of and very costly. At present there are some mixed wastes for which no disposal option exists. The production of mixed wastes during experimental procedures shall be avoided if at all possible. The type and potential quantities of radioactive waste that may be generated is a major point of consideration when new experimental protocols requiring radioisotopes are reviewed by the Radiation Safety Committee. Therefore, prior to submission of grant proposals which require the use of radioisotopes for research, it would be prudent to submit a detailed list of the potential quantities and types of waste anticipated to ensure that a disposal avenue exists and that the future request for RAM will be viewed favorably.

Radioactive waste shall be segregated in regard to isotope, if possible, to facilitate monitoring, processing, and disposal. Specific attention shall be paid to isotopes having extreme differences in their respective half-lives. Currently VIMS/SMS is authorized to store for decay those radioisotopes with a half-life of 120 days or less, thereby reducing the cost of disposal for those types of waste. For example, Sulfur-35 waste with a half-life of 87.2 days should not be mixed with Carbon-14 waste having a half-life of 5,730 years.

Radioactive material or waste shall not be disposed of by personnel other than the RSO and/or an individual designated by the RSO. Radioactive waste typically is picked up one day each week by the RSO or assistant. To have waste picked up, notify the RSO and it will be removed during the next regular pick-up. Waste will not be removed however, unless the appropriate Request for Disposal of Radioactive Waste form (Appendix K), is complete and signed. This form should be forwarded by campus mail or delivered to the RSO prior to the scheduled pickup date. The waste must also be in the proper container as well as labeled correctly.

1. RAM Waste Containment

Each laboratory using RAM for research is required to have a minimum of one plastic foot operated solid waste receptacle labeled with a Caution Radioactive Material sign on the top. Furthermore, a yellow and black RAM label, furnished by the RSO, shall also be attached to the waste container with the appropriate identifying information complete.

Solid waste shall be segregated with paper, plastic, latex gloves, and similar material maintained in one waste receptacle and glass and metal in another. This will allow the combustible materials to be incinerated and minimize the quantity of material sent to a landfill. Waste receptacles shall be lined with a clear durable plastic bag resistant to tearing and punctures. When the bag is full it shall be twisted securely at the top and taped closed with strong durable tape. Liquids of any type or quantity are not allowed for disposal as solid waste.

Specialty type solid wastes such as sediment, animal or animal parts, and "Sharps" (needles, surgical blades, etc.) shall be maintained and handled in specific types and size containers. For information in regard to type and size of containers contact the RSO.

Liquid radioactive waste shall be maintained in strong plastic jugs or carboys if possible. Each carboy or jug shall be placed on a tray lined with adsorbent paper should there be spillage and or a small leak. Maximum volume for pickup and disposal is 20 liters per container.

Glass jugs are allowed for liquid RAM waste if maintained in a secondary container sufficient to contain the maximum quantity of disposed liquid. Furthermore, multiple glass jugs or containers shall be separated by shock absorbing material sufficient to prevent accidental breakage by contact between adjoining containers. Maximum capacity for individual glass containers shall be 4.0 liters.

2. Marking and Labeling of RAM

All radioactive waste shall be properly labeled with the appropriate RAM tag and pertinent information complete. RAM waste should be isolated with respect to location from normal laboratory waste in an effort to minimize the possibility of housekeeping inadvertently collecting it for disposal. The Office of Safety and Environmental Programs will supply the appropriate labels to each laboratory upon request and prior to pick-up.

To ensure waste pickup, fill the tag out completely including: isotope, date, specific or total activity, mass/volume, and medium/matrix. The identification number requested is to aid in tracking quantity and disposal of RAM waste. Assign an ID number that is traceable to your respective laboratory.

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K. Equipment Calibration

RAM survey instruments must be calibrated on an annual basis as a minimum or whenever the instrument is damaged and repaired. The instrument should be calibrated for all the radioisotopes commonly used by the respective laboratory that are within the detection capacity of the instrument. The efficiencies of the instrument for each radioisotope should be requested from the calibration laboratory as they are required for subsequent calculations. The instrument manufacturer usually operates a calibration laboratory, for additional information on calibration labs contact the RSO.

