CENTER FOR HEALTH SCIENCES

RADIATION SAFETY MANUAL

May 2015

Oklahoma State University
Center for Health Sciences
RADIATION SAFETY MANUAL

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Approval Date	CHRUC Chair Signature
March 11, 2015	

RADIATION SAFETY MANUAL

The Oklahoma State University Center for Health Sciences has received a limited scope materials license from the Oklahoma Department of Environmental Quality (DEQ) and is subject not only to recognition by the College, but also the rules and procedures of the College. The license delegates administrative responsibilities to the College for possession, use, storage, and disposal of radioactive materials. The DEQ reserves to itself certain rights to revoke or cancel arrangements, to repossess or recall active materials, to inspect facilities and to review procedures.

The receipt, continued existence, and renewal of the license depends on the acceptance and observance of recognized procedures by all members of the faculty and staff of this institution concerned in any way with the handling of radioactive materials. The purpose of such procedures is to ensure insofar as is possible that radioactive materials are handled with the least possible hazard to the individual worker, coworkers, the college facilities, and the general public. Therefore, to comply with federal and state requirements for such procedures, this manual has been adopted by the Chemical Hygiene and Radioisotope Use Committee as a guide for the safe use of radioactive materials, in teaching and/or research. The use of radioisotopes for diagnostic or tracer purposes in humans is specifically prohibited by these guidelines.

This manual along with other policies, required radiation safety forms, information and training can be found online at OSU-CHS Radiation Safety - OSU Center for Health Sciences.

1.0 RADIATION SAFETY PERSONNEL

1.1 Chemical Hygiene and Radioisotope Use Committee Bylaws

The Chemical Hygiene and Radioisotope Use Committee (CHRUC) shall act as the faculty liaison between the PI's, staff and students and the regulatory/compliance arm of the Office of Research. Committee responsibilities consist of; a) development, coordination, implementation, and annual review of the OSU-CHS Chemical Hygiene manual and the Radiation Safety manual, b) work in concert with regulatory/compliance in the Office of Research to maintain oversight and assure compliance with appropriate regulatory compliance rules regarding the safe and appropriate use of (hazardous) chemicals and radioisotopes, c) review all research and instructional activities involving radioisotopes and/or other hazardous chemicals performed by individuals acting as agents of OSU-CHS (e.g., faculty, researchers, staff, students, and employees) and d) formulate recommendations and guidelines concerning hazardous chemical policies in order to assure compliance with applicable laws, regulations, and guidelines, as well as OSU-CHS policies. The CHRUC will work with the Laboratory Safety Coordinator and the Office of Research Regulatory Compliance personnel to stop work where imminent hazards to the health and safety of employees/students exist until the hazards are eliminated. The CHRUC will have a direct report to the Research Committee, but may report to other

entities where appropriate. Membership shall consist of no fewer than five (5) faculty to include one (1) with expertise in the areas of chemical behavior, hazard mitigation, and containment principles, at least two (2) with expertise in the areas of proper radioisotope containment, usage, and handling principles, the Radiation Safety/Chemical Hygiene Officer [RSO/CHO ex officio]. A designate of the Office of Research will serve as an ex-officio member. Meetings shall be held bi-monthly and are open to the public. The committee may close to the public any meeting, or part of a meeting, consistent with protection of privacy; proprietary interests; health and safety of University employees, the environment, and the community; or as required by law or regulation.

1.2 Radiation Safety Officer (RSO)

A Radiation Safety Officer is appointed by the Vice President for Research and Director of Regulatory Compliance of the Oklahoma State University Center for Health Sciences. This individual must have had significant experience with the use of isotopes, successfully completed a certified radiation safety course (DEQ approved). The RSO is responsible for monitoring adherence to the DEQ regulations and this manual concerning radiological safety and health on the campus.

The RSO assumes the following responsibilities:

1. Dissemination of information on radiation safety.

2. Review all proposals for isotope use.

3. Inspection of restricted areas.

4. Approve all new radioisotopes and radiation restricted areas.

5. Obtain all DEQ licenses, amendments and other registrations and licenses associated with radiation for the College.

6. Process the procurement of radioisotopes.

7. Oversee the receiving, storing, processing, and dispensing of all isotopes as well as record keeping pertaining to those activities.

8. Radiation surveys and monitoring of radioisotopes and restricted areas, as needed.

9. Manage radioactive waste disposal.

10. Personnel monitoring planning including processing exposure records.

11. Investigate any incident or spill involving radioisotopes on College property. Oversee decontamination procedures in case of an incident and report incidents to the proper agencies as specified by regulations.

The RSO may investigate the use and method of handling isotopes in the College at any time. The RSO will point out to the individuals using the isotopes any unsafe conditions or practices observed. In the event that the practices are not appropriately modified, the RSO may demand cessation of the project. If cessation of a project is determined, the RSO must report the action to the Director for Compliance and Vice President for Research at once.

The RSO may, with administrative approval, request the services of qualified individuals to assist in carrying out assigned duties, including license development, laboratory monitoring, waste disposal, personnel monitoring, and the ordering and dispensing of radioactive materials.

1.3 Authorized Users (AU)

1. An AU is a faculty member, generally a PI who has received permission to act in this capacity through following the requirements in section 2.3.

2. The authorized user or AU has the responsibility for safe use of radioisotopes in the area assigned and all workers working in the general area including non-radiation workers. The radiation worker may be delegated specific tasks; however, the responsibility for safe use of radioactive material to assure that areas or personnel are not contaminated remains with the AU.

3. The AU must assure that radiation training is up-to-date for themselves and all radiation workers working in the assigned area.

4. The AU shall maintain security of the assigned area including prohibiting all untrained workers from entering the restricted area.

5. The AU shall ensure that all required procedures are being performed in their area and documented in a radiation log, e.g. receipt, surveys, contamination control and personnel monitoring. Required log forms shall be sent to the RSO on a scheduled basis, see Appendix A.

6. Each AU responsible for an approved project using radioisotopes shall keep a current inventory of all isotopes ordered for the project, when they were received, the chemical form of those isotopes, quantities used, disposal procedures, and quantities currently possessed. Those records shall be made available to the RSO as indicated in Appendix A.

1.4 Radiation Workers

1. Each individual using radioisotopes (or "radiation worker or user") on the college campus does so with explicit consent to abide by all state regulations pertaining to such use and all College requirements as outlined in this manual.

2. Each radiation worker is required to follow the instructions of the AU and be aware of emergency procedures including spill control. They must be aware of how to reach the AU for the project and the RSO at all times during unsupervised work.

3. Each radiation worker shall attend the initial 40-hour radiation safety training before working in a restricted area without supervision; thereafter-annual radiation safety refresher training is required.

4. The radiation workers are required to be aware of the radiation log and the entry requirements, survey procedures and radioactive waste procedures.

5. The radiation workers shall be aware of their environment while working and stop work if a hazardous situation is present or suspected until it can be resolved.

2.0 RADIATION STANDARDS AND AUTHORIZATION PROCEDURES

The worker is referred to 10 CFR Part 19 "Notices, Instructions and Reports to Workers: Inspection and Investigations" and10 CFR Part 20 "Standards for Protection Against Radiation"; other applicable Parts of the Nuclear Regulatory Commission, Title 10 of the Code of Federal Regulations (10 CFR); Oklahoma Title 252. Department of Environmental Quality, Chapter 410 Radiation Management; Consolidated Guidance about Materials Licenses, NUREG-1556, Vol. 7, "Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope"; and the CHS Material License and application. These documents describe acceptable procedures and standards which must be followed to protect workers in processing, handling, and disposing of radioactive materials. These documents also establishes limits which govern exposure of personnel to radioactive materials or instruments and provides for certain precautionary procedures and administrative controls. The purpose is to reduce, to an acceptable level, the risk that any person will be injured by radiation during any step in the course of procuring, handling, and disposing of radiation-producing materials.

Therefore, these regulations and the information contained in this manual apply to all persons who receive, possess, use, dispose, or transfer radioisotopes under a license issued by the DEQ Commission to the Oklahoma State University Center for Health Sciences (OSU-CHS).

