
# St. John's University

# RADIATION SAFETY PROGRAM

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# TABLE OF CONTENTS

# 1. INTRODUCTION

St. John's University is committed to its employees, and students to provide a safe and healthy work, and study environment. The primary objective of this document is to provide a general guide for handling radioactive materials at St. John's University and meet the requirements of Federal, State and local regulations.

The Environmental Health & Safety Office (EHS) is responsible for implementing the University's radiation safety program as defined by the Radiation Safety Committee, the New York City Department of Health Limited Scope Non-Human Use License, and applicable state and federal regulations. It is expected that all users of radioactive materials at St. John's University will utilize safe work practices, and conduct and complete all required activities to maintain compliance with these regulations.

The St. John's University Limited Scope Non-Human Use License

St. John's University operates under the NYS Department of Health License Number 52-3008-01. This license is an institutional limited scope license.

The limited scope license has one feature which must always be remembered by each radioactive materials user: **there is only one license for the entire university, and any individual or action which jeopardizes the license endangers the permission of all researchers to utilize radioactive material at the University**. If, for any reason, the license is suspended or terminated, no individual or principal investigator may use radioactive materials of any kind until the license is reinstated. Therefore, this license places significant responsibility on each individual who uses radioactive materials to conform to safe work practices, and to conduct and complete all required compliance duties, however large or small they may be.

# 2. ADMINISTRATION OF THE RADIATION SAFETY PROGRAM

The guidelines included in this manual apply to the use of radioactive materials at St. John's University's laboratory.

## *2.1. Regulatory Authority and Licensing*

The lead regulatory agency for St. John's University's radioactive materials usage is the New York City Department of Health and Mental Hygiene (NYCDOHMH) through which St. John's is licensed to use radioactive materials under License No. 52-3008-01. The

NYCDOH is authorized by the US Nuclear Regulatory Commission agreement state program to oversee use of radioactive materials in New York City. NYC Health Code Article 175 contains the applicable radiation protection regulations and is compatible with Title 10 CFR.

The NYS Department of Environmental Conservation (DEC) also has jurisdiction over emissions from facilities in New York per the NYS Sanitary Code, Part 380. However, because St. John's releases no significant radioactive materials from its facility, thus no permit is necessary per Article 380-3.4. However, St. John's may at times require a release permit if concentrations of releasable radioactive materials present are greater than that 1/10 of the concentrations specified in Article 380-3.4.

All documents concerning radioactive materials, operating procedures, records of personnel monitoring, and any regulatory correspondence are available for inspection in the St. John's Environmental Health and Safety Office by appointment. Inquiries regarding radiation safety should be directed to the Radiation Safety Officer.

## *2.2. Radiation Safety Committee*

The Radiation Safety Committee is comprised of faculty, administrators and staff who have been delegated responsibility for radiological health, safety and compliance at the University. Approval for use of radioactive materials, reviewing policy and campus radiation safety procedures, advising the university administration in radiation safety issues and programs, and auditing the operations and activities of the Radiation Safety Staff are some of the duties of the RSC.

Radiation Safety Committee members are appointed by the University administration, according to their experience and skills, which enable them to effectively perform their duties.

Current members of the committee are listed in the Radiation Safety Office. The list is updated by the RSO as the committee changes.

## *2.3. Approvals for Use of Radioactive Materials*

Approval for the use of radioactive materials is given by the Radiation Safety Committee for a period of one or more years. Approval may be obtained by submitting a brief application describing the requested material and quantity to be used, the location, individuals who will handle the material, the training and experience of the applicant, the training of workers, the protective equipment to be used, if any, monitoring equipment, a brief description of experimental procedures with emphasis on potential safety concerns, and waste disposal information. Applicants must have faculty status, assistant professor or greater, experienced in the use of radioactive materials and must be trained by the RSO. The application will be reviewed by RSC members, wherein approval may be granted.

The RSC may require additional conditions under which the use of the material must be conducted. The approved principal investigator may then order, receive and use the requested materials, but must do so according to the statements and representations made in the application, and any conditions set forth by the safety committee and all applicable local, state and federal laws, regulations and license conditions. Violations or infractions of these conditions may be cause for suspension or termination of the approval to receive and use radioisotopes.

For most applications to use radioactive materials, interim approval may be given by the Radiation Safety Officer (RSO) until the Radiation Safety Committee gives final approval. This precludes a long waiting period for approval. Principal investigators who are currently approved and have a good safety record may be given verbal interim approval to initiate a new use, except for work that involves a significantly higher risk. Applications for new principal investigators must be approved directly by the Radiation Safety Committee, regardless of previous approvals at other institutions.

New applications are required for the use of a new radionuclide, for a change in experimental procedures which have an impact on safety, a change in chemical or physical form of a material previously approved, and for substantial increases in the quantity. Amendments to current approvals are given for slight increases in quantity or moderate changes in chemical form, and may be obtained by submitting a short memo stating the desired change and the reason for the change, referencing to the original approved application to be amended. Applications for approval or amendments should be directed to the Radiation Safety Officer.

## *2.4. Responsibilities and Qualifications of Personnel*

The responsibilities of key personnel with respect to radiation safety follow:

1. Director of Environmental Health:

Responsibilities:

a. To ensure the safety of employees and the public.

b. To maintain off-site releases as low as reasonable achievable (ALARA) and avoiding significant increases in environmental radioactivity.

c. To provide the necessary management support to the Radiation Safety Officer such that his/her duties can be performed.

2. Radiation Safety Officer (RSO):

The RSO will have overall responsibility for the conduct of the radiation protection program for the handling of radioactive materials in all forms:

RSO Qualifications:

a. a minimum of a bachelors degree and three years of experience in working with radioactive materials (The bachelors degree may be substituted with equivalent experience.);

b. training in or a working knowledge of the types of radioactive materials used;

c. complete knowledge of management policies and company administrative, operating and safety procedures related to the protection against radiation exposures;

d. a working knowledge of applicable regulations.

RSO Authority:

The RSO is authorized to direct all employees in the conduct of activities involving radioactive materials. He/She has full authority to direct employees to take actions necessary to ensure radiation safety and regulatory compliance and to cease actions which the RSO deems to be hazardous or out of compliance.

RSO Responsibilities:

a. General surveillance of all activities involving radioactive material including routine monitoring and special surveys of all areas in which radioactive material is used.

b. Determining compliance with rules and regulations, license conditions and the conditions of individual laboratory project approval.

c. Monitoring and maintaining all safety systems associated with the safe use, storage and disposal of radioactive material.

d. Furnishing consulting services on all aspects of radiation safety to personnel at all levels of responsibility.

e. Supervising and coordinating receipt, storage and off-site shipment of radioactive material in all forms.

f. Distributing and processing personnel monitoring equipment, determining the need for bioassays, keeping personnel exposure and bioassay records, and notifying individuals and their supervisors of exposures approaching ALARA levels and recommending appropriate remedial action.

g. Conducting training programs and otherwise instructing personnel in the proper procedures for the use of radioactive material prior to use, at periodic intervals (refresher training), and as required by changes in procedures, equipment, regulations, etc.

h. Supervising and coordinating the radioactive waste disposal program, including keeping waste storage and disposal records, and monitoring effluents.

i. Storing all radioactive materials not in current use, including wastes.

j. Ensuring that all leak tests are properly performed.

k. Maintaining an inventory of all radioisotopes at the facility and limiting the quantity of radioisotopes to the amounts authorized by the license. The inventory should include the date the quantity was received, its location, and if applicable, the person responsible for the use of the material. Items are removed from the inventory by showing how and when the radioisotope was disposed.

l. The authority to terminate immediately a project that is found to be a threat to health or property.

m. Maintaining other records not specifically designated above (e.g., receipt, transfer and survey records).

n. Assume control with the Director and institute corrective action in emergency situations;

o. Authorize qualified persons to act in his/her stead if absent;

p. Verify that all necessary instructions are posted and are clearly visible;

q. Maintain on file copies of Licenses of Vendors performing licensable activities (e.g., meter calibration, waste disposal, etc.);

r. Enforce radiation protection procedures and institute disciplinary action for employees breaking safety rules.

3. Radiation Safety Committee

Responsibilities:

The Committee is responsible for:

1. Ensuring that lab staff working under authorized users are provided proper initial and annual refresher training; ensuring that university staff and students who work in labs with radioactive material are provided proper basic training on the characteristics of ionizing radiation and radiation protection.

2. Ensuring that all program and license requirements for the use of radioactive material are met.

3. Duties:

The Committee shall:

1. Be familiar with all pertinent regulations, the terms of the license, and information submitted in support of the request for the license and its amendments.

2. Review the training and experience of all individuals who use radioactive material (including principal investigators, technologists, and other personnel and students) and determine that their qualifications are sufficient to enable them to perform their duties safely and in accordance with regulations and the conditions of the license.

