



RADIATION SAFETY PROGRAM

Prepared by

the

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RISK MANAGEMENT OFFICE

DEPARTMENT OF FINANCE

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Purpose

The purpose of the written Radiation Safety Program is to provide information and guidance regarding the safe handling and management of radioactive materials and waste at Gustavus Adolphus College. Actions described in this policy are intended to assure compliance with the State of Minnesota Radioactive Materials License held by the college. A copy of this license is attached as Appendix A.

General ALARA Guidelines

In practice, radiation doses should be *As Low As Reasonably Achievable* (ALARA). It is the responsibility of anyone working with radioactive materials to maintain ALARA exposures by minimizing time exposed, maximizing distance from the source, and utilizing adequate shielding materials when possible.

Radiation Safety Officer Duties (See Appendix B)

Licensed Authorized Users

Authorized users are listed in the Radioactive Materials License and are required to review and implement applicable Radiation Safety Program elements and Appendices A-J. This review will be documented and documentation sent to the Radiation Safety Officer.

Training for Individuals Working in or Frequenting Restricted Areas (Occupationally Exposed Individuals. See Appendix C)

All unlicensed, supervised individuals working with source material and students performing required experiments for a laboratory course under the supervision of an authorized user are required to complete radiation safety training and complete an exam. The completed exams are kept on file onsite. Training elements will include, but not limited to the following:

General Information on Radiation Safety

- Radiation vs. contamination
- Internal vs. external exposure
- Biological effects of radiation
- ALARA concept
- Use of time, distance, and shielding to minimize exposure
- Monitoring Exposure
- Types of survey meters
- Restricted Areas

Laboratory Safety and Safe Use of Radioisotopes (see Appendices G & H)

Control procedures for obtaining permission to use radioactive materials at the facility; give limitations on quantity to be handled per user, allowed per experiment, etc.

- Protective clothing, laboratory apparel, and equipment.
- Limitations and conditions relative to handling unsealed licensed material and what laboratory equipment to use when working with such material.
- Shielding or remote handling equipment to be used when beta and/or gamma emitting licensed materials are handled.

- Routine survey and monitoring procedures to be followed for contamination control.
- Where and how contaminated articles and glassware are to be handled and stored.
- Emergency procedures concerning spills, fires, release of material, and/or accidental contamination of personnel.
- Decontamination procedures to use and whom to contact in case of an emergency.
- Instructions concerning transfer of licensed materials between rooms, halls, or corridors.
- Requirements for storage, labeling of containers, and identification of areas where licensed materials are used.
- Personnel monitoring devices to use, where to obtain them, and exchange procedures and exposure results.
- Waste disposal procedures to follow, limitations for disposal of liquid or solid wastes, and procedures to use for waste storage.
- Records to be maintained on use and disposal of licensed materials.
- Prohibition of pipetting by mouth, eating, smoking, and drinking in areas where licensed materials are used.

Training Frequency

Training must occur under the following conditions:

- Before assuming duties with, or in the vicinity of, radioactive materials.
- Whenever there is a significant change in duties, regulations, or terms of the license.
- During semester coursework or research involving radioactive materials. Semester coursework and research involving radioactive materials may or may not occur annually.

Approved Locations for Radioactive Work

The following facilities at Gustavus Adolphus College are approved for the use of isotopes (see Appendix D):

Nobel Hall (NHS) 235: This facility is used for molecular biology research. The quantity of material to perform tracer studies is always less than 250 microcuries, usually less than 50 microcuries. This room contains a locked -70°C freezer used for isotope storage.

Olin Hall (OH) 11, 108, 109: Sealed sources and x-ray diffraction are used in Olin Hall. OH 11 is the storage vault for radioactive materials used in this building. OH 108 and 109 are labs for sealed sources and an X-ray Diffraction unit is used in 108.

Isotope Orders

When a licensed authorized user wishes to order radioactive materials, notification must be given to the Radiation Safety Officer (R.S.O). Once notification is made, the order will be placed by either the R.S.O or the requesting licensed authorized user. Quantities of material onsite must be verified prior to placing any orders to assure that license limits are not exceeded.

Package Receipt and Opening

Carriers are requested to deliver radioactive packages to an approved location to prevent commingling with regular mail. Upon delivery of the radioactive material, the R.S.O. and the requesting user will be notified and the outer package will be visually inspected for obvious signs of damage. If the outer package is significantly damaged, the entire room will be evacuated and response measures will be determined by the R.S.O and/or authorized user.