All laboratory documentation for approvals and radioactive material handling shall be placed in a radiation log. An example of the log content and forms that shall be placed in

the log upon completion can be found in Appendix A "Radiation Users Safety and Log Forms."

2.1 Definitions

For all purposes of the regulations, the following definitions shall apply:

ALARA is as low as is reasonably achievable.

ALI Annual limit of intake which would result in the maximum level of occupational exposure of a given radionuclide (10 CFR 20, App. B).

Absorbed dose of any ionizing radiation is the energy imparted to matter by ionizing particles per unit mass of irradiated material at the place of interest. The unit of absorbed dose is the rad.

Authorized User is a person who is named on the license, who uses or directly supervises the use of licensed material, and is responsible for the safe and compliant use of licensed material in the laboratory or area.

Calendar quarter means any of the following periods:

- January 1 – March 31
- April 1 – June 30
- July 1 – September 30
- October 1 – December 30

College refers to The Oklahoma State University Center for Health Sciences (OSU-CHS).

Commission means the Department of Environmental Quality (DEQ) of Oklahoma.

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

DEQ The Department of Environmental Quality of Oklahoma has been given the authority as an "agreement state" by NRC to operate the nuclear regulatory program for Oklahoma. It may be known as the Commission.

Dose, as used in these regulations, means dose expressed in REM (see the definitions of REM).

Dose rate is the dose per unit time.

High Radiation Area means an area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour at 30

centimeters from the radiation source or 30 centimeters from any surface that the radiation penetrates.

Monitoring is the determination of the amount of radiation or radioactive material present in any location or of the dose received by the person.

NRC is the Nuclear Regulatory Commission or its duly authorized representative.

Personnel monitoring is the determination of the radiation dose received by the person during a specified period by film badges, small ionization chambers, or other dosimeters.

Principal Investigator (PI) tenure track or research faculty with assigned research laboratory space at CHS.

Radiation (ionizing radiation) mean alpha particles, beta particles, gamma rays, x-rays, neutrons, high speed electrons, high speed protons, and other atomic particles, but not sound or radio waves, or visible, infrared, or ultraviolet light.

Radiation Area means any area, accessible to personnel, in which there exist radiation at such a level that a major portion of the body could receive in any one hour a dose in excess of five millirem at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

Radiation Safety Officer (RSO) is a person qualified by training and/or experience to implement the radiation protection program.

Radioactive material or source is any material, solid, liquid, or gas that emits radiation spontaneously. A "sealed source" is a quantity of radioactive material enclosed to prevent the escape of any radioactive material.

REM is the unit of dose and is equal to the dose in rads multiplied by the appropriate relative biological effectiveness.

Restricted Area means an area, access to, which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. It is an area under the supervision of an individual in charge of radiation protection, generally an authorized user. (This implies that a restricted area is one that requires control of access, occupancy, and working conditions for radiation protection purposes). The boundaries of a restricted area shall be determined with the advice of the RSO and CHRUC.

Sealed source is a quantity of radioactive material enclosed to prevent the escape of any radioactive material.

Survey is a critical evaluation of the hazards and the risk of injury from a source of radiation.

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

Very High Radiation Area means an area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in 1 hour at 1 meter from a radiation source or 1 meter from any surface that the radiation penetrates.

2.2 Training Programs

The training program will be provided online through the oversight of the RSO with training specific to the experimental work provided by the AU. New user and annual refresher training is assessed by observation of work in the restricted area. Notification of training quiz pass completion is maintained in the CHS research safety training database.

Certain personnel may have occasion to work near restricted areas, however not work directly with radioactive materials. These personnel are known as "ancillary personnel" and include employees from shipping and receiving, security, physical plant and those who work near restricted areas but are not radiation workers. A briefing module has been developed to help ancillary personnel recognize radioactive materials, and identify the hazards and the safeguards one should use when working around these materials. The module will be provided by their supervisor and may be accessed online or as a hardcopy, signed once read and the signature page sent to the RSO.

1. Training of New Radiation Users

   Individuals that are new or have had no practical experience with radiation safety will be trained for approximately 40 hours before duties begin as radiation workers. The individual will be trained using various methods e.g. online instruction, videotapes, classroom instruction, and observation. Training will include topics listed in section 2.2(2) "Training for All Radiation Users". The trainees will receive training specific to the restricted area by the AU and have oversight of procedures and practical application in which first no radioactivity is used and then normal radioisotope use. An online or written examination will be given to the individual to determine if the person has a good grasp of concepts important to radiation safety and regulatory requirements.

2. Training for All Radiation Users

   Annual safety refresher training will be provided to the individuals currently using radioactive materials through online training; observation of compliance during workplace inspections to identify, communicate and correct inappropriate actions; and through classroom instruction. This

training is required annually for AUs, other employees and students participating in radiation work. Topics will include the following:

- Principles and practices of radiation protection.
- Radioactivity measurements, monitoring techniques, and using instruments.
- Mathematics and calculations basic to using and measuring radioactivity.
- Biological effects of radiation.
- Safe handling procedures for the protocols to be used in the lab.
- Areas properly designated for use of radioactive material in the lab.
- Recording radioactive material receipt, usage and disposition.
- Maintaining security of radioactive material and appropriate waste practices.
- Radiation emergency procedures.
- Applicable topics listed in NUREG 1556, vol.7 Appendix J

2.3 Authorized User Approval

A conscientiously organized working environment allows for safe and confident work with radioactive materials. A solid foundation requires a qualified person; the "authorized user" (AU), generally the principal investigator, who directly supervises the radioactive material.

An AU shall control the use and is responsible for the safe and compliant use of radioactive materials in a laboratory (restricted) area that is approved for such work. Individuals desiring to become an AU will make their intentions known to the CHRUC by making application on form RS-3 "Radiation Authorized User Application" and sending it to the RSO. The RSO will send copies to the CHRUC who will in turn, review the application to determine if:

- The applicant has had sufficient training and/or experience with radioisotopes so as to carry out the proposed work in a knowledgeable and safe manner

- The applicant will generally be required to meet a minimum of the following requirements: A college degree at the bachelor level (or equivalent training) in physical, chemical or biological sciences or in engineering, and at least 40 hours of training and experience in the safe handling of radioactive materials, the characteristics of ionizing radiation, units of radiation dose and quantities, radiation detection instrumentation, and biological hazards of radiation exposure.

- The applicant agrees to follow all college, state, and federal regulations governing the use of radioactive materials; all responsibilities listed in section 1.3 and agrees to assume all responsibility for personal injury resulting from failure to comply with such requirements.

- The applicant meets any special medical requirements that the RSO, CHRUC or DEQ may stipulate from time to time depending on radioisotope and planned use.

- The applicant may be asked to take a written exam to demonstrate retention of radiation safety techniques.

If in the opinion of the CHRUC the applicant is qualified, a letter will be sent to the applicant stating such and an amendment to the materials license to the DEQ by the RSO will be sent requesting that the individual be authorized to use radioactive materials under the license. Once the AU is approved by the CHRUC and DEQ (and their name appears on the revised CHS materials license) the AU will be allowed to use radioactive materials in an approved restricted area under an approval to use radioactive materials in a specific project.

2.4 Radiation User Approval

Persons, including students, other than the AU may work as radiation users once the following conditions are met:

- an AU agrees to supervise the user and assume responsibility for their safety and compliance in work with radioactive materials

- the user has received the "Radiation Safety 40 Hour Training" and is approved by the RSO

- the AU completes the online "Supervisor's Information and Completion Form" component of the training

- the AU informs the RSO and requests and receives a personal dosimeter for the person working as a radiation worker

- the AU ensures the radiation worker receives the "Radiation Safety Refresher Training" annually or other training as lack of work skills may suggest

2.5 Approval of Restricted Areas

The restricted area must be designated, set apart, and set up appropriately and specifically for safe use of the radioactive materials being used. The restricted area must provide security from unauthorized access or removal, for work with and storage of radioactive materials. It must provide storage areas, *either the storage unit or the room,* which can be locked to prevent access to the material and structured so that workers will be with "line of sight" of the materials whenever licensed materials are in use.