3. Be responsible for monitoring the institution's program to maintain individual and collective doses as low as reasonably achievable (ALARA).

4. Review the Radiation Safety Officer's summary report of occupational radiation exposure records of all personnel working with radioactive materials; paying special attention to workers or groups of workers whose exposures appear excessive or are otherwise remarkable due to late or lost badges or absence of expected exposures.

5. Establish a table of investigational levels for occupational radiation exposure, which when exceeded, will initiate an investigation and consideration of action by the Radiation Safety Officer.

6. Establish a program to ensure that all individuals whose duties may require them to work in the vicinity of radioactive material (i.e. research, students, security, and housekeeping personnel) are properly instructed as required by regulations.

7. Review and approve all requests for use of radioactive material within the Institution (this may be delegated to the RSO in case of small quantities).

8. Prescribe special conditions that will be required during a proposed use of radioactive material such as requirements for bioassays, physical examinations of users, and special monitoring procedures.

9. Review the entire radiation safety program at least annually to determine that all activities are being conducted safely and in accordance with New York City Health Department regulations and the conditions of the license. The review shall include an examination of records, reports from the Radiation Safety Officer, results of regulatory inspections, written safety procedures, and the adequacy of the institution's management control system.

10. Recommend remedial action to correct any deficiencies identified in the radiation safety program or quality assurance programs.

11. Maintain written records of all Committee meetings, actions, recommendations, and decisions; including members present and numerical results of all votes taken.

12. Ensure that the radioactive materials license is amended, when necessary, prior to any changes in facilities, equipment, policies, procedures, radioactive material, possession limits, and personnel, as specified in the license.

13. Identify problems and develop solutions.

Meetings

1. The Radiation Safety Committee shall meet as often as necessary to conduct its business, but not less than once in each calendar year.

2. A quorum shall consist of at least one-half of the Committee's membership, including the Radiation Safety Officer and a management representative.

4. Authorized Users:

Principal investigators are directly responsible for compliance with all regulations governing radiation safety in the laboratory, and for safe practices of individuals working under their supervision.

Responsibilities:

a. Instruct those employees for whom they are responsible in the use of approved radiation safety procedures and ensure attendance at required radiation safety courses;

b. Enforce radiation protection procedures and institute disciplinary action for employees breaking safety rules.

c. Contact the RSO whenever any changes in operational procedures are anticipated that may affect the safe use of radioactive materials.

d. Ensure that the laboratory complies with all requirements of the radioactive materials use permit, the RSO's recommendations, and applicable regulations. Requirements of the permit may include: record keeping for radioisotope use, shipment, receipt, inventory and disposal; conduct contamination surveys; ensure that radioactive materials are safely and securely stored and kept from unauthorized use.

e. Ensure that all personnel receive training in the use of radioactivity and that female workers are informed of the risks of radiation exposure during pregnancy.

5. Other Personnel and Students

Responsibilities:

a. Follow all safety procedures and keep exposures to radiation as low as reasonably achievable (ALARA);

b. Wear personal dosimetry and conduct contamination surveys during and after experiments as specified by the RM use permit.

c. Remove all protective clothing before leaving work areas;

d. Keep work areas neat and clean. The work areas should be free of equipment and materials not required for immediate work;

e. Keep or transport materials in such a manner as to prevent breakage or spillage.

f. Report ANY unusual occurrence regarding radiation safety to the Principal Investigator or RSO.

## *2.5. Internal Audits*

Internal Audits must be performed to determine if proper safety practices are utilized, radiation safety regulations are met, the performance of the RSO is adequate, and quality assurance protocols are followed. Audits will be made on the job and should, insofar as possible, be unannounced. An audit must be performed by the RSO or a Radiological Consultant at least annually. Such audits may include visual inspections, review of records, discussions with employees, etc.

## *2.6. Violations*

Prompt action will be taken by management to modify any operations resulting in a noncompliance situation. If exposure action limits are exceeded or quality assurance requirements not met, the RSO or Principal Investigator must notify the Director immediately. Applicable regulatory agencies will be notified of incidents as required in Part XX.

Persons deemed responsible for the infraction due to carelessness and/or negligence will be notified as per EH&S policy.

## *2.7. ALARA*

Adherence to the As Low As Reasonably Achievable Philosophy (ALARA) of Radiation Protection is required by NYC Article 175. Radiation exposures are kept ALARA by means of the ALARA Program outlined in the Appendix. The Program is summarized as follows:

- This Radiation Safety Manual and lab protocols have ALARA considerations built into their design.

- ALARA reviews of laboratory procedures will be used to further reduce exposures. The need for ALARA reviews of specific projects or operations will be determined by the RSO. Operations not causing significant occupational exposure (i.e., less than 100 mrem/year) will not be reviewed. Survey and exposure records will be reviewed to reveal which operations result in significant exposures and may not be conducted within the ALARA philosophy. If a suspected nonconforming operation is found, an ALARA review will be ordered by the RSO. During the review, alternatives to techniques, procedures, equipment, and the operation itself will be assessed with respect to the reduction of collective dose equivalent, other potential safety risks, and costs incurred. Results of any reviews conducted will be discussed by the Director, RSO and Principal Investigator and corrective actions will be implemented.

## *2.8. Training*

The training program shall consist of classroom and on-the-job training. The training procedure is outlined in the Appendix and is summarized as follows:

Persons Conducting The Training Program:

The RSO has primary responsibility for implementing and directing the training program. On-the-job training may be conducted by the RSO, safety consultants, lab supervisors or other members of staff who have expertise in some particular aspect of the operations to be conducted.

Frequency of Training, Periodic Training and Safety Meetings:

Personnel working with radioactive materials must have training commensurate with the type of work to be performed. Personnel will be instructed in radiation safety as follows:

1. before assuming duties with radioactive materials,
    a. Students / professors working with radioactive materials must notify other lab personnel; optional training and dosimetry is available for those who work in labs which have active users
2. during annual refresher training,
3. whenever there is a significant change in duties, regulations, or the terms of the license.

The basic radiological training outline is shown in the Appendix.

Records

All records pertaining to past and present training of employees shall be kept on file for at least 5 years. Records of initial and refresher training shall include:

- name of the instructor
- name of the person receiving the training
- dates and duration of the training
- a list of topics covered.

## *2.9. Special Procedures For Pregnant Employees*

It is the responsibility of the RSO to inform all female employees of their responsibilities concerning pregnancy as discussed in the following paragraph. The employee must sign an appropriate form which declares that such responsibility is noted and accepted. This form is included in the Appendix.

While not required, it is recommended that each female employee to immediately notify the RSO when she knows of her pregnancy and to follow the appropriate safety precautions as specified by the RSO. A "declared pregnant woman" per NYC Article 175 means a woman who has voluntarily informed her employer, in writing, of her pregnancy. The written declaration shall include an estimated date of conception or the estimated age of the embryo/fetus in days or weeks as of the date of declaration. An additional fetal dosimeter will be provided for an employee who declares pregnancy.

Immediately upon notification by the employee that she is pregnant, the RSO, the employee's supervisor and the Director will immediately review the employee's past exposures and work responsibilities and specify any changes in work or safety procedures necessary to ensure that the dose to the fetus will be less than 0.5 rem during the approximate 39 consecutive week gestation period and less than 50 mrem/month as specified in Article 175.

These recommendations shall be written and signed by all participants including the pregnant employee.

# 3. FACILITIES AND EQUIPMENT

## *3.1. Facilities*

The location of the main accumulation area for radioactive waste is Saint Albert Hall, room G-016. This room provides storage for long-lived isotopes, as well as decay-in-storage for shorter lived isotopes. The main accumulation area can only be accessed by Environmental Health and Safety staff, and the radiation safety officer must be contacted prior to depositing waste.

## *3.2. Equipment*

All radiation detection instrumentation shall be calibrated annually. Procedures for use of survey meters are shown in the appendix. All calibration logs will be stored with the RSO for the duration of the license. It is the responsibility of the authorized user to notify the RSO if equipment is malfunctioning or in need of repair / replacement.

# 4. GENERAL RADIATION SAFETY CONSIDERATIONS

## *4.1. Laboratory Radiation Safety Precautions*

Potential radiological hazards in the laboratory areas consist of radioactivity in samples and in standards and tracers. Because of the low quantities of radioactivity used in standards and tracers and occurring in most environmental soil, water, and other samples, these potential hazards will be very small.

General safety guidelines follow:

1. All personnel must follow the "Model Rules for the Safe Use of Radioactive Material" as specified in the NYC radioactive materials license and posted in the Laboratory area.

2. Eating, drinking, and smoking are prohibited in laboratory areas. Food, beverages, cigarettes, etc. shall not be kept in the same storage area as radioactive materials.

3. Use of laboratory equipment is strictly limited to personnel designated by authorized users and the radiation safety officer.

4. Radioactive standards must be marked by labels on drawers or cabinets and on protective cases. Damaged standards must not be used for calibration or QA and must be disposed of properly.