If the package appears to be intact, the R.S.O. or authorized user will monitor the package at the surface meter using a survey meter. Gloves and body protection (lab coat, apron, etc) will be worn during the exterior survey and the entire unpacking procedure. The survey results will be noted and retained onsite. If the package is demonstrated to be leaking by the initial package survey, all areas in the building on the pathway of the leading package will be cordoned off and the R.S.O. or approved user will immediately survey the area for the presence of radioactive material. Due to the amount of material most likely received, the majority of leaks and/or spills would be defined as minor. The delivery personnel will be notified that a leak had occurred during the time the package was in their possession. Cleanup will be performed by the R.S.O. or authorized user. Individuals responsible for the cleanup will wear gloves and body protection. Absorbent paper will be used to contain evident areas of a spill. Decontaminating detergents will be used to clean up contaminated regions. All contaminated clean-up materials (absorbent paper, gloves, etc.) will be placed in plastic bags and stored in the radioactive waste barrels. The decontaminated area and the clothes and shoes of the cleanup personnel will be monitored with a survey meter.

If the package is determined to have an uncontaminated exterior, the packing slip will be checked to ensure that the correct material was shipped. The exterior packing will be removed and the contents checked against the packing slip. Once the exterior packing is removed, moistened filter paper wipe tests on the inner containers will be completed and analyzed in the TRI-CARB 4910TR scintillation counter and the values compared with a background control filter. The material will then be stored in their appropriate storage location until used. All packing materials will be monitored with a survey meter.

Personnel Monitoring

It is not expected that experiments will lead to greater than 10% of the limits specified in MN Rule 4731.2020. Therefore, the use of personal dosimeters is not required. However, it is required that all personnel utilizing unsealed radioactive materials perform a post work survey of their hands and other potentially exposed body parts prior to leaving an approved area. If a declared pregnant woman is planning on conducting work with isotopes, notification must be made to the R.S.O. to determine if personal dosimeter monitoring is required per MN. Rule 4731.2210

Inventory and Contamination Surveys

When isotopes or waste (see below) are being stored in NHS 235, the storage areas will be checked for unauthorized removal of the isotopes and surveyed for possible contamination on a monthly basis. Surveys for leakage from the waste barrels in NHS 235 are conducted at the same time. Survey results will be recorded in an appropriate logbook. If hydrogen-3 is stored in NHS 235, the locked refrigerator and waste barrels are surveyed with a wipe test, the filters counted in the TRI-CARB 4910TR liquid scintillation counter, and the results recorded in an appropriate logbook. Surveys are not required when isotopes and/or decay-in-storage material is not present.

Sealed Sources

Olin Hall rooms 11, 108, and 109 will be surveyed for unauthorized removal of sealed sources and for possible contamination due to leakage. Surveys will be conducted with an appropriate survey meter and records will be kept onsite. The R.S.O. or authorized user conducts these surveys. Surveys are not required when licensed sources are not present. Counts of more than twice the background control will require a resurvey of the sources and the laboratory to ascertain

the integrity of the source. The R.S.O or approved user will complete the analysis. The results will be kept onsite.

X-ray Diffraction Source

Olin Hall room 108 will be surveyed upon initial startup and quarterly for contamination when the X-ray Diffraction Unit is in operation. Surveys will be conducted with an appropriate survey meter and records will be kept onsite. The R.S.O. or approved user conducts these surveys. Surveys are not required when the unit is not in service. The X-Ray unit is required to be registered with the Minnesota Department of Health annually until removed from site.

Wipe Testing

When inventory or waste (see below) is present, complete surveys are conducted by the R.S.O. or authorized user. Laboratory surveys in NHS235 will be completed using moistened filters. Ten or more points in NHS235 are checked in each survey. The filters are counted in the TRI-CARB 4910TR scintillation counter and the values compared with a background control filter. Any area showing activity of more than 50 counts above background levels must be cleared of radiation until it reaches this level. The surveys are conducted by the R.S.O. or approved users and the results are kept on site. Wipe testing is not required when isotopes and/or decay-in-storage materials are not present.