1. Classification of Location of Use

Radioactive materials are to be used only in restricted areas, facilities (e.g. rooms, areas) that have been approved by the RSO and the CHRUC for use of radioactive materials. Based on the radiation levels the area will be considered a “radiation,” “high radiation” or “very high radiation” area. The area must be labeled as such. See section 2.1 “Definitions” to determine the type of area in which use shall occur. At CHS the least restrictive area, less than that described as a radiation area, will be posted with the words "Caution-Radioactive Materials".

2. Requests for Restricted Area Approval

AUs desiring to use radioactive materials in a restricted area which has not been approved by the CHRUC must submit a complete description of equipment, fixtures, and other facility features, using form RS-2 “Restricted Area Approval Request” in addition to submitting a diagram of the restricted area and any adjacent laboratory area. The form may be submitted with form RS-1”Radiation Material Project Use Approval” or after RS-1 is approved, as the radioactive material use approval may have an impact on requirements for the restricted area and financing of equipment requirements. However, the restricted area approval form must be received and approved prior to a radioactive materials procurement application is submitted. Representatives of the CHRUC will examine each restricted area and either approve or make recommendations for improvement prior to approval.

3. Monitoring Instruments

Unless specifically exempted by the CHRUC or the RSO, each laboratory in which radioactive materials are used shall have on hand and in operating condition, a properly calibrated survey or monitoring instrument appropriate to the type and level of ionizing radiation used.

4. Other Radiation Safety Equipment

The RSO and the CHRUC may require the use of other special equipment or devices that are determined to be necessary to assure the safe use of radionuclides in a given situation. This includes special shielding, handling tools or tongs, alarms and warning devices, air sampling equipment, and other such apparatus.

5. Radiation Waste

Radioactive waste containers are required as specified in Section 5. Liquid radioactive waste can be disposed, after appropriate dilution, down designated sinks depending on type of radioisotope and quantity. Designated radiation sinks must be limited and thus the sink indicated on

the form may not be in the restricted area for which the form is being completed.

6. General Laboratory Floor Plan

   The general floor plan consists of approximately 180 square foot laboratory for a single space laboratory and a double space laboratory consists of 360 square foot in building A. The dimensions of laboratories in building E are approximately 780 square feet and 1500 square feet. The layout of the laboratory shall be designed to prevent contamination and facilitate decontamination. See Appendix B for a generic diagram and schematic of radioisotope ventilation hood. The area shall be well lighted.

7. Specific Diagram

   A specific diagram of the laboratory that contains the restricted area shall be developed by the AU. It will be attached to contamination survey forms to show where wipes were taken. The diagram shall indicate radiation use, storage, radiation effluent sinks, safety related equipment and waste areas; show relationship between restricted area and unrestricted area; place general location of hoods, counters, refrigerators and other equipment; and indicate what sites and equipment will be routinely surveyed for contamination. The relevant features should be shown with applicable name and sites planned to be surveyed should include a number.

2.6 Approval of Projects using Radioactive Material

The project material use must be evaluated thoroughly to ensure the necessary safeguards and training is made available.

Approvals for use of radioactive material will be granted in terms of "projects", taking into account the type and level of material to be used, the method of use, the restricted area where the material will be used, and the personnel involved. For purposes of these procedures, "project" is understood to refer to a particular usage of radioactive materials and is not necessarily the same as or associated with a particular budget or grant. The procedures for obtaining and maintaining approval for use of radioactive materials in a project are:

1. Submit form RS-1, "Radiation Material Project Use Approval", for each radiation "project". (This should normally be submitted by the AU).

2. The work to be performed, including licensed isotopes and quantities as set forth in the "Specific application of compound" section of form RS-1 is commensurate with the AU knowledge and ability as indicated in form RS-3, "Radiation Authorized User Application" and the use approved by DEQ on the CHS Material License. Table 1 below shows the CHS site limits.

Table 1. CHS Material License Site Limits

Byproduct or source	Chemical and/or physical form	Max. amount licensee may possess at any one time
Carbon-14	Any (non-volatile)	30 millicuries
Cesium-137	Sealed sources	150 microcuries
Chromium-51	Any (non-volatile)	10 millicuries
Hydrogen-3	Any (non-volatile)	250 millicuries
Iodine-125	Any (non-volatile)	30 millicuries
Phosphorus-32	Any (non-volatile)	50 millicuries
Phosphorus-33	Any (non-volatile)	50 millicuries
Sulfur-35	Any (non-volatile)	25 millicuries

3. If the project is to be carried out in a laboratory or area not already approved for such work, submit form RS-2, "Restricted Area Approval Request".

4. Upon receipt of the above forms, the CHRUC will determine the adequacy of the precautionary procedures set forth. Projects judged to meet the requirements of qualified personnel, adequate facilities and proper handling procedures will be approved.

5. Upon approval of the "project", the applicant will be notified by letter and return of submitted form RS-1, "Radiation Material Project Use Approval" signed by the RSO and CHRUC chair. The letter and form will carry an authorization number which the applicant must use in further communication such as ordering radioactive materials for use in the "project".

6. Project approvals will expire after three years, but are renewable upon written request to the CHRUC through the RSO and submission of a new form RS-1, checking the upper box "Renewal (3yrs)".

7. An annual review shall be submitted to the CHRUC through the RSO on form RS-1 by placing the date in the upper area "Annual Review Date." Projects may be amended at this time to report such changes as types or levels of materials, the procedures, the restricted areas, or personnel.

8. Procedural changes may be made at any time by submitting form RS-1, checking the upper box "Modification" and sending for review by the CHRUC through the RSO.

2.7 Ordering Radioactive Materials

The RSO shall process the procurement of radioactive material including exempt quantities through submission of a hard copy or online form RS-5 "Radiation Materials Order Form" by the AU or delegated person ensuring that the requested material and quantities are authorized by the license and that the possession limits

are not exceeded. The procurement shall be according to procedures established for procurement of any other item by the College or its faculty or staff, with the following additional requirements:

- The project for which the radioactive material is to be used must have prior CHRUC approval
- The Project Authorization Number must accompany the request
- The RSO must maintain a copy of all requisitions for radioactive materials.

2.8 Receipt of Radioactive Materials

All shipments of radioactive materials, either sealed or unsealed, shall be received by the lab personnel who ordered the material or the RSO shall be notified, for safety checks, accounting and proper storage. The RSO will be notified and maintain current accurate records by receipt of a completed copy of form RS-6 "Radiation Materials Receipt Report" completed by the lab personnel receiving the radioactive material. Certain procedures shall be followed by lab personnel upon receipt of all shipments of radioactive materials that are labeled DOT Radioactive White I, Yellow II, or Yellow III.

1. Monitoring shall be performed as soon as practical after receipt, but no later than **three hours** after the package is received at the College. Packages should not be received after normal working hours. If a package is received outside of normal working hours, it shall be surveyed within three hours after the beginning of the next workday.

2. The package will be opened using the following safe opening procedures:

    i. Wear gloves to prevent hand contamination.
    ii. Place package on absorbent material to prevent contamination to surface area.
    iii. Visually inspect the package for any sign of damage (e.g. crushed, punctured). If damage is noted, stop and notify the RSO.
    iv. Monitor the external surfaces of a labeled package for radiation level and survey for contamination.
    v. Open the outer package (following supplier's directions if provided) and remove packing slip.
    vi. Check DOT White I, Yellow II, or Yellow III label or packing slip for activity of contents, so shipment does not exceed license possession limits. See section 2.6, Table 1 for license possession limits. (The material is required to be returned if limit is exceeded)
    vii. Open inner package to survey and verify contents (compare requisition, packing slip and label on the bottle or other container).
    viii. Check integrity of the final source container (e.g. breakage of seals or vials, loss of liquid, discoloration of packaging material, high-count

rate on wipe). Again, check that the shipment does not exceed license possession limits.

ix. If you find anything other than expected, stop and notify the RSO.

x. Survey the packing material and packages for contamination before discarding. If contamination is found, treat as radioactive waste. If no contamination is found, obliterate the radiation labels prior to discarding in the regular trash.

xi. Maintain records of receipt, package survey, and wipe test results on form RS-6 “Radiation Materials Receipt Report”.