4. Wipe testing of the laboratory floors and equipment surfaces must be conducted as specified in the RM use permit. The results must be recorded and maintained in a binder or computer database. These records will be retained by the RSO for the duration of the license.

5. All samples are to be treated carefully to avoid spillage which may result in the loss of sample and the possible contamination of the lab. No uncovered or unlabeled liquids or volatile samples are to be brought into the laboratory area.

6. Hands should be washed before and after handling samples; plastic gloves and lab coats must be worn when handling radioactive solutions or chemicals. Potentially contaminated clothing shall not be worn outside of the controlled areas.

7. Work areas are to be kept neat and clean. The work areas should be kept free of equipment and materials not required for the immediate procedure.

8. Incoming and outgoing samples, standards, and reagents shall be stored in an orderly fashion using dedicated cabinets and shelves.

9. Samples containing tritium, radioiodine or other volatile forms of radioactivity must not be heated or processed until the RSO determines the potential for release of airborne radioactivity and specifies precautions and regulatory notifications necessary.

10. Any incident shall be reported immediately to the RSO. This includes theft, loss, spillage, or injuries involving radioactive materials.

11. Equipment used in a radioactive materials controlled area shall not be removed until after a survey has shown it to be free of contamination.

# 5. RADIATION MONITORING PROGRAM

## *5.1. External Exposure Monitoring*

The External Exposure Monitoring Procedure is shown in the Appendix. The requirements are summarize as follows:

(a) All employees working with gamma or high-energy beta emitters at the University are provided a whole body TLD (thermoluminescent dosimeter) or film badge. Whole body badges are normally worn at waist or chest level in front, and near the center of the body.

(b) Personnel whose duties include handling gamma-emitters producing greater than 50 mR/hr are also assigned extremity monitors (wrist badges). Wrist badges are normally worn on the right wrist for right-handed persons, and on the left for left-handers. Ring TLD's must also be specified for jobs in which source handling may produce greater beta or gamma doses at the fingers than at the wrist.

(c) Visitors entering radiation areas which may exceed 2 mR/hr are required to wear a whole body badge or self reading dosimeter, and must be logged into the Visitor's Log Book. Badges shall not be re-used.

(d) Badges shall not be taken home unless transit to a remote site is to occur subsequently.

(e) Badges will be changed at least quarterly for laboratory personnel that do not have the potential for greater than 100 mrem/quarter whole body dose equivalent as estimated by the

RSO. Personnel with the potential for receiving greater than 100 mrem/quarter will have badges changed monthly.

(f) Exposure reports, as they're received from the processor, will be reviewed and signed by the RSO. Any significant abnormalities must be explained and noted in the file.

(g) The occupational dose limits in effect are those specified in NYC Health Code Article 175.

(h.) An ALARA review will be conducted by the RSO if any badge reading exceeds 100 mrem.

## *5.2. Internal Exposure Monitoring*

If tritium ($^3$H) is handled in an amount greater than or equal to 100mCi, internal exposure assessment shall be performed by means of air sampling and/or bioassay as specified by the RSO. Bioassay techniques may include:

- liquid scintillation analysis of urine
- other tests or analyses as specified by the RSO for non-routine exposures or incidents.

Unless otherwise specified, "bioassay" in this manual shall mean the analysis of urine and or feces for radioactivity.

Normal operations at University facilities will not produce the potential for internal exposure, thus such monitoring is not required. However, the RSO may specify bioassay testing for special laboratory projects.

### *5.2.1.Bioassays*

#### *5.2.1.1. Types of bioassays*

- pre-operational (baseline),
- routine,
- diagnostic,
- post-operational.

#### *5.2.1.2. Frequency of Sampling*

Baseline samples will be collected before each laboratory project in which the potential for internal exposure exists. Such operations include greater than mCi levels of radioactivity and would not normally include less than mCi quantities of H-3, C-14, or S-35 unless there is an especially high chance of loose or airborne contamination.

Routine samples will be collected during such laboratory operations, at a frequency of daily, weekly, or monthly as specified by the RSO.

Diagnostic samples may be required by the RSO if routine samples reveal unusual results. Guidance regarding additional samplings can be found below and in the bibliography.

Post-operational samples must be collected at the end of each worker's participation in operations for which baseline samples were required.

#### *5.2.1.3. Sample collection*

Urine samples must be collected in an uncontaminated area, such as an uncontrolled area. Employees must wash their hands thoroughly before touching the sample container. Any protective clothing must be removed before submitting the sample. Routine samples should be submitted in the morning before work, to further minimize the possibility of sample contamination and to also allow better assessment of long term radionuclide retention in the individual tested. The minimum sample size shall be specified by the RSO (e.g., ~ 10 ml tritium analysis, 24 hr void for actinides, etc.)

#### *5.2.1.4. Sample Analysis*

Bioassay samples shall be analyzed for the primary radionuclides of concern occurring during a project. Minimum detectable concentrations for the analysis should be less than those necessary to detect investigation levels recommended in the literature or 1/2 to 1/10 of the concentration corresponding to the annual limit of intake (ALI).

If there are no primary radionuclides of concern associated with a bioassay sample (e.g., pre- and post-employment samples), then the samples should be analyzed for tritium and gross beta.

#### *5.2.1.5. Action Levels*

Bioassay data must be used to assess radiation doses from both chronic and acute exposures. These action levels are given below in terms of bioassay results derived from the Maximum Permissible Body/Organ Burden (q) for chronic exposures, and the Annual Limit of Intake (ALI) for acute exposures. If there are no primary radionuclides of concern associated with a bioassay sample, a gross beta action level (for beta energies above tritium) in urine is shown.

(a) Action levels for chronic exposures:

| Urinary Concentration | Action |
|---|---|
| <3X gross beta baseline | None |
| > 3X gross beta baseline | Analyze individual nuclides; apply the following table: |

| Body burden | Action |
|---|---|
| < 1/10 q | None |
| 1/10q to 1/2q | Sample weekly, investigate cause & take corrective actions. |
| >1/2q | Restrict employee from work with loose radioactivity, estimate dose, take corrective actions, perform diagnostic bioassay |

(b) Action levels for acute exposures (24 hr.post-exposure measurements):

| Intake Activity | Action |
|---|---|
| <1/100 ALI | None |
| 1/100 to 1/10 ALI | Weekly samples, investigate cause and take corrective actions. |
| > 1/10 ALI | Restrict employee from work with loose radioactivity, take corrective actions, estimate 13 and 52 week committed dose |

(c) Reporting Requirements

If the estimated whole body dose equivalent is estimated to exceed the dose limits given in Article 175, the New York City Department of Health must be notified within 24 hours by telephone.

### *5.2.1.6. Dose Calculations*

The calculation of radionuclide body or organ burdens, the effective dose equivalent, and committed effective dose equivalent may be performed using guidance from the literature. Recommended references include:

- HPS ANSI N13.14 for tritium
- ICRP 10 for several selected radionuclides
- INDOS and "Intake Retention Functions and Their Applications to Bioassay and the Estimation of Internal Radiation Doses"
- Reg Guides: 8.9 (Tritium), 8.11 (Uranium), 8.20 (Iodine), 8.22 (Uranium mills), 8.26 (Fission and Activation Products)

See the references for the above citations.

## *5.3. Radiation Surveys*

Model procedures for posting and training are shown in the Appendix. The program requirements are also discussed below.

### *5.3.1.Radiation Surveys at University Facilities*

1. Frequency:

Radiation and contamination surveys are conducted on a monthly basis.

2. Types:

- Wipe tests to be analyzed by LSC for H-3 and gross beta
- Exposure rate measurements using GM or scintillation meters
- Air Sampling is not specified for operations at St. John's facilities. However, air sampling may be specified by the RSO if the potential exists for a laboratory procedure to produce greater than 1/10 of the general public DAC.

3. Contamination Limits:

- Limits for unrestricted areas and are those specified in NYC Article 175 Appendix D.

4. Instrument Calibration:

- Survey instruments shall be calibrated annually.
- Counting instruments shall be calibrated and used as specified in the manufacturer's instructions and in the laboratory's Standard Operating Procedures.
- Radionuclide standards used for calibration of instruments shall be traceable to the National Institutes of Standards and Technology (NIST).
- Records of calibration shall be kept in the appropriate log books, files or computer databases.
- All spare or backup equipment and instruments out of calibration or in need of repair must be tagged out. The tag indicates the status of the instrument and what needs to be done before use.

5 Leak Testing

All licensed sealed sources exceeding 100 uCi of beta- or gamma-emitting material or 10 uCi of alpha-emitting material must be leak tested every six months according to the model procedure.

6 Personnel Contamination Monitoring:

Personnel conducting projects using greater than 1 mCi of radionuclides (other than tritium) shall check their hands and clothes for contamination using an appropriate instrument specified by the RSO each time they leave the controlled area.