Users are to inform the R.S.O. when sealed sources are removed from storage. Leak testing will be performed on the sealed source in approved locations by the R.S.O. or authorized user in accordance with 4731.2360 and Appendix J. Leak testing will occur at the frequency specified by the manufacturer or if sources are in storage a leak test will occur at a minimum of once every three years. Moistened filter paper is used to wipe the exterior of the sources at two different positions. The filters are then counted in the TRI-CARB 4910TR scintillation counter in NHS 235. Counts of more than twice the background control will require a resurvey of the sources and the laboratory to ascertain the integrity of the source. The R.S.O or authorized user will complete the analysis and the conversion is 2.22 million cpm per microCurie. The results will be kept onsite. Wipe testing is not required when sealed sources are not in use (see Appendix J).

Instrument Calibration

The Bicon Surveyor 50 and Rados RAD-60R is calibrated annually by:
Ludlum Measurements, Inc.
P.O Box 810
Sweetwater, Texas 79556
(325) 235-5494

The RPI 9000-GM1 survey meter is calibrated annually by:

Research Products International Corp.
410 N. Business Center Drive
Mount Prospect, Illinois 60056-2190
(847) 635-1177

The Perkin-Elmer TRI-CARB 4910TR liquid scintillation counter is to be calibrated as required by the manufacturer.

Records Management

Records of receipt, use of materials, laboratory survey results and wipe results are to be kept onsite.

Waste Management

Off-site disposal of licensed radioactive material will be coordinated by the R.S.O. Users are expected to contact the R.S.O. when they do not have any more use for the isotope.

Phosphorous-32 and sulfur-35 are allowed to decay in storage (DIS) before being disposed of with other non-radioactive wastes. In addition to separating liquid and solid wastes, these wastes are separated by isotope and dated. Liquid waste is separated by isotope and stored in marked jars in NHS 235. Solid waste is separated by isotope, sealed in plastic bags, marked with the isotope and date, and stored in the waste barrels in NHS 235. Two Plexiglas containers are used to store the plastic bags containing solid waste and full jars of liquid waste. A log recording the isotope, form, estimated amount of the isotope, and the date in which the waste was placed in the barrel is kept in NHS 235. This log also contains room for recording the date of disposal and the survey results at the time of disposal.

All phosphorous-32 waste will be stored for a minimum of 143 days, and sulfur-35 waste for a minimum of 880 days: this is equal to 10 half-lives for each isotope. At the end of the minimum storage time, materials are removed from the storage barrels by the R.S.O. using usual precautions (lab coat, gloves, etc.). For solid waste, the exterior of the plastic bags containing waste are monitored with a survey meter, and if the material has decayed to background level, the contents of the bag are surveyed individually before disposal. The waste log described above contains the reading for the exterior of the bag, unless individual waste items are found to be above this level – these items are noted in the log, repackaged, and placed back into the barrel for further DIS. Liquid waste is sampled, surveyed by liquid scintillation, and the results compared to a background control sample. All surveys before disposal will take place in NHS 235. Any labels identifying the waste as radioactive are removed or obliterated before disposal.

Program Review

This program will be reviewed annually by the R.S.O. In addition, if there is ever a deficiency found by any authorized user or the R.S.O., corrections will be made when necessary (See Appendix E).

APPENDIX B

DUTIES AND RESPONSIBILITIES OF THE RADIATION SAFETY OFFICER (RSO)

The RSO's duties and responsibilities include ensuring radiological safety and compliance with MDH and DOT regulations and the conditions of the license. Typically, these duties and responsibilities include the following:

- Ensure that licensed material possessed by the licensee is limited to the types and quantities of radioactive material listed on the license.
- Maintain documentation that demonstrates that the dose to individual members of the public does not exceed the limit specified in 4731.2090.
- Ensure security of radioactive material.
- Posting of documents as required by 4731.1010.
- Ensure that licensed material is transported in accordance with applicable MDH and DOT requirements.
- Ensure that radiation exposures are ALARA.
- Oversee all activities involving radioactive material, including monitoring and surveys of all areas in which radioactive material is used.
- Act as liaison with MDH and other regulatory authorities.
- Provide necessary information on all aspects of radiation protection to personnel at all levels of responsibility and any other applicable regulations.
- Oversee proper delivery, receipt, and conduct of radiation surveys for all shipments of radioactive material arriving at or leaving from the institution, as well as packaging and labeling all radioactive material leaving the institution.
- Determine the need for personnel monitoring, distribute and collect personnel radiation monitoring devices, evaluate bioassays, monitor personnel radiation exposure and bioassay records for trends and high exposures, notify individuals and their supervisors of radiation exposures approaching the limits, and recommend appropriate remedial action.
- Conduct training programs and otherwise instruct personnel in the proper procedures for handling radioactive material prior to use, at periodic intervals (refresher training), and as required by changes in procedures, equipment, regulations, etc.
- Supervise and coordinate the radioactive waste disposal program, including effluent monitoring and recordkeeping on waste storage and disposal records.
- Oversee the storage of radioactive material not in current use, including waste.
- Perform or arrange for leak tests on all sealed sources and calibration of radiation survey instruments.
- Maintain an inventory of all radioisotopes possessed under the license and limit the quantity to the amounts authorized by the license.
- Immediately terminate any unsafe condition or activity that is found to be a threat to health and safety or property.