3. If radiation levels are found on the external surface of the package in excess of 200 mR/hr, or at three feet from the external surface of the package in excess of 10 mR/hr, or if radiation contamination is found to be greater than 22 dpm/cm^2 the RSO shall immediately notify the final delivery carrier and the DEQ hotline, 1-800-522-0206.

4. After the material has been received and if labeled as White I, Yellow II or III-monitored, and recorded, it shall be placed in proper storage. A record of the material details, each usage and disposal activity shall be recorded on form RS-7 “Radiation Materials Accountability Record”.

3.0 PROCEDURES FOR USING RADIOACTIVE MATERIALS

The worker is referred to Part 20, "Standards for Protection Against Radiation", U. S. Nuclear Regulatory Commission, Title 10, Chapter 1, Code of Federal Regulations. This regulation establishes standards which must be followed in handling radioactive materials. It also prescribes limits which govern exposure of personnel to radiation and concentrations of radioactive material which may be discharged into air and water, and disposal of radioactive wastes. In addition, it establishes certain precautionary procedures and administrative controls. In addition to procedures stated in this manual, the standards and regulations provided in 10 CFR 20 are those with which workers at CHS are expected to comply. As future amendments or modifications of regulations become official, they will apply, unless alternative regulations that are applicable are provided by the CHRUC and approved by DEQ.

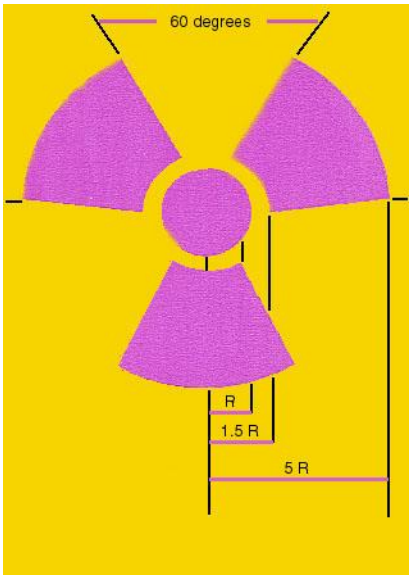
A copy of the current Part 20, "Standards for Protection Against Radiation" is available for review or inspection in the office of the RSO.

3.1 Labeling and Signs

1. All stored and in use isotopes will be labeled with the warning insignia described below. The label will also identify which isotope is being stored, the chemical form of that isotope and the quantity.

2. All such radiation warning signs and labels shall bear the standard symbol as shown below:

Standard Radiation Warning Sign.



3. The standard color specifications for these radiation warning signs and labels shall be background of yellow with the distinctive symbol in purplish-red (magenta).

4. The use of this symbol for any other purpose is expressly prohibited. The symbol and the lettering used with it shall be as large as practical, consistent with size of the equipment or material. The lettering shall not be superimposed on the symbol.

5. The user shall use such signs or labels to designate each restricted area. In addition to posting signs and labels, the restricted area (use or storage area) shall not be readily accessible when not occupied.

6. Where feasible, the user shall put such signs or labels on radiation equipment and on all containers, source holders, manufactured products or other items containing radioactive material or that reside in the restricted area. Labels placed on such containers shall specify the nature of the isotope contained and the quantity where appropriate. The user is not required to label small laboratory containers, such as test tubes and scintillation vials, used for a short time while under the control of the user.

7. Laboratories with signs denoting radiation areas shall bear the name and telephone number of the principal investigator of that area and the RSO so they can be notified in case of emergency.

8. The AU shall remove all signs and labels bearing the radiation symbol when radioactive material is no longer present and the restricted area has been decommissioned.

9. Each restricted area shall have posted "General Radioisotope Safety Procedures" and "OSU-CHS Laboratory Emergency Response". These documents can be obtained under Manuals at the CHS Research Safety Training and Information online site or by contacting the RSO.

10. Each hallway that leads to a laboratory with a restricted area has a posting entitled "Notice to Employees", DEQ Form #410-3(4/01). This document has safety questions and answers for radiation workers.

3.2 Unsealed Source Use

Extreme personal cleanliness and careful techniques are the primary means of preventing contamination and protecting against ingestion of activity. In order to minimize contamination and to prevent entrance of activity into the body, the following rules must be observed in radioisotope laboratories where unsealed sources are used:

1. Eating, drinking, food preparation, food storage, food wrappers in lab trash and application of makeup will not be permitted in areas where licensed materials is used or stored.

2. The pipetting of radioactive solutions by mouth is not permitted. Remote pipetting devices shall be available and mandatory for such applications.

3. If personal dosimeters are required to be worn they shall be worn whenever working in a restricted area. When not in use the dosimeters shall be stored in CHS, at a distance from the restricted area where they will received no activity, not in direct sunlight or heat and not taken out of the building.

4. It is advisable that new radioactive experiments should be done with dry runs, complete in every detail, are made with non-radioactive materials. Such runs should be made until the procedure is reproducible, and safety and waste minimization improvements incorporated as needed.

5. Any work with materials susceptible to atmospheric distribution (that is, from vaporizing, spillage, dusting, effervescence of solution, or other releases of radioactive gas) should be done in a radioactive use hood.

6. Extreme precautions must be taken to avoid cuts or puncture wounds, especially when working with materials of high radiotoxicity and/or of high activity.

7. Care must be exercised when using organic solvents to avoid skin contact with radioactive materials. Solvents may make the skin more permeable.

8. Protective clothing, e.g. lab coat, close-toed shoes, safety glasses and devices as needed shall be used for all manipulations with unsealed

sources. In particular, suitable gloves shall be worn. Surgical glove techniques should be used for putting on and removing gloves in order to avoid contaminating the inside surfaces. Frequent glove changes should be made to minimize exposure to the individual and avoid the spread of contamination in the restricted area or the possible penetration of gloves by radioisotopes. Two sets of gloves are recommended for all procedures.

9. Laboratory clothing or protective garments (such as lab coats) used only in restricted areas shall be worn when working with radioactive materials. This clothing shall be monitored routinely during work hours and when work with the radioactive material is complete. Such garments shall not be released for washing or cleaning until they have been monitored by the user and found to be free of contamination. Such garments shall not be worn elsewhere (outside the restricted area or in "clean" areas). Articles that show contamination shall be left in the work area, or other areas designated for this purpose. Such clothing shall be marked by the user with name, the date, and the nature and degree of contamination and held for storage until the activity has decayed to background level; or decontaminated; or disposed as radioactive waste.

10. Thorough monitoring of hands, feet and clothing is mandatory whenever leaving a radioisotope area (except where using isotopes that cannot be directly surveyed, i.e. ^{3}H, ^{14}C; and then frequent contamination surveys should be done).

11. Appropriate shielding that consists of a high density plastic shall be use to separate the user from radioactive materials, including generated waste, that emit high energy beta radiation.

12. Appropriate shielding that consists of lead bricks shall be in use with materials including generated waste that emit x-ray and gamma radiation.

13. Secure all licensed material when it is not under the constant surveillance and immediate control of the user.

14. Continue to keep appropriate form RS-7 "Radiation Materials Accountability Record" up-to-date as material is used. Perform routine inventories of materials.

3.3 Controlling Contamination

1. Auxiliary containers, absorbent disposable paper, and covers shall always be used where danger of spills and contamination of the person or equipment is possible.

2. Contaminated equipment and tools, or equipment that has been used and is suspected of contamination, shall remain in a restricted area unless it is decontaminated inside and out and then it may be released for general use.

3. Maintain good housekeeping, e.g. tools, equipment, and apparatus when used, may be placed in non-porous metal trays or pans, which are lined with absorbent disposable paper. This paper should be monitored and changed frequently.

4. Equipment that is not immediately necessary to the operations being performed shall not be brought into the restricted area.

5. Removable contamination shall not be allowed to remain on floors. This is particularly important in the low energy isotope laboratories where shoe covers are not routinely required. Where floors are known or suspected of being contaminated, the area involved shall be immediately restricted to further traffic and designated as a shoe cover area until such time as it is shown to be free of removable contamination.