O. Temporary Deactivation of a RAM Research Laboratory

A RAM Research Laboratory may be deactivated if in the opinion of the respective PI and RSO there does not appear a need to conduct RAM research in the laboratory for the upcoming year as a minimum. If the laboratory does not have pending grants, contracts or individual research requiring the use of RAM for the upcoming year a memorandum of understanding (MOU) shall be drawn up between the RSO and the PI addressing the necessary specifics required to inactivate the laboratory while meeting the pertinent RAM regulatory requirements.

To initiate a temporary deactivation of a RAM Research Laboratory the RSO shall remove all stock and waste radioactive material from the laboratory, as well as, all equipment that is internally contaminated and store it in a facility under the RSO's purview. A minimum amount of RAM exposed glass ware, hand tools and assorted equipment may be stored under the RSO's control dependent upon storage capacity of the RSO's facilities. The RSO's RAM inventory must reflect the addition of the RAM removed from the lab and the inventory of the PI of the laboratory must reflect the removal of all RAM from his or her respective inventory. The RSO must conduct a through radiation and contamination survey of the respective laboratory to insure there is no residual radiation or contamination in excess of the general background radiation and contamination anticipated for the specific building in which the laboratory is located.

To reactivate a RAM laboratory the RSO will require 30 days advanced notification from the PI and all personnel who will perform research with RAM must meet all current requirements of the Institute, Commonwealth, and Federal government. RAM inventories and equipment transfers from the RSO back to the lab of the previous materials and equipment will be required as well.

P. Bioassay

Typically, VIMS/SMS does not use types or quantities of RAM that require bioassay. Certain radioisotopes such as Iodine-125 and 131 in unbound forms, Phosphorus-32 and Tritium may require bioassay under certain conditions. A summary of these conditions and additional information as required are available from the RSO.

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Q. RAM Aboard VIMS/SMS Research Vessels

The use of RAM aboard VIMS/SMS research vessels is authorized in waters under the jurisdiction of the Commonwealth. However, the use of RAM aboard vessels presents a number of potential problems not associated with a dedicated laboratory space occupied solely by a Principal Investigator and staff. A major concern, other than basic protective measures one employs to minimize exposures and perform their research activities within established rules and regulations, is that of researchers who are interested in environmental levels of natural and artificial radionuclides. These personnel, who often use research vessels to deploy equipment, are interested in levels of radioactivity at or close to zero values measured by state-of-the-art equipment. Thus, their research is extremely sensitive to levels of radioactive material far below those of concern from a public health or regulatory perspective. For this reason, and in the interest of maintaining a minimum number of vessels upon which RAM research has been conducted, the following requirements have been established:

1. If you require a research vessel upon which experiments with radioisotopes will be conducted, note this on your original Request for Radioisotope Approval and Use form (Appendix C).
2. Determine the approximate size of vessel, on board equipment necessary, and services required to conduct your experiments and note this on the form. Field Operations should be consulted to determine if a research vessel that has been used previously for RAM research is available that will fulfill your requirements. If a suitable

vessel is identified submit the vessel name or otherwise indicate no suitable vessel was identified.

3. The quantities of RAM required on vessels must be justified as the minimum amount necessary to perform the research.

4. Consult RSO with regard to required precautions and procedures for loading and unloading RAM to and from research vessels. **Transportation of RAM on public highways by research personnel is prohibited.** Furthermore, **no disposal of RAM is Permitted Overboard.**

5. Proper monitoring of personnel and surfaces is required by researchers. Wipe surveys shall be conducted in and around surfaces exposed to RAM. If the RAM is of sufficient energy to be detectable by hand held survey instruments, scan surveys shall be conducted in addition to wipe surveys. Prompt survey documentation and submittal to the RSO is required. If objects, surfaces, or personnel are found to be contaminated notify the RSO immediately. Decontamination and resurveys are the responsibility of the researcher at the discretion of the RSO.

6. Researchers are responsible for supplying consumable supplies such as adsorbent workbench paper, protective clothing, waste containers, decontamination supplies, and appropriate tags and labels.