- Supervise decontamination and recovery operations.
- Maintain other records of receipts, transfers, and surveys as required.
- Hold periodic meetings with, and provide reports to, licensee management.
- Ensure that all users are properly trained.
- Perform periodic audits of the radiation safety program to ensure that the licensee is complying with all applicable MDH regulations and the terms and conditions of the license (e.g., leak tests, inventories, use limited to trained, approved users, etc.). The audits should also review the efforts to achieve occupational doses and doses to members of the public are ALARA. The audit should also verify that the required records are maintained.
- Ensure that the results of audits, identification of deficiencies, and recommendations for change are documented and maintained for at least three years and provided to management for review; ensure that prompt action is taken to correct deficiencies.
- Ensure that the audit results and corrective actions are communicated to all personnel who use licensed material.
- Ensure that all incidents, accidents, and personnel exposure to radiation in excess of ALARA or MDH limits are investigated and reported to MDH and other appropriate authorities, if required, within the required time limits.
- Maintain understanding of and up-to-date copies of MDH regulations, the license, revised licensee procedures, and ensure that the license is amended whenever there are changes in licensed activities, responsible individuals, or information or commitments provided to MDH during the licensing process.

APPENDIX C MODEL TRAINING PROGRAM

This Appendix is intended only as a guide for developing a training program. Individuals working with radioisotopes may not require training on every topic provided. For example, housekeeping staff may need to know only what symbols to look for, which waste cans to empty, or which areas to enter or avoid. Conversely, laboratory technicians may require detailed information on particular topics. As a result, instruction for some individuals may be provided via a simple handout, whereas others may require extensive training, including a written exam to assess retention of the topics presented.

Frequency of Training:

- Before assuming duties with, or in the vicinity of, radioactive materials
- Whenever there is a significant change in duties, regulations, or terms of the license
- During semester coursework or research involving radioactive materials. Semester coursework and research involving radioactive materials may or may not occur annually.

General Information

1) Radiation safety

- radiation vs. contamination
- internal vs. external exposure
- Biological effects of radiation
- ALARA concept
- use of time, distance, and shielding to minimize exposure

2) Regulatory issues:

- material control and accountability
- personnel dosimetry
- radiation safety program audits
- transfer and disposal
- record keeping
- surveys
- postings
- labeling of containers
- handling and reporting of incidents or events
- licensing and inspection by MDH
- need for complete and accurate information
- employee protection
- deliberate misconduct

3) Licensee-Specific Program Elements:

- Authorized users and supervised users
- Ordering and receiving radioisotopes
- Applicable regulations and license conditions
- Areas where radioactive material is used or stored
- Potential hazards associated with radioactive material in each area where the individuals will work
- Appropriate radiation safety procedures
- Licensee's in-house work rules
- Each individual's obligation to report unsafe conditions to the RSO
- Appropriate response to spills, emergencies or other unsafe conditions
- Worker's right to be informed of occupational radiation exposure and bioassay results, if applicable
- Locations where the licensee has posted or made available: notices, copies of pertinent regulations, and copies of pertinent licenses and license conditions (including applications and applicable correspondence), as required by 4731.1010.

- 4) Emergency procedures:
 - RSO name and telephone number
 - immediate steps to prevent or control spread of contamination
 - clean-up instructions, decontamination
- 5) Survey program:
 - survey instrument accessibility
 - who is responsible
 - types, contamination and area
 - frequency
 - levels of contamination
 - personnel, hands, shoes
 - records
- 6) Waste:
 - liquid
 - solids
 - storage
 - decay-in-storage
 - waste storage surveys
 - records
- 7) Dosimetry
 - whole body
 - extremities
 - dose assessment
 - bioassay procedures
 - records
- 8) Instrumentation
 - survey meters-use, calibration frequency, use of check sources
 - analytical instruments-gas chromatographs, liquid scintillation counters
- 9) Procedures for receiving packages containing radioactive materials
 - normal
 - off-duty
 - notification of user and RSO
 - security
 - exposure levels
 - possession limit
 - receipt of damaged packages
- 10) Procedures for opening and examining packages for leakage and contamination
 - monitoring packages
 - monitoring packing materials
 - gloves
 - transferring material to users
- 11) Sealed sources
 - leak test requirements
 - inventory requirements
 - exempt quantities
 - records