6. Decontaminate all spills and areas found to be contaminated as soon as possible

7. When there is reasonable possibility that chemical, radiation, or other action might lead to leakage of radioactive material from a container, the user shall provide a secondary tray or catchment to the container adequate to retain the entire amount of radioactive material.

8. Any transfer of materials must be done in such a manner as to avoid the possibility of spillage or breakage. Double containers are recommended in such manipulations.

3.4 Sealed Source Use

A sealed source is one in which radioactive material is permanently encapsulated (in stainless steel, plastic, glass lacquer or other material) to prevent leakage, and in which the intent is to utilize the radiation emitted rather than the material itself. It is imperative that handling information be obtained and followed for each type of sealed source. Different isotopes and encapsulation will have different techniques to use safely.

1. General Handling Precautions

   i. Some sealed sources should not be handled directly by the hands. The use of remote handling tools for sources of high activity is essential to minimize both whole body and hand exposure.

   ii. Users of sealed sources should monitor themselves routinely during periods of work with the sources to assure that source rupture or leakage has not occurred.

iii. Under no circumstance should a user attempt to repair a ruptured or leaking source.

iv. In the case of devices containing sealed sources, users may use the device only as recommended by the manufacturer. Sources may not be removed from such devices except in those cases where the devices are specifically designed for usage of the source outside of the device.

v. Repair of devices containing radioactive sources is normally not permitted when such repair involves those parts of the device containing the source. The RSO should be consulted to determine the conditions under which minor repairs or corrections may be authorized.

vi. Secure source when not under the constant surveillance and immediate control of the user.

2. Leak Testing

Unless otherwise exempted by Commission regulations (see 10 CFR 39.35 which exempts beta and gamma sources 100 µCi or less), periodic leak test are required on all sealed sources.

i. Such tests will be carried out at intervals not to exceed 6 months, except in cases where the Commission specifically permits a longer interval for particular sources.

ii. Required leak tests will be performed by the RSO or an authorized representative. Users are required to make their sealed sources available for such tests at the necessary intervals. The list of sources, data and calculations shall be signed, dated and retained for 3 years.

iii. Whenever leak tests reveal the presence of 0.005 µCi or more of removable contamination on a sealed source, the source must be immediately removed from further use and steps must be taken to control the spread of contamination. The Commission shall be notified.

iv. Leaking sources must either be disposed of as radioactive waste or returned to the manufacturer for repair.

3. Source Inventory

All sealed sources in use or in storage must be inventoried every 6 months. A record shall be maintained for 3 years that contains date of inventory, radionuclide, quantities, manufacturers name and model number.

3.5 Maximum Permissible Levels of Dose Allowed

The maximum permissible level for external total body radiation or the deep dose equivalent for adult workers shall not exceed 5 rems (0.05 Sv) annually or 1.25 rem (12.5 msieverts) per calendar quarter. A rate greater than 0.1 rem per week is not allowed except when operating conditions require a higher rate for a special project in compliance with 10 CFR 20.1206.

The deep dose equivalent for exposure to a limited portion of the body shall be the same as for whole-body exposure except that the lens of the eye is limited to 15 rems (0.15 Sv), and the shallow dose equivalent to the skin of the whole body or to the skin of any extremity is limited to a maximum of 50 rems (0.5 Sv).

CHS shall ensure that the dose equivalent to a declared pregnant woman's fetus does not exceed 0.5 rem during the term of the pregnancy. A declared pregnant woman is one who voluntarily declares her pregnancy in writing to her supervisor. Additional information for a pregnant woman is provided in Regulatory Guide 8.13. Records related to dose during the term of the pregnancy must be maintained by the RSO until the license is terminated.

No individual under 18 years of age may receive in any one calendar quarter or annually from radioactive material and radiation producing devices a dose in excess of 10 percent of the limits specified above for adult workers.

Even with the established dose limits mentioned previously, the DEQ/NRC requires that every operation limit exposures so that the dose received will be "As Low As Reasonably Achievable" or ALARA. The term ALARA means making every reasonable effort to maintain exposures to radiation as far below the dose limits as is practical consistent with the purpose of the activity undertaken, the state of technology available, economic gains, and societal and socioeconomic considerations.

The dose limits listed above represent the total additive exposure from all components of radiation involved.

3.6 Personnel Monitoring

Adults working with radioactive materials under the College's DEQ license are required to wear personnel monitoring devices whenever entering a restricted radioisotope area under conditions where they are likely to receive a dose in excess of 10% of the limits listed in section 3.5. Minors shall be monitored where doses are likely to be in excess of a deep dose equivalent of 0.1 rem, a lens dose equivalent in excess of 0.15 rem, or a shallow dose equivalent to the skin or to the extremities in excess of 0.5 rem and declared pregnant women who are likely to receive during the entire pregnancy a deep dose equivalent in excess of 0.1 rem.

1. Exemptions from Personnel Monitoring Devices

Personnel monitoring devices may not be required in cases where it has been definitely established by the RSO and CHRUC that external exposures will not exceed the specified limits. Although dose evaluation of worker's monitoring equipment for whole body and extremity dosimetry for recent years using records provided by a National Voluntary Laboratory Accreditation Program-approved dosimetry service is well below the 10% exceedance limit, the CHRUC has determined that all radiation workers will be required to wear monitoring devices. This decision was made to ensure exposure is ALARA.

2. Film Badge and Dosimeter Service

The RSO issues Luxel® Plus OSL Dosimeters to individuals who require them. Ring badges will be required for individuals working under conditions where it is likely that annual hand exposures may exceed 5 rems for hands.

The dosimeter, when required, must be worn at all times when the individual is occupationally exposed. It should be worn in a fashion so as to indicate whole body exposure (breast, pocket, collar, or belt) except in the case of ring, wrist or ankle badges.

The dosimeter is not to be worn when the individual is undergoing diagnostic or therapeutic radiation exposure.

When not in use, the dosimeter should be stored in a location away from radiation (not in excess of background), excessive heat, sunlight or moisture. The dosimeter should not be taken from the licensed building.

3. Records and Reports

Permanent records of dosimeter exposures are maintained by the RSO (NRC Form 5 or other equivalent forms). Copies of these reports are distributed annually to all monitored individuals.

In cases where the dosimeter report that is provided every other month for each individual exhibits doses that exceed 100 millirem, the RSO will notify the individual and supervisor in writing of the exposure as a means of alerting the individual and supervisor to investigate experimental procedures to determine further ALARA practices.

Upon written request by an individual, the RSO will provide a copy of the individual's permanent occupational exposure history. Records of exposure will be forwarded to new employers upon written request of the individual using form similar to RS-10 "Authorization for Releasing Radiation Exposure Information".

4. Tritium (^{3}H) Bioassays

Personnel using ^{3}H in activities in excess of 100 mCi in the form of water or gas and personnel performing activities in excess of 25 mCi in any other form will be required to have a urine assay performed within one week of single contact or weekly for repeated use.

- In these and subsequent statements, "repeated use" is taken to mean operational procedures involving separate contacts with the stated activity amounts which occur at times averaging less than a week apart.
- Liquid scintillation counting of urine specimens for ^{3}H activity is the accepted bioassay procedure. If ^{3}H levels greater than 25 µCi/liter are observed in an assay, the person involved will be required to cease all use of ^{3}H pending further investigation. Levels greater than 2.5 µCi/liter will be considered "cause for concern" and immediate steps will be taken to review the mode of operation.

5. Iodine (^{125}I or ^{131}I) Bioassays

Personnel performing operations which involve only simple handling and/or dilution of ^{125}I or ^{131}I purchased in forms stabilized by the addition of a reducing agent will be required to undergo bioassays upon use of activities in excess of 25 mCi. The assays will be performed within one week of single contact or weekly for repeated use.

Personnel performing iodination operations using ^{125}I or ^{131}I in activities in excess of 5 mCi will be required to undergo bioassays within one week of single contact or weekly for repeated use.

Bioassays will consist of a gamma count of thyroid activity carried out at a hospital approved by the CHRUC. A detectable thyroid burden will be treated as "cause for concern".