# 6. INVENTORY CONTROL, SHIPPING AND RECEIVING RADIOACTIVE MATERIALS

## *6.1. Posting and Labeling*

CAUTION RADIOACTIVE MATERIAL signs must be conspicuously displayed on each door to areas where radioactive materials are being used or stored.

Containers and equipment in which there are radioactive materials must bear a durable and clearly visible label bearing the words "CAUTION RADIOACTIVE MATERIALS" and the radiation caution symbol. This label should state the quantities and kinds of radioactive materials in the containers and the date of measurement.

"EMERGENCY PROCEDURES", or "SPILL PROCEDURES", and "NOTICE TO EMPLOYEES" signs must be posted in a conspicuous place in all areas where radioactive materials are used. The name and current phone numbers of emergency personnel and agencies must be listed on the "Emergency Procedure" lists.

## *6.2. Inventory Control*

The quantity of radioactive materials at the University must be known in order to ensure that licensed limits are not exceeded. The RSO shall be responsible for updating the radioactive materials inventory record or database monthly as new material is received and used material is disposed or returned. The activity of standard sources possessed shall be totaled separately from that of samples to be analyzed and returned / disposed.

Samples or reagents received for use in laboratory procedures that contain less than 10 uCi of radioactivity per item are not subject to radioactive material inventory tracking. If subsequent analysis of items reveals significant activity (i.e., greater than 10 uCi ), then possession of such activity shall be indicated in the inventory record.

Samples or reagents that have greater than 10 uCi of radioactivity per item, must be included in the radioactive materials inventory tabulation. The handling of such items shall be performed with designated "high activity" glassware and proper containment so that standard glassware, facility surfaces, and instrumentation will not experience an increase in background radioactivity. Warning of receipt of such items should be obtained from the Principal Investigator with knowledge of the facility of origin, from notations on the chain of custody or packing slip, or from the results of the receipt survey. The RSO may specify pre-testing of samples that are suspected of having > 10 uCi of alpha or low-energy beta emitters that would not be detectable by external measurements conducted during package opening.

## 6.3. Ordering and Receiving

All radioactive materials shall be ordered by the RSO who must insure that the ordered materials and quantities are authorized by the license. Written records of the order shall be maintained including the isotope, compound, activity, and supplier per the procedure shown in the Appendix. The records shall be referenced when opening the shipments. A memorandum shall be posted to instruct delivery personnel if no one is available at the facility to accept the shipment.

All incoming shipments marked as containing radioactive materials must be recorded in the receipts log or database. Additionally, shipments marked as containing radioactive materials shall be surveyed and recorded on a "Radioactive Shipment Receipt Record". The survey shall include:

- measurement of radiation levels
- results of wipe tests the external surface are required for all shipments of tritium ($^3H$)
- The transport index and inner and outer label quantities shall be verified by measurement or observation. Results shall be recorded in the "Radioactive Shipment Receipt Record".

Contamination limits are:

| Nuclide | Contamination limit (dpm/cm$^2$ averaged over 300 cm$^2$) |
|---|---|
| Beta/gamma emitters | 22 |
| U-nat, Th-nat, U-238, U-235, Th-232, U ore, Th ore | 22 |
| other alpha emitters | 2 |

## 6.4. Shipping

All outgoing shipments of radioactive materials must only be prepared by persons trained per 49CFR. The regulations for the transportation of radioactive materials specified in 49CFR and NYC Article 175 shall be followed.

In addition to the regulations, all radioactive shipments shall be recorded in the shipping log or database.

# 7. DISPOSAL OF RADIOACTIVE MATERIALS

Operations at the St. John's facility will generate small quantities of low level radioactive waste (LLRW) including gloves, pipettes, counter top liners, glassware, used standards, and biological samples. Scintillation vials will also be produced. Typically, small waste containers (5 gallon pails with poly liners) will be maintained in the laboratories, one for dry radioactive waste (lab trash) and another for LSC vials if a scintillation counter is present. When full, the poly bags will be transferred to large 30- or 55-gallon drums in the Radioactive Waste Storage Room in St. Albert's Hall. Full drums will be transferred periodically to a licensed radioactive waste broker for disposal.

Sanitary sewer disposal of radioactive material may be authorized by the RSO under the limits set under 10 CFR Part 20 Appendix B. All sanitary sewer disposal procedures require written authorization by the RSO before they are allowed to take place.

# 8. EMERGENCY PLANNING

These emergency planning procedures apply to radiological emergencies such as lost source incidents, spills, or fire/floods in radioactive materials storage areas. The Model Emergency Procedure for Posting and Training is shown in the Appendix

## *8.1. Emergency Response Equipment*

The following equipment is kept available in the Radiation Safety Office:

1. survey meters
2. protective clothing
3. sampling supplies including wipes, swabs, jars, planchetts, etc.
4. transportation labels, manifests, data sheets, etc.
5. hand tools, tongs and implements

The following additional equipment is also available at on-campus laboratories or contractor consulting firms:

1. portable gamma spectrometer
2. power tools, HEPA vacuums
3. liquid scintillation counter

## *8.2. Emergency Response Personnel*

In the event of an emergency, the EH&S Director at the University will act as Emergency Director and will have ultimate responsibility for implementing radiological contingency procedures with the RSO acting as technical consultant. The Emergency Director responsibilities may be given to the RSO in the absence of the EH&S Director.

If it is necessary for St. John's to begin emergency response actions in response to an accident, the Emergency Director will enlist personnel from qualified individuals available and assign emergency response locations and duties to each. Emergency personnel will be chosen from the personnel on site at the time of the emergency and personnel included in a list of potentially available emergency responders (see Appendix). The list of emergency responders will be updated periodically as availability of the individuals change.

The members of the team and their specific responsibilities will be chosen on the basis of:

1. the magnitude of the emergency
2. the qualifications of the individual with respect to the duties to be performed
3. the availability of the individual.

For large-scale emergencies, the Emergency Director will need to cooperate with police and fire department authorities.

The duties and responsibilities of the emergency response team members are:

A. Emergency Director

1. Make available the personnel, facilities and equipment necessary to respond to the emergency.

2. Coordinate the on-site group with off-site groups such as a laboratory, fire department, police, and regulatory agencies.

3. Evaluate situation (airborne contamination, surface contamination of facility, equipment or personnel).

4. Evacuate and confine (cordon) area if necessary.

5. Survey personnel and order bioassay and/or decontamination, if necessary.

6. Supervise entry into and out of the area (respiratory protection, anti-contamination, shielding, proper instrumentation, etc.).

7. Document on-site problems encountered, action taken, personnel involved, etc.

8. After area is under control, confer with proper personnel to implement cleanup, if necessary.

B. Laboratory Personnel and Technicians

1. Assist in implementing contamination control actions.

2. Perform instrument surveys, air sampling, wipe surveys, etc.

3. Perform emergency decontamination of personnel.

C. University Security and Maintenance Personnel

1. Follow instructions from the Emergency Director to cordon-off areas, transport samples to be analyzed, assist in mitigation of the problem, etc.

## *8.3. Emergency Instruction*

As part of the initial safety briefing, all workers will be shown:

- the location of exits
- the location of working telephones and the correct numbers to call for EMS/Fire/Police (911 or individual numbers)
- the locations of fire extinguishers and first aid kits.
- the location of gathering areas should evacuation of the facility be necessary.

All workers will be instructed to report any accidents or injuries to the Principal Investigator or Radiation Safety Officer.

## *8.4. Emergency Actions*

Listed below are generic actions that may be taken by the Emergency Response team to evaluate and stabilize the extent and severity of an incident:

1 Quickly identify the type, approximate quantity, and extent of the hazard:

a. Make observations including reading labels, postings, manifests, etc.

b. Interview personnel in the area involved.

c. Perform measurements.

2 Attend to injured personnel via first aid, CPR, or ambulance if radiation or contamination levels are not immediately dangerous to life. Mitigation of non-hazardous levels of contamination on personnel shall not take precedence over treatment of serious injury. If the injured person is stable, then contamination control actions may be performed.

3 Implement initial contamination control actions to stabilize the site including:

a. isolation of the affected area through the use of roping, signs, barriers, etc.

b. issuance of personnel protective equipment and respirators

c. the use of absorbent materials to limit the spread of liquids

d. the use of poly sheeting to separate contaminated and non-contaminated areas

4 Inform governmental authorities.

5 If readily possible, mitigate the problem while minimizing exposures through the use of time distance, shielding, and protective clothing.

6 Perform contamination surveys and bioassay of all persons involved.

7 Document actions taken, measurements and observations.

## *8.5. Off-site Assistance*

A list of facilities, agencies, and individuals that may be called for assistance in case of emergency at University facilities is included in the Appendix.

## *8.6. Example Accidents and Responses*

The following accidents are examples. The list is not all-inclusive but intended to be typical.