- 12) Other topics, as applicable
- 13) Question and answer period

Laboratory Safety and Use of Radioisotopes Training

Control procedures for obtaining permission to use radioactive materials at the facility; give limitations on quantity to be handled per user, allowed per experiment, etc.

- Protective clothing, laboratory apparel, and equipment.
- Limitations and conditions relative to handling unsealed licensed material and what laboratory equipment to use when working with such material. As an example, discuss which licensed materials and what procedures should be confined to radiochemical fume hoods or glove boxes. Explain what shielding or remote handling equipment is to be used when beta and/or gamma emitting licensed materials are handled.
- Routine survey and monitoring procedures to be followed for contamination control. Include where and how contaminated articles and glassware are to be handled and stored.
- Emergency procedures concerning spills, fires, release of material, and/or accidental contamination of personnel.
- Decontamination procedures to use and whom to contact in case of an emergency.
- Instructions concerning transfer of licensed materials between rooms, halls, or corridors, if applicable.
- Requirements for storage, labeling of containers, and identification of areas where licensed materials are used.
- Personnel monitoring devices to use, where to obtain them, and exchange procedures and exposure results.
- Waste disposal procedures to follow, limitations for disposal of liquid or solid wastes, and procedures to use for waste storage.
- Records to be maintained on use and disposal of licensed materials.
- Prohibition of pipetting by mouth, eating, smoking, and drinking in areas where licensed materials are used.

APPENDIX E AUDIT PROGRAM

An audit is conducted, in part, to fulfill the requirements for an annual review of the content and implementation of the licensee's radiation protection program. It should also identify program weaknesses and allow licensees to take early corrective actions (before an MDH inspection). During an audit, the auditor needs to keep in mind not only the requirements of MDH's rules, but also the licensee's commitments in its applications and other correspondence with MDH. The auditor should also evaluate whether the licensee is maintaining exposures to workers and the general public as low as is reasonably achievable (ALARA) and, if not, make suggestions for improvement.

Section 1: Audit History. Enter the date of the last audit, whether any deficiencies were identified, and whether actions were taken to correct the deficiencies.

Section 2: Organization and Scope of Program. Give a brief description of the organizational structure, noting any changes in personnel. Describe the scope of licensed activities at the audited location. Check whether the Radiation Safety Officer (RSO) is the person identified in the license and fulfills the duties specified in the license.

Section 3: Training, Retraining, and Instructions to Workers. Ensure that workers have received the training required by 4731.1020. Be sure that, before being permitted to use radioactive material, the user has received training and has a copy of the licensee's safe use and emergency procedures. Note whether refresher training is conducted in accordance with licensee commitments. Ensure that each worker has a copy of the licensee's procedures, and by interview and/or observation of selected workers that he/she can implement them.

Section 4: Audits. Verify that audits fulfill the requirements of 4731.2020, are conducted in accordance with licensee commitments, and are properly documented.

Section 5: Facilities. Verify that the licensee's facilities are as described in its license documents.

Section 6: Materials. Verify that the license authorizes the quantities and types of radioactive material that the licensee possesses.

Section 7: Leak Tests. Verify that all sealed/plated foil sources are tested for leakage at the prescribed frequency and in accordance with licensee commitments. Records of results should be maintained.

Section 8: Inventories. Verify that inventories are conducted at least once every six months to account for all sources; inventory records should be maintained.

Section 9: Radiation Surveys. Verify that the licensee has appropriate, operable and calibrated survey instruments available, and that the instruments have been calibrated at the required frequency. Calibration records must be retained for 3 years after the record is made. Check that radiation levels in areas adjacent to use are within regulatory limits. Verify compliance with 4731.2090. Records of surveys must be retained for three years after the record is made.

Section 10: Receipt and Transfer of Radioactive Material (Includes Waste Disposal). Verify that packages containing radioactive material, received from others, are received, opened, and surveyed in accordance with 4731.2350. Ensure that transfers are performed in accordance with 4731.3105. Records of surveys, receipt, and transfer must be maintained.