7. Spill control/containment equipment shall be supplied and carried on board by the researcher that is sufficient to contain and clean up that quantity of RAM being used. Should a spill occur, the researcher shall initiate a prompt cleanup and shall notify the RSO as soon as possible. After the initial cleanup, a detailed survey and documentation is required and the RSO notified of the results.

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R. Disciplinary Action Procedures

The procedures listed below are applicable to anyone using RAM at VIMS/SMS, as well as to anyone who misuses or otherwise mishandles RAM within the confines of the VIMS/SMS campus and or on VIMS/SMS research vessels.

1. *Verbal Reprimand* - A verbal reprimand may be issued for minor violations of rules within the VIMS/SMS Radiation Safety Plan or for minor infractions involving state or federal regulations for which the consequences are minimal and easily rectified. If a verbal reprimand is issued during a laboratory inspection the circumstances may be recorded on the inspection form. An example of a situation in which a verbal reprimand could be issued is failure to document a required survey in the laboratory notebook although it had been performed.

2. *Written Reprimand* - A written reprimand is issued for violations or omissions of a more serious nature and or for repeat violations of minor rules or regulations after which, when discovered, a verbal reprimand had been issued. A written reprimand will be sent to the person who caused a violation to occur as well as a copy sent to the respective supervisor or Primary Investigator, the Departmental Chairman, and the Associate Dean of Research and Advisory Services. A copy of the reprimand will be maintained in the individual's file in the Radiation Safety Office. An example of a circumstance in which a written reprimand would be issued is failure to secure a RAM laboratory door when no other qualified researcher is present and after exiting the lab.

3. *Suspension of RAM Privileges* - A suspension of RAM privileges would be issued for repeated violations of minor rules or regulations for which a verbal or written reprimand had been issued. Furthermore, if an initial violation is of serious consequence, a suspension of privileges may be invoked. Again, this will be documented and forwarded to the involved party as well as to supervisor or Primary Investigator, Departmental Chairman, and to the Associate Dean of Research and Advisory Services. A suspension of privileges is at the discretion of the RSO and or may be discussed and acted upon after consultation by the RSO with the Radiation Safety Committee and/or the Associate Dean of Research and Advisory Services. The minimum period of suspension of privileges is one week. Furthermore, violations may require reporting to the Commonwealth or NRC and may be subject to legal recourse.

An example of a violation of this nature might be the unauthorized disposal of RAM by a researcher or student.

The inclusion of Disciplinary Action Procedures in this plan has been deemed necessary by the Radiation Safety Committee and the RSO to make RAM researchers, students, and staff aware of potential consequences involved when RAM is misused or when rules and regulations are violated. These potential disciplinary actions are not indicative of a change in attitude or relationship by the RSO or the Radiation Safety Committee toward any individual(s) or laboratory. A cooperative effort between the RSO, the Radiation Safety Committee, and personnel using RAM continues to be the most beneficial and productive avenue.

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S. Radiation Safety Plan Review and Update

Review and update of this plan will be undertaken periodically as deemed necessary by the RSO. Emergency changes may be published and incorporated by the RSO as an addendum until such time that a revision may be undertaken.

Suggestions and proposed draft inputs from VIMS/SMS personnel are welcome at any time. The Dean/Director maintains overall responsibility for the safe and secure use of RAM at VIMS/SMS and exercises this responsibility through the RSO.

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III. LIST OF APPENDICES

- A. VIMS/SMS Radiation Safety Compliance Statement
- B. Statement of Permission for Minors to Participate in Research in RAM Research Labs

- C. Request for Radioisotope Approval and Use
- D. Radioactive Material Receipt/Inspection Report
- E. Radioisotope Inventory Control
- F. General Safety Rules for RAM Researchers
- G. Emergency Procedures
- H. Radioactive Material Survey Report
- I. Radioisotope Inventory Report To RSO
- J. Request for Disposal of Radioactive Waste

Appendix A

VIMS/SMS RADIATION SAFETY COMPLIANCE STATEMENT

Office of Safety and Environmental Programs

This statement is to attest to the fact that I have read and am familiar with the VIMS/SMS Radiation Safety Plan and that I am aware of my responsibilities in regard to the proper receipt, storage, use, and disposal of radioactive material. Furthermore, I am aware that these responsibilities extend beyond the VIMS/SMS campus proper to include research performed while aboard VIMS/SMS research vessels.