1 Accident: Worker cuts hand, requiring stitches, with contaminated glassware.

a. Apply first aid measures.

b. Estimate type and level of contamination on glassware and set aside for later analysis.

c. Take worker to hospital for stitches; if significant contamination is suspected, inform hospital of such.

d. Inform the RSO at the earliest possible moment.

e. Perform bioassay of worker after hospital visit and again after 24 hours.

2 Accident: Fire involving the St. John's facility.

a. Confirm with the fire department that radioactive materials are present.

b. Inform the RSO and EH&S Director at the earliest possible moment.

c. Estimate if any significant sources are involved in the fire. Conduct gamma exposure measurements to ensure source containers or shielding is intact. If not, work with the fire department to mitigate the source or to minimize firefighters' time in the vicinity.

d. Other small radionuclide standards and reagents will not present a significant radiological hazard to firefighters. However, follow-up wipe tests and bioassay may need to be conducted to confirm this if greater than 1 mCi quantities have been involved.

e. Inform regulatory authorities.

f. Plan for later source recovery and cleanup.

# 9. ENVIRONMENTAL MONITORING AND SAMPLING

## *9.1. Airborne Releases*

At University laboratories, fume hoods may be used to prevent airborne contaminants from entering the laboratory's internal air. The hood discharges may be exempt from NYSDEC release permit requirements of Part 380 per Article 380-3.4 if the annual average discharge is less than 1/10 of the concentrations in Table II Column 1 in Part 380-11.

The RSO may require air sampling of the discharge if:

- tritium, radioiodine, or other volatile radionuclides may be in samples being dried, and
- the total quantity of radioactivity in the samples is greater than 1/10 of the Table II Col. 1 effluent limit times the volume of air discharged in 24 hours.

For example, if the exhaust flow rate is 300 CFM then the 24 hour volume is $1.2 \times 10^{10}$ ml. For tritium, the Table II limit is $1 \times 10^{-7}$ uCi/ml. Therefore, the investigation level is $1/10 \times 1.2 \times 10^{10}$ ml $\times 1 \times 10^{-7}$ uCi/ml = 120 uCi. Thus, if over 120 uCi of loose tritium is used in the hood, the discharge will be sampled. (This calculation is subject to the sum of the ratios method for use of multiple radionuclides). These maximum quantities should posted on the hood.

If the radionuclide concentration in the effluent exceeds 1/10 the Table II level for a 24 hour period, then the RSO shall calculate the expected annual average concentration and may order continued air sampling and/or a reduction of the sample quantity so that the annual average discharge is proven to be less than 1/10 of the concentrations in Table II Column 1 in 12NYCRR38 Appendix B or in Part 380-11.

Thus, through the use of the above procedure limiting the quantity of radioactive material used in the hood, the discharge is exempt from the release permit requirement per Part 380, Article 380-3.4.

## *9.2. Liquid Releases*

If projects are to be performed that have the possibility of radionuclide concentrations in the effluent exceeding 1/10 the Table II level for a 24 hour period, then the RSO shall calculate the predicted annual average concentration from the sampling results and work load estimates. If the predicted annual average concentration is greater than 1/10 of the concentrations in Table II Column 1 in Part 380-11 then the RSO either shall order a reduction of the radionuclide quantity so that the annual average discharge will be less than the investigation level or shall apply for a NYS Department of Environmental Conservation release permit.

## REFERENCES

1. 12NYSCRR38, NYS Industrial Code Rule 38, NYS Department of Health, Albany, NY.

2. 10NYCRR16, NYS Sanitary Code, NYS Department of Health, Albany, NY.

3. NYS Sanitary Code Part 380, NYS Department of Environmental Conservation, Albany, NY

4. 10 CFR Part 20 - U.S. Nuclear Regulatory Commission

5. NYC DOHMH Article 175 – Radiation Protection

6. Federal Guidance Report No. 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors For Inhalation, Submersion, and Ingestion", 1988.

7. HPS ANSI N13.14 "Applications of Bioassay for Tritium"

8. ICRP 61 "Annual Limits on Intake of Radionuclides by Workers Based on the 1990 Recommendations", 1991.

9. INDOS and "Intake Retention Functions and Their Applications to Bioassay and the Estimation of Internal Radiation Doses", Skrable Enterprises, Inc.

10. USNRC Regulatory Guides: 8.9 (Tritium), 8.11 (Uranium), 8.20 (Iodine), 8.22 (Uranium mills), 8.26 (Fission and Activation Products), 8.10 (ALARA)

# ***APPENDICES***

# MODEL PROCEDURE FOR DELEGATION OF AUTHORITY TO THE RADIATION SAFETY OFFICER AND FOR ESTABLISHING A RADIATION SAFETY COMMITTEE

## DELEGATION OF AUTHORITY

MEMO TO: All Employees

FROM: The Trustees of St. John's Universtiy

SUBJECT: Authority of Radiation Safety Officer and Radiation Safety Committee

_____ has been appointed Radiation Safety Officer and is responsible for ensuring the safe use of radioactive materials. The Radiation Safety Officer is responsible for managing the radiation safety program; identifying radiation safety problems; initiating, recommending, or providing corrective actions; verifying implementation of corrective actions; ensuring compliance with regulations; and other duties and responsibilities listed in the Radiation Safety Manual.. The Radiation Safety Officer is hereby delegated the authority to meet those responsibilities.

The Radiation Safety Officer is also responsible for assisting the Radiation Safety Committee in the performance of its duties and serving as its secretary.

The following individuals have been appointed to the Radiation Safety Committee:\

_____

_____

_____

_____

***T/he Committee is responsible for overall management oversight of the safe use of radioactive materials and other duties and responsibilities listed in the Radiation Safety Manual.***

## *INTERNAL AUDIT CHECKLIST*

Date: _____ Time: _____ Inspector: _____

1. Are radioactive materials workers wearing the specified protective clothing:

   lab coats ? _____ gloves ? _____

   film or TLD badges ? _____ SRD's ? _____

2. Are supervisory personnel readily available in case of an emergency? _____
   Names: _____
3. Are radioactive materials properly stored and labeled: _____
4. Was the restricted area properly controlled and posted to prevent unauthorized entry?

_____

5. Are emergency phone #'s posted in radioactive work areas?

_____

6. Are the following records properly maintained ?

   radioactive material receipt log _____

   radioactive material shipping log _____

   radioactive material inventory _____

   monthly wipe tests _____

   semiannual bioassay _____

   annual survey meter calibration _____ (or meter tagged-out)

   counting instrument QA Charts and logs: _____

Were there any items of noncompliance other than those listed on this form? _____
(If any, explain below.)

Signature:_____ Date:_____

## *Radioactive Materials Inventory*

Start Date of Inventory Period: _____ By: _____

| **SEALED AND OTHER CALIBRATION SOURCES:** | | | | | | |
|---|---|---|---|---|---|---|
| Nuclide | Activity | Model/Serial #/Description | Location | Date Rcvd | Inv. Date | Notes |
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| **LIQUID OR GASEOUS RADIOACTIVE MATERIALS** | | | | | | |
| Nuclide | Activity | Model/Serial #/Description | Location | Date Rcvd | Inv. Date | Notes |
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## *LIST OF QUALIFIED INDIVIDUALS FOR EMERGENCY RESPONSE*

| Name | Qualified Position | Business Phone | Home Phone |
|---|---|---|---|
| **William Borgeson** | **RSO** | **718-990-1815** | **347-909-3364** |
| **Colleen Greaney** | **Director of EH&S** | **718-990-1348** | **917-731-1207** |
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## *PERSONNEL AND PHONE NUMBERS FOR ASSISTANCE DURING EMERGENCIES*

St. John's University - Radiation protection personnel:
Colleen Greaney, Radiation Safety Officer
Office: 718-990-1348 Cell: 917-731-1207
William Borgeson, Assistant Radiation Safety Officer
Office: 718-990-1815 Cell: 347-909-3364

CoPhysics Corporation – Radiological consultant and services contractor
Theodore E. Rahon, Ph.D., CHP, Health Physicist
Office: 845-783-4402 Cell: 914-260-1293

New York City Department of Health
Hailu W. Tedla, MSc., CHP Office: 347-396-6134 Cell: 347-538-0923

New York State Warning Point 518-457-2200
(for after hours emergencies)

New York State Dept. of Environmental Conservation, Bureau of Radiation
518-402-8579

Brookhaven National Laboratory, Health and Safety Division, 516-282-4207
"RAP-TEAM" Radiological Assistance Program 516-282-2200

Radiac Environmental Services, 261 Kent Ave., Brooklyn NY 11211 718-963-2233
(Waste Disposal and Transportation)

National Climate Data Center 704-271-4800

## ***ORGANIZATION CHART***

## *PREGNANCY NOTICE FOR EMPLOYEES*

Although not required, it is recommended that each female employee to notify the RSO immediately when she knows of her pregnancy and to follow the appropriate safety precautions as specified by the RSO. Such notification is not required by law nor by company rules. However, it is in the best interest of the child to make such a declaration.