Section 11: Transportation. Determine compliance with Department of Transportation (DOT) requirements. Verify that radioactive packages are prepared, marked, and labeled in accordance with 49 CFR Parts 172 and 173 requirements. Verify that shipping papers are prepared, that they contain all 41

needed information, and that they are readily accessible during transport (49 CFR 172.200, 201, 202, 203, 204 and 177.718).

Section 12: Personnel Radiation Protection. Evaluate the licensee's determination that unmonitored personnel are not likely to receive more than 10 percent of the allowable limits. Alternately, if personnel dosimetry is provided and required, verify that it complies with 4731.2200 and licensee commitments. Review personnel monitoring records; compare exposures of individuals doing similar work; determine reasons for significant differences in exposures. If any worker declared her pregnancy in writing, evaluate the licensee's compliance with 4731.2080. Check whether records are maintained as required.

Section 13: Auditor's Independent Measurements (If Made). The auditor should make independent survey measurements and compare the results with those made or used by the licensee.

Section 14: Notification and Reports. Verify compliance with the notification and reporting requirements.

Section 15: Posting and Labeling. Check for compliance with the posting and labeling requirements.

Section 16: Recordkeeping for Decommissioning. Check to determine compliance with 4731.3080.

Section 17: Bulletins and Information Notices. Check to determine if the licensee is receiving bulletins, information notices, NMSS Newsletters, etc., from MDH. Check whether the licensee took appropriate action in response to MDH mailings.

Section 18: Special License Conditions or Issues. Verify compliance with any special conditions on the licensee's license. If the licensee has any unusual aspect of its work, review and evaluate compliance with regulatory requirements.

Section 19: Evaluation of Other Factors. Evaluate licensee management's involvement with the radiation safety program, whether the RSO has sufficient time to perform his/her duties, and whether the licensee has sufficient staff to handle the workload and maintain compliance with regulatory requirements.

Note: All areas indicated in audit notes may not be applicable to every license and may not need to be addressed during each audit.

APPENDIX G

SAFE USE OF RADIOISOTOPES AND EMERGENCY PROCEDURES GENERAL TOPICS FOR SAFE USE OF RADIOISOTOPES

Copies of emergency procedures should be provided to all users. Post a current copy in each laboratory or other area where radioactive material is used.

Each laboratory or area where radioactive material is used or stored have general rules so workers know what is required:

- Wear a laboratory coat or other protective clothing at all times in areas where licensed materials are used.
- Wear disposable gloves at all times when handling licensed materials.
- After each procedure or before leaving the area, monitor hands, shoes, and clothing for contamination in a low-background area.
- Do not eat, drink, smoke or apply cosmetics in any area where licensed material is stored or used.
- Do not store food, drink or personal effects in areas where licensed material is stored or used.
- Wear personnel monitoring devices, if required, at all times while in areas where licensed materials are used or stored.
- Dispose of radioactive waste only in designated, labeled and properly shielded receptacles.
- Never pipette by mouth.
- Store radioactive solutions in clearly labeled containers.
- Secure all licensed material when it is not under the constant surveillance and immediate control of the user(s).

GENERAL SAFETY PROCEDURES TO HANDLE SPILLS

The name and telephone number of the RSO or an alternate person(s) should be posted conspicuously in areas of use, so that it is readily available to workers in case of emergencies. Licensee should have emergency equipment readily available for handling spills.

Spill kits should include the following:

- Disposable gloves
- Housekeeping gloves
- Disposable lab coats
- Disposable head coverings
- Disposable shoe covers
- Roll of absorbent paper with plastic backing
- Masking tape
- Plastic trash bags with twist ties
- "Radioactive Material" labeling tape
- Marking pen
- Pre-strung "Radioactive Material" labeling tags
- Box of Wipes
- Instructions for emergency procedures
- Clipboard with a copy of the Radioactive Spill Report Form for the facility
- Pencil
- Appropriate survey instruments including batteries (for survey meters).

MINOR SPILLS OF LIQUIDS AND SOLIDS

Instructions to Workers

- Notify persons in the area that a spill has occurred.