The RSO will be furnished a copy within 48 hours of the record of each bioassay showing levels in excess of the limits stated above; a permanent record will be kept of all bioassays even though the results may be negative. Persons performing the bioassays and the method of procedure will have the prior approval of the RSO.

NOTE: Under current use conditions, CHS personnel are not using radioactive materials at or above the limits discussed in this section. As such, the College does not have an active bioassay program. It is the PIs responsibility to notify the RSO if their programs plan to use such levels.

NOTE: These figures apply only to persons 18 years of age or above; in this regard or any other involving radiation exposure of persons under 18 years of age, refer to 10 CFR 20. Background levels also will be

established, as stated above, for persons whose duties require them to work in an area where they would likely ingest material released in case of an incident.

3.7 Audit Program

The DEQ periodically conduct laboratory inspections. The licensee, CHS, through the RSO is required to conduct annual audits. The audits are for the purpose of reviewing each research group's compliance with the College radiation safety program. The inspection process involves the review of recordkeeping (e.g. usage log, waste disposal, and lab survey reports), radiation safety practices, and restricted area requirements. Following are some details of radiation issues that are audited:

- Safe handling procedures for the protocols to be used in the lab.
- Areas properly designated for use of radioactive material in the lab.
- Recording radioactive material receipt, usage and disposition.
- Appropriate location of radioactive waste containers and any special waste procedures applicable to isotope and work performed in lab.
- Procedures for post-work surveys and routine documented surveys of radiation work performed at required intervals.
- Maintaining security of radioactive material.
- Radiation emergency procedures posted and followed.

Audit and inspection records are required to be kept on file for 3 years.

4.0 PROCEDURES FOR MONITORING OF WORK AREAS

4.1 Radiation Survey Standard Operating Procedures

State and Federal regulations require routine monitoring for contamination of workspace in which radioactive isotopes are used. The frequency required is based on the isotope, the quantity used and how often the isotope is used. The isotope should have a minimum survey frequency as denoted in Table 2 below. The contamination survey frequencies are based on the Annual Limit on Intake (ALI) for the lowest value of either ingestion or inhalation found in 10 CFR 20, App. B, Table 1. If licensed material has not been used for a period of time greater than the required survey frequency, then it is considered to be "not in use" and shall be surveyed every 6 months.

Table 2. Radioactive Isotope Minimum Frequency of Surveys

In Use Survey Frequency	Monthly Less than .1 ALI in µCi	Weekly .1 ALI to 1 ALI in µCi	Daily greater than 1 ALI in µCi	Lowest value ALI for oral/inhalation in µCi
hydrogen-3	7999.99	8000.0 to 80000	80000.01	8.00E+04
carbon-14	199.99	200.0 to 2000	2000.01	2.00E+03
phosphorus-32	59.99	60.0 to 600	600.01	6.00E+02
phosphorus-33	599.99	600.0 to 6000	6000.01	6.00E+03
sulfur-35	199.99	200.0 to 2000	2000.01	2.00E+03
chromium-51	3999.99	4000.0 to 40000	40000.01	4.00E+04
iodine-125	3.99	4.0 to 40	40.01	4.00E+01
cesium-137	9.99	10.0 to 100	100.01	1.00E+02

Check with the RSO to assure compliance if you are unsure of the frequency required for your survey requirements.

An online form, RS-9 "Radiation Contamination Survey Form" will allow regular reports to be sent to the RSO. Also, a printable format of form RS-9 may be used to log your surveys, send a copy to the RSO and maintain a record for audits.

4.2 Methods for Performing Surveys

Routine surveys should be carried out in two parts to determine both radiation levels and removable contamination levels with the exception of use of ^{3}H and ^{14}C. Due to low energy, when using ^{3}H and ^{14}C only the removable contamination levels will need to be determined. Dose-rate surveys are required where workers are exposed to radiation levels that might result in radiation doses in excess of 10% of the occupation dose limits (see section 3.5). Although personnel dosimetry monitoring and calculations show that CHS radiation workers are not exposed at that level, routine surveys are conducted to maintain ALARA levels.

1. Radiation Levels

   Radiation levels or dose-rates, e.g. in the restricted area, near radioactive materials, personnel (frisk) surveys, are taken with a survey meter sufficiently sensitive to detect 0.1 mR/hr, to assist in determining exposure monitoring. Contamination surveys are more commonly performed to determine unintentionally deposited radioactive material on surfaces and equipment in the restricted area and other nearby surfaces where the radioactive materials may have been spread, e.g. handles, phones, keyboards. An end window GM or gas flow proportional counter normally

may be used for assaying beta emitters at or above C-14 energies. Radiation level results are documented on form RS-9 "Radiation Contamination Survey Form" and are associated with a laboratory diagram to show what areas have been surveyed. All fields in the form must be completed.

2. Removable Contamination

"Wipe" tests or generally what is known as removable contamination surveys are conducted by wiping a 100 cm^2 area of surface, using an "S" wiping motion or other motion that does not require going over the same area twice, with an absorbent material (e. g. fiber disk, cotton swab) that may be moistened with detergent solution, water or an appropriate solvent. Estimate, document and consider in calculations the area wiped when wiping uneven surfaces, do not wipe over an area twice. (Note: wipes may be used dry except when wiping surfaces such as clothing). The wipes are placed in scintillation vials with a specified amount of scintillation fluid and then counted per equipment instructions. (Note: take care not to place fingers around the sides of the vials, e.g. shake holding vial by rim, use tissue when securing lid or change gloves often). The activity per 100 cm^2 of surface shall be calculated in DPM.

A background count of 5-10 minutes is recorded using the same counting conditions used with the wipes.

Low energy beta emitters will require liquid scintillation counting. A gamma-scintillation counter (example: NaI well counter), should be used for pure gamma emitters. The analyzer threshold must be set below the lowest gamma energy source used in the lab (usually I-125).

In case of wipes contaminated with gamma emitters, the radionuclide can be identified from successive counts with different analyzer settings if the settings have been calibrated with known energy standards.

Ideally, any contamination more than a few DPM above background should be cleaned up; however, a more usual level for β - γ at which cleanup is initiated is about 200 DPM. At approximately 1000 DPM a contamination zone shall be established until the contamination is removed. The RSO shall be contacted if a contamination zone is designated. Take the steps to decontaminate in accordance with section 7.0 "Emergency Procedures"

4.3 Laboratory Monitoring Devices

1. Area Monitors

Laboratories in which sources (sealed or unsealed) may give rise to radiation levels such that whole body doses in excess of 5 mR/hr are

possible (or 100 mR in any 5 consecutive days), are required to have on hand and in operating condition a calibrated monitoring instrument capable of measuring the exposure or dose rate for the type and energy of radiation in use.

2. Contamination Survey Meters

Except as provided in 3 below, laboratories using unsealed sources are required to have on hand and in operating condition a sensitive survey instrument capable of detecting the presence of the radionuclide in use when such nuclide is brought, unshielded, in close proximity to the detector. An absolute calibration shall not be required for such a survey meter, except that it shall be capable of detecting 0.05 μCi (10^5 dpm) of the nuclide in question.

The survey meter must be used frequently during and following work to determine the presence of activity on working surfaces and on the body and clothing.

The survey meter shall be calibrated annually. The meters are returned to the manufacturer for calibration.

3. Exemption from Survey Devices

In the case of work with tritium (^{3}H), and certain low levels of other nuclides as may be specified by the RSO, a laboratory survey meter will not be required; however, the individual user must monitor the work area by means of a standard wipe test when work is in progress.

4. Special Monitoring Instruments

For unusual high levels and for certain nuclides of high radiotoxicity, the CHRUC may specify the use of special types of survey instruments or area monitors. These will be considered and specified on the basis of individual projects and/or specific areas.

5. Air Sampling Devices

In cases where the CHRUC believes that radioactive aerosols or gases may be generated or released, air sampling equipment or air monitoring devices appropriate to the type and level of activity will be required.

6. Instrumentation

See Appendix C for detectors that should be used to monitor radiation types.