Immediately upon notification by the employee that she is pregnant, the Radiation Safety Officer will review the employee's past exposures and work responsibilities and specify any changes in work or safety procedures necessary to ensure that the dose to the fetus will be less than that specified in NYC Department of Health Regulations. A fetal dosimeter will be provided once an employee notifies the RSO of their pregnancy.

Children are more sensitive to radiation then are adults. So, it is important to follow extra safety precautions to protect unborn children from exposure to radiation.

Please sign the acknowledgment below:

I, _____, have read this notice and declare that I assume responsibility for informing or not informing management of a pregnancy.

_____ _____

Radiation Safety Officer Date

## *Personnel Training Program*

It may not be assumed that safety instruction has been adequately covered by prior professional or occupational training, board certification, etc. Also ancillary personnel (i.e. nursing, clerical, housekeeping, security) whose duties may require them to work in the vicinity of radioactive material (whether escorted or not) need to be informed about radiation hazards and appropriate precautions. The following program is a NYS model procedure for personnel training:

Personnel will be instructed:

1. Before assuming duties with, or in the vicinity of, radioactive materials.

2. During annual refresher training.

3. Whenever there is a significant change in duties, regulations, or the terms of the license.

Instruction for individuals in attendance will include the following subjects:

1. Applicable regulations and license conditions.

2. Areas where radioactive material is used or stored.

3. Potential hazards associated with radioactive material in each area where the employees will work.

4. Appropriate radiation safety procedures.

5. Licensee's in-house work rules.

6. Each individual's obligation to report unsafe conditions to the Radiation Safety Officer.

7. Appropriate response to emergencies or unsafe conditions.

8. Worker's right to be informed of occupational radiation exposure and bioassay results.

* NOTE: An excellent resource for providing information to personnel working where radiation may be used is NCRP Report No. 105, "Radiation Protection for Medical and Allied Health Personnel".

## *SAFETY REFRESHER OUTLINE*

1 Types of Exposure and Exposure Monitoring

a. External

(1)meter surveys

(2)personnel dosimetry

b. Internal Exposure

(1)Routes: inhalation, ingestion, skin absorption

(2)Bioassay

2 Protective Equipment

a. use of PPE (gloves, lab coats, shoe covers, etc.)

b. use of engineered controls (spill prevention, barriers, ventilation systems, etc.)

c. use of respirators (seal testing, maintenance, applicability)

3 Personnel Decontamination Procedures

4 Facility Diagram & Restricted Areas

5 Expected levels of radioactive materials: exposure rates, surface contamination, airborne contamination.

6 General Safety

a. review of trip & fall hazards, ladders/scaffolds, electrical safety

b. use of specialized equipment

c. location of first-aid equipment, fire extinguishers & exits

d. location of working telephone(s) with police/fire/EMS telephone number(s)

e. location of main power switch and breakers, natural gas cutoff valve, water main cutoff valve

7 Emergency Procedures

8 Regulatory requirements, license conditions, worker's right to be informed of exposure and bioassay results, location of notices and regulations

9. Locations where the licensee has posted or made available notices, copies of pertinent regulations, and copies of pertinent licenses and license conditions

10. Question and answer period.

B. Records that Document Training

Records of initial and refresher training will be maintained for inspection by regulatory authorities and will include:

1. The name of the individual who conducted the training,
2. The names of the individuals who received the training,
3. The dates and duration of the training session,
4. A list of the topics covered, and
5. The results of tests administered to determine the effectiveness of training.

# *CERTIFICATE OF COMPLETION OF REFRESHER TRAINING*

NAME: _____

CERTIFICATION: The above named person has attended training sessions which meet the requirements of:
OSHA Part 1910-120(e)(8) (Refresher Training), USNRC 10CFR19, and New York City Rules Article 175
requirements regarding work with radioactive materials.

Date of Training: _____

Place: _____

_____
Instructor:

## *RADIATION SAFETY TRAINING AND ACKNOWLEDGMENT FORM*

**Name: _____**

**Date: _____**

CERTIFICATION: The above named person has been trained regarding radiological, safety and hazardous materials work
per NYC Rules Article 175 and 10CFR19.

Instructors: _____

_____

I, (print)_____, have been instructed in the work to be performed, the purpose of the operation, the nature of the radioactive materials to be handled, and the precautions to be taken to protect myself from those materials (including protective clothing, time, distance, shielding, and radiation monitoring). I have no objection to the performance of work with radioactive or hazardous materials.

Trainee: _____

## *Procedures for Ordering / Receiving Radioactive Materials*

1. The Radiation Safety Officer or a sole designate must authorize each order for radioactive materials and ensure that the requested materials and quantities are authorized by the license and that possession limits are not exceeded.

2. The Radiation Safety Officer will establish and maintain a system for ordering and receiving radioactive material. The system must contain the following information:

a. For routinely used materials
   1) Written records that identify the authorized user or department, isotope, chemical form, activity, and supplier will be made.
   2) The above records will be checked to confirm that material received was ordered through proper channels.

b. For occasionally used materials (i.e. therapeutic dosages)
   1) The authorized user who will perform the procedure will make a written request that indicates the isotope, compound, activity, and supplier.
   2) The person who receives the material will check the physician's written request to confirm that the material received is what was ordered.

3. For deliveries during normal working hours, the Radiation Safety Officer will tell carriers to deliver radioactive packages directly to a specified area.

4. For deliveries during off-duty hours, the Radiation Safety Officer will tell security personnel or other designated persons to accept delivery of radioactive packages in accordance with procedures outlined in the sample memorandum below.

Sample Memorandum

MEMO TO: Chief of Security
FROM: Radiation Safety Officer
SUBJECT: Receipt of Packages Containing Radioactive Material

The security guard on duty shall accept delivery of packages containing radioactive material that arrive during other than normal working hours. Packages should be placed on a cart and taken immediately to the Radioactive Materials Storage Room. Unlock the door, place the package on top of the counter, and relock the door. If the package appears to be damaged, immediately contact one of the individuals identified below. Ask the carrier to remain at the hospital until it can be determined that neither the driver, nor the delivery vehicle is contaminated.
If you have any questions concerning this memorandum, please call the Radiation Safety Officer, _____, at extension _____, or mobile # _____.

## *Procedures for Package Opening*

1. Special requirements will be followed for packages containing quantities of radioactive material in excess of Type A quantity limits (e.g. more than 20 curies of Mo-99 and Tc-99m or more than 3 curies of I-131, Cs-137, Ir-192, or more than 1 millicurie of RA-226). They will be monitored for surface contamination and external radiation levels within 3 hours after receipt if received during working hours or within 18 hours if received after working hours. The NYC Health Department will be notified if removable contamination exceeds 0.01 uCi/100 cm2 (22,000 dpm) or if external radiation levels exceed 200mR/hr at the package surface or 10mR/hr at 3 feet (or 1 m).

2. For all packages, the following procedures for opening packages will be carried out:

a. Put on gloves to prevent hand contamination.
b. Visually inspect package for any sign of damage (i.e. wetness, crushed). If damage is noted, stop procedure and notify Radiation Safety Officer.
c. Measure exposure rate at 3 feet (or 1 m) from package surface and record. If it is higher than usual, stop and notify the Radiation Safety Officer. If it is higher than 10mR/hr notify the Radiation Safety Officer and the Department of Health at once.
d. Open the package with the following precautionary steps:
    1) Open the outer package (following manufacturer's directions, if supplied) and remove packing slip.
    2) Open inner package and verify that contents agree with those on packing slip.
    3) Check integrity of final source container (i.e. inspect for breakage of seals or vials, loss of liquid, or discoloration of packaging material).

    If anything is other than expected, stop and notify the Radiation Safety Officer.

e. If there is any reason to suspect contamination, wipe external surface of final source container and remove wipe to low background area. Assay the wipe with an appropriate instrument. The procedure should specify the instrument and method to use. Record amount of removable radioactivity (i.e. dpm/100 cm2, etc.). Take precautions against the spread of contamination as necessary.
f. Monitor the packing material and packages for contamination before discarding.
    1) If contaminated, treat as radioactive waste.
    2) If not contaminated, obliterate radiation labels before discarding in regular trash.

3. Maintain records of the results of checking each package, using "Package Receipt and Monitor Log" or a form containing the same information.

## *General Safety Procedures for Radioactive Materials*

1. Wear laboratory coats or other protective clothing at all times in areas where radioactive materials are used.

2. Wear disposable gloves at all times while handling radioactive materials.

3. Monitor hands and clothing for contamination after each procedure or before leaving the area. Do this in an area away from radiation sources using a thin window pancake probe G.M. with the audio function turned on.

4. a. Do not eat, drink, smoke, or apply cosmetics in any area where radioactive material is stored or used.
   b. Do not store food, drink, or personal effects with radioactive material.