- Prevent the spread of contamination by covering the spill with absorbent paper. (Paper should be dampened if solids are spilled).
- Clean up the spill, wearing disposable gloves and using absorbent paper.
- Carefully fold the absorbent paper with the clean side out and place in a plastic bag for transfer to a radioactive waste container. Put contaminated gloves and any other contaminated disposable material in the bag.
- Survey the area with an appropriate low-range radiation detector survey meter or other appropriate technique. Check the area around the spill for contamination. Also, check hands, clothing, and shoes for contamination.
- Report the incident to the Radiation Safety Officer (RSO) promptly.
- Allow no one to return to work in the area unless approved by the RSO.
- Cooperate with the RSO (e.g., investigation of root cause, provision of requested bioassay samples).
- Follow the instructions of the RSO (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).

RSO Duties

- Follow up on the decontamination activities and document the results.
- As appropriate, determine cause and corrective actions needed; consider bioassays if licensed material may have been ingested, inhaled, and/or absorbed through the skin.
- If necessary, notify MDH.

MAJOR SPILLS OF LIQUIDS AND SOLIDS

Instructions to Workers

- Clear the area. If appropriate, survey all persons not involved in the spill and vacate the room.
- Prevent the spread of contamination by covering the spill with absorbent paper (paper should be dampened if solids are spilled), but do not attempt to clean it up. To prevent the spread of contamination, limit the movement of all personnel who may be contaminated.
- Shield the source only if it can be done without further contamination or significant increase in radiation exposure.
- Close the room and lock or otherwise secure the area to prevent entry. Post the room with a sign to warn anyone trying to enter that a spill of radioactive material has occurred.
- Notify the RSO immediately.
- Survey all personnel who could possibly have been contaminated. Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water and then washing with a mild soap.
- Allow no one to return to work in the area unless approved by the RSO.
- Cooperate with the RSO (e.g., investigation of root cause, provision of requested bioassay samples).
- Follow the instructions of the RSO (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).

RSO Duties

- Confirm decontamination of personnel. If decontamination of personnel was not fully successful, consider inducing perspiration by covering the area with plastic. Then wash the affected area again to remove any contamination that was released by the perspiration.
- Supervise decontamination activities and document the results. Documentation should include location of surveys and decontamination results.
- Determine cause and needed corrective actions; consider need for bioassays if licensed material may have been ingested, inhaled, and/or absorbed through the skin.
- If necessary, notify MDH.

INCIDENTS INVOLVING RADIOACTIVE DUSTS, MISTS, FUMES, ORGANIC VAPORS, AND GASES

Instructions to Workers

- Notify all personnel to vacate the room immediately.

- Shut down ventilation system, if appropriate, to prevent the spread of contamination throughout system and other parts of facility.
- Vacate the room. Seal the area, if possible.
- Notify the RSO immediately.
- Ensure that all access doors to the area are closed and posted with radiation warning signs, or post guards (trained) at all access doors to prevent accidental opening of the doors or entry to the area.
- Survey all persons who could have possibly been contaminated. Decontaminate as directed by the RSO.
- Promptly report suspected inhalations and ingestions of licensed material to the RSO.
- Decontaminate the area only when advised and/or supervised by the RSO.
- Allow no one to return to work in the area unless approved by the RSO.
- Cooperate with the RSO (e.g., investigation of root cause, provision of requested bioassay samples).
- Follow the instructions of the RSO (e.g., decontamination techniques, surveys, provision and collection of bioassay samples, requested documentation).

RSO Duties

- Supervise decontamination activities.
- Perform air sample surveys in the area before permitting resumption of work with licensed materials.
- Provide written directions to potentially contaminated individuals about providing and collecting urine, breath, blood, or fecal samples, etc.
- Consider need for medical exam and/or whole body count before permitting involved individuals to return to work with licensed material.
- Determine cause and corrective actions needed; consider need for bioassays if licensed material may have been ingested, inhaled, and/or absorbed through the skin. Document incident.
- If necessary, notify MDH.

MINOR FIRES

Instructions to Workers

- Pull the fire alarm. If trained, immediately attempt to put out the fire by approved methods (i.e., fire extinguisher) if other fire hazards or radiation hazards are not present.
- Notify all persons present to vacate the area and have one individual immediately call the RSO and fire department (as instructed by RSO).
- Once the fire is out, isolate the area to prevent the spread of possible contamination.
- Survey all persons involved in combating the fire for possible contamination.
- Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water, then washing with a mild soap.
- In consultation with the RSO, determine a plan of decontamination and the types of protective devices and survey equipment that will be necessary to decontaminate the area.
- Allow no one to return to work in the area unless approved by the RSO.
- Cooperate with the RSO (e.g., investigation of root cause, provision of requested bioassay samples).
- Follow the instructions of the RSO/RSO staff (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).