5.0 WASTE DISPOSAL

5.1 General Waste Procedures

Most of the radioactive wastes that will be produced at the College shall be stored on campus for radioactive decay, sewer disposed or transported elsewhere by an authorized recipient for permanent disposal. Non-radioactive waste such as leftover reagents, boxes, and packaging shall not be mixed with the radioactive waste.

It shall be the responsibility of all AUs producing radioactive waste to be aware of the appropriate disposal method to use, disposal limits and to conform to all requirements pertinent to safe disposal. The AU shall ensure that the disposal information on form RS-7 "Radiation Materials Accountability Record" for the material being used is current and a copy is sent to the RSO when the material is expended.

The volume of radioactive waste should be kept as small as practical, segregated and labeled according to type. In particular, efforts shall be made to furnish information concerning the nature of wastes being collected for subsequent disposal by affixing a label reading "Caution Radioactive Material" and noting, 1) user and department, 2) isotope(s), 3) estimated total activity in waste (mCi or µCi), 4) date of estimation, and 5) if applicable, any constituents that may affect the disposal methods, such as corrosives, solvents, or biological materials.

It is strongly recommended that all radioactive waste materials or equipment be removed from the working area as rapidly as possible. During the time that these materials or equipment remain in the working area, with the exception of low level isotopes, shielding should be utilized to minimize the radiological risks and hazards.

Where the radioactive waste contains strong acids, bases or biological material, the user is required to neutralize or disinfect the waste before determining one of the waste disposal methods below.

In the case of organic solvents, especially those that may be highly volatile or otherwise reactive, appropriate precautions must be noted on the waste container.

Arrangements shall be made by the RSO for pickup of radioactive waste that cannot be made non-radioactive. The waste shall be transferred to a properly certified/licensed entity for shipping and final disposition of the specific waste type. All appropriate manifests and other documentation will be completed. Copies will be retained by the College until the license is discontinued by DEQ.

5.2 Solid or Dry Waste

Special waste containers for disposal of dry contaminated wastes are to be available in all laboratories using unsealed radioisotopes. These are generally

yellow bags with the radiation symbol and appropriate labeling. Users should contact the RSO regarding the type of dry-waste containers recommended.

If waste cans with a plastic bag liner are necessary, they will normally be purchased by the user. Waste containers must be conspicuously labeled with a "Caution Radioactive Material" sign. In addition, inside liner bags (yellow), when filled, shall be sealed and properly labeled with the standard radioactivity caution label and should bear the following additional information: 1) user's name and department, 2) isotope(s), 3) estimated total activity in waste (mCi or µCi), 4) date of estimation and 5) if applicable, any constituents that may affect the disposal methods, such as corrosives, solvents, or biological materials.

The RSO shall be contacted to remove to long-term storage the labeled solid waste bags once they are sealed properly. Large containers shall be made available by the RSO for long-term storage of solid waste in an area separate from common travel and/or occupancy by personnel. This area of storage is a radiation storage shed near the dock that is posted, locked and maintained by the RSO.

Separate waste containers applicable to the isotope used shall be provided by the AU for storage of short-lived waste materials (short-lived shall indicate those materials with half-lives of 120 days or less). Disposal methods for short-lived material are discussed in section 5.5.

5.3 Sanitary Sewer Disposal

Whenever the release of any liquid waste will exceed the maximum radioactive concentration limits of 10 CFR 20, App. B, table 3, the waste shall be

- diluted below the maximum concentration limits and then released to the sewer,
- if a short-lived radioisotope, held for radioactive decay to a point below the maximum concentration limits and then released as non-radioactive waste, or
- prepared for shipment to an authorized recipient of waste

When release to the sewer is planned, the radioactive material must be readily soluble or biological material easily dispersed in water. Biological material must be disinfected prior to release. Filtration of effluent must occur prior to release, where there is solid material in the waste. Solid material will be managed according to section 5.2.

The radioactive concentration limits of 10 CFR 20, App. B. table 3 may be complied with by dividing the total quantity of radioactivity to be released in a month by the monthly average volume of water released into the sewer from CHS (see Appendix D), then diluting as necessary, adding an additional 20% to the dilution amount to ensure an adequate margin of error. All calculations shall be documented in the radiation log.

In addition to using the sewage system's dilution factor, it is advisable to use an additional dilution factor at the point of release by running a constant stream of water while slowly discharging waste to a sink designated for radioactive waste disposal. This will minimize the possibility of a slug effect where a material might remain concentrated all the way through the sewage system.

After the waste is discharged, the sink and surrounding work surfaces shall be surveyed to confirm that no residual material or contamination remain in the sink or on work surfaces. Prior to leaving the area, decontaminate all areas or surfaces, if found to be contaminated.

The possibility exists of several individuals using the sewage system dilution factor simultaneously. To assure that this problem does not arise, the individual user shall notify the RSO whenever the campus sewage system's dilution factor will be used in liquid waste disposal calculations to conform to maximum concentration values. If a conflict on time of disposal exists, the RSO will arrange another time for the project involved.

Calculations and disposal information shall be retained by the AU in the radiation log or transferred to the RSO to be retained until the license is discontinued by DEQ.

5.4 Liquid Scintillation Counting Medium

Medium used for scintillation counting of ^{3}H or ^{14}C at a concentration of 0.05 µCi or less per gram of medium may be disposed of as if it were not radioactive. Records shall be retained of all such disposal until the license is terminated by DEQ.

5.5 Decay in Storage (DIS)

The decay of isotopes that have a half-life of 120 days or less may be disposed by decay in storage (DIS) procedures. The DIS isotopes shall be segregated from other isotopes. The radioactive material shall be segregated by physical state (liquid or solid) as well.

Waste containers shall be labeled with the radioactive material symbol and the isotope that is contained. The containers shall be placed within suitable storage for the material that will provide adequate shielding for personnel working in the area while the material is decaying. The containers must be suitable for the physical state (liquid or solid) of material being stored. Waste containers shall be sealed when they are filled and labeled indicating the date in which it was sealed, date when 10 half-lives of the longest-lived radioisotope should expire and the initials of the individual who sealed the container.

After a minimum of 10 half-lives of the isotope, the container shall be monitored as follows:

- Check survey instrument for proper calibration and proper operation.
- Monitor and record background radiation level.
- Survey and record results of each container in an area with low background radiation, making sure that after the outside container has been surveyed that the shielding is removed and the contents are surveyed to assure that all surfaces are monitored.

If survey results indicate that there is no residual radioactivity (indistinguishable from background radiation), then the contents may be disposed of in ordinary trash (for solids) or sinks (for liquids). All radioactive labeling will be defaced. The survey shall be documented in the radiation log to record the date the waste was sealed and placed in storage, date of disposal, radionuclide disposed, physical type of material disposed (liquid or solid), survey instruments used, initials of the individual that performed the surveys, and type of waste (e.g. used or unused material, paper waste).

If survey results indicate that residual radioactivity is higher than background radiation, then the contents must remain in storage until the survey indicates that the radioactivity is indistinguishable from background readings. The RSO will advise users on the amount of time to wait if the 10 half-lives have passed and the material is still emitting residual radioactivity, based upon the survey results.

5.6 Gaseous and Airborne Wastes

In cases where the release of volatile radioactive products or radioactive aerosols is anticipated, means should be provided to trap such materials (either by chemical or physical methods). The resultant product activity shall be calculated to determine whether the waste shall be considered radioactive waste or if it may be handled as liquid or dry waste as appropriate.

5.7 Animal and Other Biological Wastes

We are currently not licensed to use radioactive compounds with animals. If you wish to use animals with radioactive compounds, contact the RSO for an amendment of the current license.

6.0 RECORDS, REPORTS, AND NOTIFICATION

6.1 Records of Surveys, Radiation Monitoring and Disposal

The RSO shall maintain records showing the radiation exposures for all individuals for whom personal monitoring is required including, where applicable, exposure records related to accidents or emergency conditions. Such records shall be on NRC Form 5, in accordance with the instructions for NRC Form 5 or in clear and legible records containing all the information required by NRC Form 5. A copy of Form 5 is sent to the user annually and is available in the RSO's office for viewing upon request.