5. Wear personnel monitoring devices (film badge or TLD) 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. Personnel monitoring devices when not being worn to monitor occupational exposures should be stored in a designated low background area.

6. Dispose of radioactive waste only in specially designated and properly shielded and labeled receptacles.

7. Never pipette by mouth.

8. Segregate pipetting devices used with radioactive materials from those used with nonradioactive solutions.

9. Always keep sources, vials, waste, and other radioactive material in appropriately shielded containers.

10. Use a cart to move sources, vials, waste, and other radioactive material. Always transport material in appropriately shielded or spill-resistant containers.

## *Spill Procedures*

**Minor Spills** (Less than 1 millicurie of radioiodines or cobalt-60, and less than 10 millicuries of other radionuclides.)

1. NOTIFY: Notify persons in the area that a spill has occurred.

2. PREVENT THE SPREAD: Cover the spill with absorbent paper.

3. CLEAN UP: Use disposable gloves and remote handling tongs. Carefully fold the absorbent paper and pad. Insert into a plastic bag and dispose of in the radioactive waste container. Also insert into the plastic bag all other contaminated materials such as disposable gloves.

4. SURVEY: With a low-range thin-window GM survey meter, check the area around the spill, hands, and clothing for contamination.

5. REPORT: Report incident to the Radiation Safety Officer.

**Major Spills**

1. CLEAR THE AREA: Notify all persons not involved in the spill to vacate the room.

2. PREVENT THE SPREAD: Cover the spill with absorbent pads, but do not attempt to clean it up. Confine the movement of all personnel potentially contaminated to prevent the spread.

3. SHIELD THE SOURCE: If possible, the spill should be shielded, but only if it can be done without further contamination or without significantly increasing your radiation exposure.

4. CLOSE THE ROOM: Leave the room and lock the door(s) to prevent entry.

5. CALL FOR HELP: Notify the Radiation Safety Officer immediately.

6. PERSONNEL DECONTAMINATION: Contaminated clothing should be removed and stored for further evaluation by the Radiation Safety Officer. If the spill is on the skin, flush thoroughly and then wash with mild soap and lukewarm water. If contamination remains induce perspiration by covering the area with plastic, then wash again.

7. The Radiation Safety Officer will supervise the clean-up of the spill and will complete a report.

RADIATION SAFETY OFFICER:

_____

OFFICE PHONE:_____

MOBILE PHONE:_____

ALTERNATE NAMES AND TELEPHONE NUMBERS DESIGNATED BY THE RADIATION SAFETY OFFICER:

_____

_____

_____

_____

## *Area Survey Procedures*

### Ambient Exposure Rate Surveys

1. Survey Areas

a. In radiopharmaceutical elution, preparation, and administration areas, survey at the end of each day of use with a low-range survey meter.

b. Around devices used for production of radioactive aerosols survey at the end of each day of use with a low-range survey meter, paying special attention to surfaces near the exhaust port.

c. In laboratory areas where only small quantities of energetic gamma-emitting radioactive material are processed (less than 200 microcuries at a time), survey monthly with a low-range survey meter.

2. Immediately notify the Radiation Safety Officer if you find unexpectedly high or low levels.

### Removable Contamination Surveys

1. Survey Areas (Be sure to include floor surfaces and surfaces near the exhaust ports of radioactive aerosol devices when surveying for contamination)
   a. In radiopharmaceutical elution, preparation, and administration areas, survey weekly for removable contamination.
   b. Around devices used for production of radioactive aerosols survey weekly for removable contamination, paying special attention to surfaces near the exhaust port.
   c. In laboratory areas where only small quantities of gamma-emitting radioactive material are processed (less than 200 microcuries at a time), survey monthly for removable contamination.
   d. In radiopharmaceutical storage and radiopharmaceutical waste storage areas, survey weekly for removable contamination.

2. The wipe sample assay procedure should be sufficiently sensitive to detect the presence of 1000 dpm/100 cm2 of removable contamination (200 dpm/100 cm2 for isotopes of iodine. You must use a radioactive source with a known amount of activity to convert sample measurements (usually in counts per minute) to dpm.

3. Immediately notify the Radiation Safety Officer if you find unexpectedly high levels.

**Records**

1. Keep a record of exposure rate and contamination survey results. It must include the following information:

a. The date, area surveyed, and equipment used.
b. The name or initials of the person who made the survey.
c. A drawing of the areas surveyed and contamination and exposure rate action levels as established by the Radiation Safety Officer.
d. Measured exposure rates in mR/hr or contamination levels in dpm/100 cm2, as appropriate.
e. Actions taken in the case of excessive exposure rates or contamination and follow-up survey information.

2. The Radiation Safety Officer will review and initial the record at least monthly

## *WASTE DISPOSAL*

Note: In view of the recent problems with shallow-land burial sites used by commercial waste disposal firms, New York State Department of Health is encouraging its licensees to reduce the volume of wastes sent to these facilities. Important steps in volume reduction are to segregate radioactive from nonradioactive waste, to hold short-lived radioactive waste for decay in storage, and to release certain materials in the sanitary sewer in accordance with Article 16.8, New York State Sanitary Code (10 NYCRR 16).

General Guidance

1. All radioactivity labels must be defaced or removed from containers and packages prior to disposal in in-house waste. If waste is compacted, all labels that are visible in the compacted mass must be defaced or removed.

2. Remind employees that nonradioactive waste such as leftover reagents, boxes, and packing material should not be mixed with radioactive waste.

3. Occasionally monitor all procedures to ensure that radioactive waste is not created unnecessarily. Review all new procedures to ensure that waste is handled in a manner consistent with established procedures.

4. In all cases, consider the entire impact of various available disposal routes. Consider occupational and public exposure to radiation, other hazards associated with the material and routes of disposal (e.g., toxicity, carcinogenicity, pathogenicity, flammability).

5. In New York State the Department of Environmental Conservation regulates releases to the environment and has enacted regulations on the transport of low-level radioactive waste in New York State (6 NYCRR Part 381). These regulations require that a properly executed manifest and a valid transport permit issued by Department of Environmental Conservation accompany all waste shipments.

For further information contact:
New York State Department of Environmental Conservation
Division of Hazardous Substance Regulation
Bureau of Radiation
518-402-9625
Albany, New York 12233

## MODEL PROCEDURE FOR DISPOSAL OF LIQUIDS AND GASES

Liquids may be disposed of by release to a municipal sanitary sewer. This does not

relieve licensees from complying with other regulations regarding toxic or hazardous properties of these materials.

1. Regulations for disposal in the sanitary sewer appear in 16.8(c), New York State Sanitary Code (10 NYCRR 16). Material must be readily soluble or dispersible in the water. There are daily and monthly limits based on the total sanitary sewerage release of your facility. (Excreta from patients undergoing medical diagnosis or therapy is exempt from all the above limitations) Make a record of the date, radionuclide, estimated activity that was released (in millicuries or microcuries), and of the sink or toilet at which the material was released.

2. Releases to the environment are regulated by the New York State Department of Environmental Conservation in 6NYCRR Part 380. You should be conversant with those regulations and possible permit requirements. For further information contact New York State Department of Environmental Conservation at the address given above.

3. Liquid scintillation-counting media containing 0.05 microcurie per gram of H-3 or C-14 may be disposed of without regard to its radioactivity. Make a record of the date, radionuclide, estimated activity (in millicuries or microcuries), calculated concentration in microcuries per gram, and how the material was disposed of.

## MODEL PROCEDURE FOR DISPOSAL BY DECAY-IN-STORAGE (DIS)

Short-lived material (physical half-life less than 65 days) may be disposed of by DIS. If you use this procedure, keep material separated according to half-life.

1. Consider using separate containers for different types of waste, e.g., capped needles and syringes in one container, other injection paraphernalia such as swabs and gauze in another, and unused dosages in a third container. Smaller departments may find it easier to use just one container for all DIS waste. Because the waste will be surveyed with all shielding removed, the containers in which waste will be disposed of must not provide any radiation shielding for the material.

2. When the container is full, seal it with string or tape and attach an identification tag that includes the date sealed, the longest-lived radioisotope in the container, and the initials of the person sealing the container. The container may then be transferred to the DIS area.

3. Decay the material for at least 10 half-lives.

4. Prior to disposal as in-house waste, monitor each container as follows:
   a. Check your radiation detection survey meter for proper operation;
   b. Plan to monitor in a low-level (less than 0.05 millirem per hour) area;
   c. Remove any shielding from around the container;
   d. Monitor all surfaces of each individual container;
   e. Discard as in-house waste only those containers that cannot be

distinguished from background. Record the date on which the container was sealed, the disposal date, and type of material (e.g., paraphernalia, unused dosages). Check to be sure no radiation labels are visible.

f. Containers that can be distinguished from background radiation levels must be returned to the storage area for further decay or transferred for burial.