RSO Duties

- Supervise decontamination activities.
- If decontamination of personnel was not fully successful, consider inducing perspiration by covering the area with plastic. Then wash the affected area again to remove any contamination that was released by the perspiration.
- Consult with fire safety officials to assure that there are no other possibilities of another fire starting.
- Determine cause and needed corrective actions; consider need for bioassays if licensed material may have been ingested, inhaled, and/or absorbed through the skin. Document incident.

- If necessary, notify MDH.

FIRES, EXPLOSIONS, OR MAJOR EMERGENCIES

Instructions to Workers

- Notify all persons in the area to leave immediately.
- Notify the fire department.
- Notify the RSO and other facility safety personnel.
- Upon arrival of firefighters, inform them where radioactive materials are stored or where radioisotopes were being used; inform them of the present location of the licensed material and the best possible entrance route to the radiation area, as well as any precautions to avoid exposure or risk of creating radioactive contamination by use of high pressure water, etc.
- Cooperate with RSO/RSO staff (e.g., investigation of root cause, provision of requested bioassay samples).
- Allow no one to return to work in the area unless approved by the RSO.
- Follow the instructions of the RSO (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).

RSO Duties

- Coordinate activities with facility's industrial hygienist or environmental health & safety office, and with local fire department.
- Consult with the firefighting personnel and set up a controlled area where the firefighters can be surveyed for contamination of their protective clothing and equipment after the fire is extinguished.
- Once the fire is extinguished, do not allow the firefighters to enter the radiation area until a thorough evaluation and survey are performed to determine the extent of the damage to the licensed material use and storage areas.
- Perform thorough contamination surveys of the firefighters and their equipment before they leave the controlled area and decontaminate, if necessary.
- Supervise decontamination activities.
- Consider bioassays if licensed material may have been ingested, inhaled, and/or absorbed through the skin. Document incident.
- If necessary, notify MDH.

APPENDIX H

SAFE HANDLING OF RADIOACTIVE MATERIALS

We will establish and implement the model safety rules published in Appendix **H** to the MDH Regulatory Guide for Research and Development, Laboratory and Industrial Use of Small Quantities of Radioactive Material.

MODEL RULES

- Wear laboratory coats or other protective clothing at all times in areas where radioactive materials are used.
- Wear disposable gloves at all times while handling radioactive materials.
- Monitor your hands for contamination in a low-background area with an appropriate survey instrument after each procedure and before leaving the area.
- Do not eat, drink, smoke, or apply cosmetics in any area where radioactive material is stored or used.
- Do not store food, drink, or personal effects in areas where radioactive material is stored or used.
- If required, wear personnel monitoring devices at all times while in areas where radioactive materials are used or stored. These devices should be worn as prescribed by the Radiation Safety Officer. When not being worn to monitor occupational exposures, personnel monitoring devices should be stored in the work place in a designated low-background area.
- If required, wear a finger exposure monitor during the preparation and use of radioactive materials and at all other appropriate times.
- Dispose of radioactive waste only in designated, labeled, and properly shielded receptacles.
- Never pipette by mouth.
- Complete daily contamination surveys using wipes **in** areas of use and preparation; complete weekly wipe tests where radioactive materials are stored. If necessary, decontaminate or secure the area for decay.
- After each use, survey with a radiation detection instrument the areas where radioactive material is prepared, used, and stored.
- Always store sources, waste, and other radioactive material in labeled containers.
- Store containers of liquid radioactive material in a secondary containment sufficient to hold the entire material if the liquid were to leak.
- Use shielding for containers, sources, and waste as necessary to maintain exposures As Low As Reasonably Achievable (ALARA).

APPENDIX J

J.1 MODEL PROCEDURE FOR TAKING TEST SAMPLES

1. Make a list of all sources to be tested. This should include at least the isotope, the activity on a specified date, and the physical form.
2. If you will be testing sources stronger than a few millicuries, set out a survey meter, preferably with a speaker, so you can monitor your exposure rate.
3. Prepare a separate wipe sample for each source. A cotton swab, injection prep pad, filter paper, or tissue paper is suitable. Number each wipe so you will know for which source it is to be used. Samples should be taken as follows:
 - a. For small sealed sources, it may be easier to wipe the entire accessible surface area. Pay particular attention to seams and joints. However, do not wipe the port of beta applicators.
 - b. For larger sealed sources and devices (survey meter calibrator), take the wipe near the radiation port and on the activating mechanism.