_____Signature _____Date

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Appendix B

**STATEMENT OF PERMISSION BY PARENT OR LEGAL GUARDIAN TO ALLOW
THE UNDERSIGNED MINOR TO PARTICIPATE IN RESEARCH ACTIVITY
WITHIN A RADIOISOTOPE RESEARCH LAB ON VIMS/SMS CAMPUS**

The Virginia Institute of Marine Science/School of Marine Science maintains a number of restricted laboratories for the purpose of research using low level radioactive material. Often only a portion of the laboratory is actually involved in research with radioactive material (RAM) and thus other types of research may be conducted within the confines of the particular laboratory. The Office of Safety and Environmental Programs through the Radiation Safety Officer is charged with maintaining RAM research laboratories in compliance with rules and regulations established by the Commonwealth and U.S. Nuclear Regulatory Commission. As part of this effort and with the understanding that many individuals maintain a concern in regard to RAM, the Office of Safety and Environmental Programs has developed a Radioactive Material Awareness Class for individuals who may perform research activity within a restricted laboratory but who do not actually use RAM. This class, in addition to the signature of the parent or legal guardian, is required to allow the minor named below to participate in research, enrichment, or mentor programs which require access to RAM research laboratories.

Name of Individual Requesting Access to RAM Laboratories:

Please Print _____

Signature of Parent or Legal Guardian and Date:

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Appendix C

VIRGINIA INSTITUTE OF MARINE SCIENCE SCHOOL OF MARINE SCIENCE

REQUEST FOR RADIOISOTOPE APPROVAL AND USE

Name of Researcher(s):

Training and Experience with Radioisotopes: (Describe type of training, duration of courses attended, date, and location. Furnish copy of certificates issued. Describe

experience, type and duration of experiments conducted and names and quantities of radioisotopes used.)

Date(s) during which Proposed Experiment will be conducted and Location of Laboratory:

Type, Form, and Quantity of Radioisotope(s) Requested:

_____ (If experiment to be conducted in phases, state amount of radioisotope required for each phase and totals)

Description of Experimental Protocol: (Attach copy of protocol or additional pages as required) _____

Safety and Monitoring Procedures: Describe overall safety/security measures and lab monitoring/survey techniques to be employed. Furnish a copy of lab survey/wipe test form with a sketch of work areas and equipment locations to be surveyed.

Quantity and Types of Waste Anticipated: (Estimate quantity of solid and liquid waste to be generated and list the constituents of each. Are mixed hazardous/radioactive

wastes anticipated and give details.)

Is a VIMS/SMS Research Vessel required upon which work with radioactive material will be performed? _____ (State approximate size of vessel and crew required as well as any equipment required as part of the vessel.)

Any Additional Information Pertinent to Above Request:

Principal Investigator's Approval: (Signature required)

Radiation Safety Officer (Signature required)

Approval and Date: _____

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Appendix D

VIMS/SMS RADIOACTIVE MATERIAL RECEIPT/INSPECTION REPORT

1. Purchase Order # _____ Date: _____ Time:

2. Condition of Package: Package Complete/Undamaged _____ Package Damaged

3. If Damaged, Describe Condition:

4. Radioisotope(s) Ordered: _____ Quantity and Radioactivity

5. Chemical Form of Radioisotope(s):

6. Exterior Radiation Levels of Package:

A. Contact Reading on Package Surface _____ mr/Hr.

B. 1 Meter from Package Surface _____ mr/Hr.

7. Does Packing Slip and Contents of Package Agree: Yes _____ No _____

8. If Packing Slip and Contents Disagree Explain:

9. Wipe Survey Results in DPM:

A. Outer package _____ B. Inner package _____ C. Source package

10. Disposition of packages after Inspection and Surveys: A. Normal Laboratory Trash

B. Radioactive Solid Waste _____

11. Final Storage/Use Location of Radioactive Material:

A. Building Name _____ B. Room Number _____ Other Location _____

12. Signature of Person Completing Report:

NOTE: If Package is Severely Damaged, Contents leaking, Contents Not as Ordered, or Radiation/Contamination significantly above background levels, notify RSO or the Office of Safety & Environmental Programs **immediately!**

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Appendix E

RADIOISOTOPE INVENTORY CONTROL

glasses, goggles, or a face shield shall be worn if a risk of splash to the eyes exists or when a bursting container or explosive force may result from research activity.