5. If possible, Mo-99/Tc-99m generators should be held 60 days before being dismantled because of the occasional presence of a long-lived contaminant. When dismantling generators, keep a radiation detection survey meter (preferably with a speaker) at the work area. Dismantle the oldest generator first, then work forward chronologically. Hold each individual column in contact with the radiation detection survey meter in a lowbackground (less than 0.05 mR/hr) area. Log the generator date and disposal date for your waste disposal records. Remove or deface the radiation labels on the generator shield.

## MODEL PROCEDURE FOR TRANSFER FOR BURIAL

Except for material suitable for DIS and some animal carcasses, solids must be transferred to a burial site. Follow the packaging instructions you received from the transfer agent and the burial site operator. For your record of disposal, keep the consignment sheet, or manifest, that the transfer agent gave you. You must also comply with regulations issued by the New York State Department of Environmental Conservation (6NYCRR Part 381) relating to waste manifests and transport permits.

## *PROCEDURE FOR LEAK-TESTING SEALED SOURCES*

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 high-activity sources, 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 is easiest to wipe the entire accessible surface area. Pay particular attention to seams and joints. However, do not wipe the port of beta applicators. Storage containers should also be wiped since contamination can accumulate here.

   b. For larger sealed sources and devices (survey meter calibrator, irradiators), take the wipe near the radiation port and on the activating mechanism.

   c. If you are testing radium sources, they should also be checked for radon leakage. This can be done by submerging the source in a vial of fine-grained charcoal or cotton for a day. Then remove the source and analyze the absorbent sample as described below. A survey should be done to be sure the sources are adequately shielded during the leak-test period.

   d. If you are testing iodine sources, they should also be checked for vapor leakage. This can be done by submerging the source in charcoal or vermiculite for a day, removing the source and analyzing the absorbent sample.

4. The samples will be analyzed as follows:
   a. Select a suitable detector that is sufficiently sensitive to detect 0.005 microcuries. For beta sources, a proportional flow counter, liquid scintillation counter, or thin-end-window GM survey meter may be appropriate. For gamma sources, a crystal with a ratemeter or scaler is usually necessary.
   b. Assay a check source that has the same isotope as the sealed source and whose activity is certified by the supplier. If one is not available, it will be necessary to use a certified check source with a different isotope that has a similar spectrum in order to estimate the detection efficiency of the analyzer used to assay the wipe samples.
   c. Assay the wipe sample. It must be in the same geometry relative to the detector as was the certified check source.
   d. Calculate the estimated activity in microcuries on the wipe sample.
   e. Continue same analysis procedure for all wipe samples.

f. If the wipe sample activity is 0.005 microcuries or greater, notify the RSO. The source must be withdrawn from use to be repaired or disposed of and the Health Department must be notified.
g. Record the wipe sample results on the list of sources, and sign and date

## *MODEL PERSONNEL EXTERNAL EXPOSURE MONITORING PROGRAM*

Personnel monitoring devices should be provided for individuals who are exposed to sources of whole-body radiation, or who handle millicurie quantities of energetic beta or gamma emitting radionuclides.

1. The Radiation Safety Officer will promptly review all exposure reports to look for workers or groups of workers whose exposure is unexpectedly high or low. This procedure does not apply to backup monitor records, for example, pocket ionization chambers, when the monitor of record is a film or TLD.

2. All individuals who are occupationally exposed to radiation on a regular basis will be issued a film or TLD whole body monitor that will be processed by a contract service on a monthly basis. This service must be accredited under NVLAP (a voluntary program for determining that a dosimetry service meets ANSI standards).

3. All individuals who handle millicurie quantities of radioactive material on a regular basis that emit energetic beta particles or ionizing photons, will be issued a film or TLD finger monitor that will be processed by a contract service on a monthly basis.

4. All individuals who are occupationally exposed to radiation on an occasional basis, such as nurses caring for radiopharmaceutical therapy or implant patients, will be issued a whole body monitor when caring for those patients.

5. Other individuals who are exposed to radiation on an occasional basis such as security personnel who deliver packages, secretarial personnel who work in the nuclear medicine clinic but do not work with patients, and nurses who occasionally care for patients who have received diagnostic dosages will not normally be issued exposure monitors.

## *Procedure for Keeping Radiation Exposures As Low As Reasonably Achievable (ALARA)*

Management Commitment

a. We, the management of St. John's University.), are committed to the program described in this document for keeping exposures as low as is reasonably achievable (ALARA). In accordance with this commitment, we hereby describe an administrative organization for radiation safety and will develop the necessary written policy, procedures, and instructions to foster the ALARA concept within our institution. The organization will include a Radiation Safety Committee (RSC) and a Radiation Safety Officer (RSO).

b. We will perform a formal annual review of the radiation safety program, including ALARA considerations. This shall include reviews of operating procedures and past exposure records, inspections, etc., and consultations with the radiation safety staff or outside consultants.

c. Modification to operating and maintenance procedures and to equipment and facilities will be made where they will reduce exposures unless the cost, in our judgment is considered to be unjustified. We will be able to demonstrate, if necessary, that improvements have been sought, that modifications have been considered, and that they have been implemented where reasonable. Where modifications have been recommended but not implemented, we will be prepared to describe the reasons for not implementing them.

d. In addition to maintaining doses to individuals as far below the limits as reasonably achievable, the sum of the doses received by all exposed individuals will also be maintained at the lowest practicable level. It would not be desirable, for example, to hold the highest doses to individuals to some fraction of the applicable limit if this involved exposing additional people and significantly increasing the sum of radiation doses received by all involved individuals.

2. Radiation Safety Committee (RSC)

a. Review of the Proposed Users and Uses

1) The RSC will thoroughly review the qualifications of each applicant with respect to the types and quantities of materials and uses for which he has applied to ensure that the applicant will be able to take appropriate measures to maintain exposure ALARA.
2) When considering a new use of radioactive material, the RSC will review the efforts of

the applicant to maintain exposure ALARA. The user should have systematized procedures to ensure ALARA and shall have incorporated the use of special equipment such as syringe shields, rubber gloves, etc., in his proposed use.

3) The RSC will ensure that the user justifies his procedures and that dose will be ALARA (individual and collective).

b. Delegation of Authority

(The judicious delegation of RSC authority is essential to the enforcement of an ALARA program.)

1) The RSC will delegate authority to the RSO for enforcement of the ALARA concept.

2) The RSC will support the RSO in those instances where it is necessary for the RSO to assert his/her authority. Where the RSO has been overruled, the Committee will record the basis for its action in the minutes of the Committee's quarterly meeting.

c. Review of ALARA Program

1) The RSC will encourage all users to review current procedures and develop new procedures as appropriate to implement the ALARA concept.

2) The RSC will perform a semi-annual review of occupational radiation exposure with particular attention to instances where Investigational Levels are exceeded (100 mrem). The principal purpose of this review is to assess trends in occupational exposure as an index of the ALARA program quality and to decide if action is warranted when Investigational Levels are exceeded.

3) The RSC will evaluate our institution's overall efforts for maintaining exposures ALARA on an annual basis. This review will include the efforts of the RSO, authorized users, and workers, as well as those of management.

3. Radiation Safety Officer (RSO)

a. Annual and Quarterly Review

1) Annual review of the radiation safety program. The RSO will perform an annual review of the radiation safety program for adherence to ALARA concepts. Reviews of specific procedures may be conducted on a more frequent basis.

2) Quarterly review of occupational exposures. The RSO will review at least quarterly the external radiation exposures of authorized users and workers to determine that their exposures are ALARA in accordance with the provisions of Article 6 of this program.

3) Quarterly review of records of radiation level surveys. The RSO will review radiation levels in unrestricted and restricted areas to determine that they were at ALARA levels during the previous quarter.

**Signature of Certifying Official**

I hereby certify that this institution has implemented the ALARA Program set forth above.

_____

Signature Name (print or type)

Title

Institution Name and Address:

# Saint John's University Radioactive Shipment Receipt Record

1. PO # _____Survey Date / Time _____ / ___:___ AM / PM

2. Principal Investigator_____

3. Surveyor (Print)_____(Sign)_____

4. Package Condition: Good?Yes / No Not Good?Yes / No

5. Isotope_____

6. Radiation Units on Label_____

7. Surveyed Radiation Level on Package **(For $^{3}$H[Tritium] do Wipe Test)**

Package / Container Surface: _____

One Meter from Package:_____

8. Do the Packing Slip and Vial Contents Agree with the Following?

IsotopeYes / NoDifference _____

AmountYes / NoDifference _____

Chemical FormYes / NoDifference _____

9. Wipe Test for **Tritium ONLY**

Outer Area_____CPM_____DPM (Efficiency)

Surface of Container_____CPM_____DPM (Efficiency)

Packing Materials_____CPM_____DPM (Efficiency)

10. Receiving Party Information

Name (Print)_____(Sign)_____

Date / Time _____ / ___:___ AM / PM

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