2. Film Badges and Ring Badges may be required when using high energy Beta emitters such as P-32 and/or when Gamma emitting radioisotopes are in use. Consult with the RSO in regard to specific requirements.

3. Personnel using or handling RAM shall perform periodic surveys of hands and body if the radioisotope in use is detectable by hand held radiation/contamination instrumentation. Suitable instruments should be present in each laboratory.

4. Contamination surveys of work area shall be performed upon completion of research activity for the day. A Scan or Wipe Survey depending upon the radioisotope being used is sufficient. **Document Your Results in Appropriate Units!**

5. Upon completion of work and surveys for RAM, remove PPE and Wash Hands.

6. Eating, Drinking, Handling Contact Lens or Applying Cosmetics is Prohibited in RAM Labs.

7. All work with RAM in research laboratories shall be performed over disposable bench top adsorbent paper or removable plastic/metal trays. Work areas shall be Clearly Labeled with Caution Radioactive Material signs or tape.

8. Acrylic plastic or Lead shielding may be required for work with some RAM, Consult the RSO.

9. ALL Containers of RAM, including those with RAM Waste, shall be Labeled with a Caution Radioactive Material Label. Information Required on the Label include: Lab ID Number, Date, Type, and Activity of RAM, User or Lab, Mass or Volume, and Medium or Matrix.

10. All RAM Waste shall be Deposited in Appropriate Containers with Required Labeled Information. Solid Waste shall be segregated into Paper and Plastic as well as Glass and Metal. Liquid Waste shall be contained in plastic carboys or glass jugs

depending on quantities. Consult VIMS/SMS Radiation Safety Plan for specifics regarding RAM Waste.

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Appendix G

EMERGENCY PROCEDURES (SWIM TECHNIQUE)

SPILLS OF RADIOACTIVE MATERIAL

1. **STOP THE SPILL:** Upright the Container, Shut Off Valves, Lay Down Adsorbent Paper, or Dike Area around the Spill with Adsorbent Pads or Pillows. Prevent Spill from Running into Floor Drains, Sumps, or Under Doors to Adjoining Locations. **(Take Precautions to Prevent Contaminating Yourself Prior to Getting Involved in Spill)**
2. **WARN OTHERS:** Warn other personnel of a Spill of RAM. Call the RSO or the Office of Safety and Environmental Programs (Pager Number Posted on Telephones).
3. **ISOLATE AREA:** Prevent other personnel from entering the area without warning by closing doors, erecting a simple barrier, or by posting a guard. Warn personnel who were in the vicinity of the spill not to exit the area without being cleared by the RSO and/or having performed a scan or wipe survey of possible affected areas with suitable results. **(Do Not Perform a Wipe Survey of Exposed Skin!)** If in Doubt, Wait in an Area Nearby until the RSO or a Health and Safety Officer arrives to assist you.
4. **MINIMIZE YOUR EXPOSURE:** Minimize radiation exposure as required by the specific radioisotope in use by moving a sufficient distance from the RAM or by placing a shield between you and the Spill. Doors and walls are good typical shields. Be sure to instruct other personnel in the area to minimize their exposure as well.

SPECIAL CIRCUMSTANCES

In the case of a minor contamination event (ex. a hand), wash with mild soap and tepid water, and blot dry. Collect rinse water and survey skin or blotting towel. In the event of a major event the RSO will direct Decontamination procedures. **Inform RSO of All Contamination Events As Soon as Possible!**

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Appendix H

RADIOACTIVE MATERIAL SURVEY REPORT

Building-Room No: _____ **Surveyor:** _____ **Date:**

Provide a simple sketch of the area or object surveyed

Radioactive Material Used or Stored in Lab since
Last Survey: _____

Reason for Survey:

Monthly Routine

Ongoing Research

Instruments/Items

Suspect Contamination SPILL of RAM

Type of Survey:

Wipe Survey

Hand held Instrument

Wipe and Hand held

Detection Method:

Liquid Scintillation

GM Instrument

Other _____

Wipe Survey Results:

Wipes Not Performed :(Hand held Survey Sufficient)

All Wipes Are Less Than Action Level

Instrument Survey Results:

Not Required Instrument Readings are Less Than Action Level

(Note: Action Level is $\geq 3 \times$ Background)

The Following Equal or Exceed the Action Level: per 100 cm. squared for Wipes **OR** per Survey Point with Instrument. (Circle One)

Site # ____ Isotope ____ Activity ____ dpm; ... Site # ____ Isotope ____ Activity ____ dpm

Site # ____ Isotope ____ Activity ____ dpm; ... Site # ____ Isotope ____ Activity ____ dpm

Site # ____ Isotope ____ Activity ____ dpm; ... Site # ____ Isotope ____ Activity ____ dpm

Course of Action Due to Contamination Discovery During Surveys:

(check one)

Article or Item Disposed of as RAM Waste _____

Article or Item Labeled and Stored for Future RAM Use _____

Article or Item Decontaminated and Resurveyed: Results _____dpm or dpm/100 cm squared.

Radiation Safety Officer Notified: Date _____ Time _____

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REQUEST FOR DISPOSAL OF RADIOACTIVE WASTE

(Forward Request Form to RSO prior to Pick-up Date)

Originator:	Date:
Building & Lab No:	Phone #

IDENTIFICATION & DESCRIPTION OF WASTE

ID #	Radioisotope & Specific Activity (Ex. uCi/gram or uCi/ml)	Chemical Components (% of each) Use Chemical or Generic Name Do Not Abbreviate or Use Chemical Formula	Total Quantity and Mass in the Container	Size and Type of Container

Total Activity of Each Radioisotope:

Hazards

(Check All That Apply)

Explosive _____

Toxic _____

Flammable _____ Estimated Temp. of Ignition _____ Degrees F.

Corrosive _____ Analyzed pH _____

Oxidizer _____

Irritant _____ Skin _____ Eyes _____ Respiratory _____ (Check All That Apply)

Reactive _____ List Incompatible Substances _____

Other Hazards: _____

The Above RAM Waste is Properly Described and Labeled and Securely Packaged for Handling

Signature of Originator and Date of Signature

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Appendix K

REQUEST FOR RADIATION EXPOSURE HISTORY AND/OR VERIFICATION OF TRAINING & EXPERIENCE WITH RADIOACTIVE MATERIALS

(Please Type or Print Legibly)

Organization:

Previous Institution or Employer where Exposure or Training/Experience was Received

Address:

City: _____ State: _____ Zip: _____

Telephone #: _____

Attention: _____

Radiation Safety Officer/Principal Investigator/Supervisor (Indicate Title)

To Whom It May Concern: Please forward the following information in regard to the undersigned to the address indicated below. Place a check in appropriate space.

____ Radiation Exposure History

____ Verification that the Undersigned has received Radiation Safety Training appropriate for Independent Work with Radioactive Materials.

Information Requested Regarding:

Last Name _____ First Name _____ M.I. _____

Maiden or Other Last Names Known By

Social Security Number _____

Other Pertinent I.D.# _____

Please Send Request Information To: RSO; Office of Safety & Environmental Programs VIMS

P.O. Box 1346

Gloucester Point, VA 23062

Telephone: (804) 684-7152; Fax (804) 684-7142

Signature _____ Date _____

Signature of Requester

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Appendix L

DECLARATION OF PREGNANCY

TO: VIMS/SMS Radiation Safety Officer
Office of Safety & Environmental Programs

In accordance with Nuclear Regulatory Commission regulations at 10 CFR 20.1208, "Dose to an Embryo/Fetus," I am declaring that I am pregnant. I believe that I became pregnant in _____ (Month/Year).

I understand the Radiation Dose to my Embryo/Fetus during the entire pregnancy will not be allowed to exceed 0.5 Rem (5 millisievert) unless that Dose has already been exceeded between the time of conception and the submission of this document. I also understand that meeting the lower Dose Limit may require a change in my job or job responsibilities during the period of my pregnancy.

Signature

Printed Name

Date

Revised 12/2019

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