In addition, records shall be maintained showing the results of all bioassays required of individuals pursuant to this document.

The above exposure records and all records related to exposure to radiation workers and non-radiation workers shall be retained until the Commission terminates the CHS license.

The AU shall also maintain records including associated calculations, with a copy sent to the RSO, of all radioisotope waste disposal, such as dry waste, sewer disposed liquids, material decayed in storage, and any special wastes such as scintillation vial liquid disposed as not radioactive. These records must be maintained until the Commission terminates the CHS license. If so desired, these records may be maintained electronically or given to the RSO for permanent storage.

The AU shall also maintain records, with a copy sent to the RSO, showing the results of radiation level and contamination surveys of work areas and receipt of incoming packages containing isotopes. These records shall be kept for three years.

6.2 Reports of Theft or Loss, Exposure or Property Damage

Contact the RSO if any of the following situations occur. The RSO will make a determination based on 10 CFR 20, Subpart M if a report to DEQ is required. However, the CHS current license limits for most radioisotopes would likely preclude the necessity of regulatory reports.

- Lost, missing or theft of radioactive material in such quantities and under such circumstances that it appears to the College and the CHRUC that a substantial hazard may result to persons in unrestricted areas.
- Exposure beyond normal safe working practices of personnel or public to radioactive material.
- Property damage caused by an incident involving radioactive material.
- Release of radioactive material to non-restricted areas.

7.0 EMERGENCY PROCEDURES

7.1 Actions Common to All Incidents

It is necessary to fully and accurately report any incident to the appropriate AU. The AU can then determine if it is required to report the incident to the RSO and CHRUC. This report may have an important bearing on staff health and legal responsibilities and may assist the RSO in making a detailed study for the purpose of avoiding similar incidents in the future.

All incidents should be investigated and appropriate measures should be taken to prevent repetition of the incident. The form "Report of Laboratory Safety Incident" shall be completed for all incidents. Also, if an incident involves personnel contamination the "Employee Injury Report" shall be completed.

7.2 Incidents Involving Radioactive Contamination

Never impede or delay medical assistance because of radiation contamination response requirements.

Radioactive materials may be unintentionally released by a spill, by a failure of equipment or by rupture of a sealed source. The actions that may be appropriate to prevent widespread contamination and exposure of personnel in such a case, and the order in which such actions should be taken, will depend upon the circumstances involved. For example, in the case of a small spill of liquid it may be desirable to contain and clean up the contamination immediately without severely affecting the routine activities in the room in which the spill occurs. However, an unreported or unknown release may be spread outside of the restricted area and require a relatively extensive response of evacuation and efforts to locate and decontaminate all contaminated areas and personnel. Actions frequently desirable in cases of unintentional releases of radioactivity are listed below. Although some effort is made to list these actions in the approximate order in which they are likely to be appropriate, some of these actions will be appropriate only in cases of large releases or under special conditions.

The protection of personnel and the containment of the radioactive material in the room in which the incident occurs should be given primary consideration. If the spill or release is of such a nature that, in the judgment of the person immediately responsible for the work, it is advantageous to take immediate action to contain the material or limit its release, such action may be appropriate.

Persons directly contaminated by a wet spill should immediately remove clothing affected and thoroughly wash the hands and other contaminated areas of the body.

If an inhalation hazard exists, all person not involved in carrying out planned safety procedures should vacate the contaminated area immediately.

The AU and the RSO or a representative in the area should be given all the available information on the nature and extent of the release.

If evacuation of the room is required, it will generally be desirable to shut off all mechanical ventilation and to close all outside openings. However, there may be local conditions that require consideration. For example, if the release occurs in or near a fume hood, it may be disadvantageous to take any action that would discontinue ventilation by the hood.

After all persons are out of the room, it may be desirable to prevent further escape of aerosolized radioactive material from the room by sealing doors and other closures with adhesive tape.

Persons suspected of inhaling or ingesting considerable quantities of radioactive material should seek or be given immediate medical attention as discussed in "Decontamination of Personnel," section 7.3(1).

Except in case of injury or other urgent need, persons who have been evacuated from a contaminated area should not leave the immediate evacuation area until they have been monitored and necessary precautions, such as the removal of shoes or outer clothing, taken to limit further spread of radioactivity.

The extent of the area of contamination should be determined and the area roped off, with appropriate warning or guards.

The person in charge of measures for dealing with incidents, or a designated alternate, should arrange for immediate decontamination of personnel as required.

Safe and efficient decontamination of the working area and equipment will generally require careful planning based on an evaluation of all factors involved. In general, the following sequence of procedures will be involved.

1. Locate and contain the contamination.

2. Assess the contamination and plan clean-up operations.

3. Reduce the contamination by appropriate methods.

4. Assess the residual contamination and repeat the procedures as necessary.

The AU for the restricted area shall ensure that personnel carrying out decontamination procedures shall don personal protective equipment (e.g. gloves, lab coat, goggles, disposable booties) and be provided with appropriate instructions and equipment for their own protection and for the protection of other personnel.

Minimum supplies (to be readied in advance by the AU) needed to clean up a radiological spill: Plastic bags, "Caution Radioactive Material" tape; absorbent material (i.e. paper towels, blue pads, gauze pads, Q-tips); and decontamination detergent like "rad con," "radiac con," or mild soap; brush and scoop. Also, appropriate protective clothing, to include, but not limited to, disposable gloves, disposable booties, lab coats, and safety goggles. A portable survey meter and/or materials for taking swipes will be needed.

All materials generated from decontamination procedures shall be considered radioactive waste and treated as such.

7.3 Decontamination of Personnel

Under the RSO's direction, the restricted area AU shall set up instructions and supplies (materials and equipment) for decontamination and first aid procedures prior to a possible incident. The staff shall be fully acquainted with these procedures.

1. Measures to be taken in Case of Internal Contamination

   Radioactive contamination of personnel can be internal through ingestion, inhalation, wounds, or skin penetration. If anyone suspects internal contamination in case of an incident during work, it should be immediately reported to the RSO and measure taken to seek medical care.

   Internal contamination is essentially a medical problem parallel in some ways to the absorption of chemical toxins. Special corrective procedures should therefore combine with normal medical practice under medical advice and supervision.

2. Measures to Follow in the Event of External Contamination

   The goal of localized skin decontamination is to decrease the external contamination to a level of no more than 2 times background.

   Begin decontamination with areas of highest contamination.

   In a water deficient environment, gently brush skin surface to remove a portion of the outer layer and dislodge contamination held by skin proteins.

   In a water sufficient environment, wash victims (or have victims wash themselves) with tepid water and soap or commercial product purchased for decontamination. Avoid damaging or abrading the skin.

   - Add mild soap (neutral pH) to water to emulsify and dissolve contamination.
   - Direct contaminated wastewater away from victim rather than over the rest of the body.

   Use serial washcloths, gauze pads or surgical sponges between washings to dry the contaminated area and to avoid recontamination. Monitor the area following each washing. Swipes will need to be taken and monitored for alpha and weak beta emitters.

   Repeat washing and monitoring up to 2 additional times.

While decontaminating the face, special care should be taken not to contaminate the eyes or lips.

Decontamination of the eyes should be undertaken immediately. Not only the radioactive isotope is to be considered, but also the chemical nature of the contaminant and eventual complications due to foreign bodies and mechanical or chemical irritants. Immediate irrigation of the eyes for 15 minutes with tepid water or with appropriate medically approved solutions is recommended. After this first procedure, every case of contamination should be submitted to medical personnel and further evaluation.

Attempts to remove contamination that resists washing should only be made under medical supervision.

All materials generated from decontamination procedures shall be considered radioactive waste and treated as such.

7.4 Decontamination of Equipment

1. Decontamination of Glassware and Tools

The decision to decontaminate material must take into account the continuing value of the material compared to the personnel risk associated with the cleaning products and the cost of decontamination.

Where the half-life of the contaminating element is short, it may be desirable to store tools and glassware for decay of activity rather than to attempt decontamination.

Decontamination of equipment should generally be done as soon as possible after its use. In many situations, this will prevent the contamination from becoming fixed and from being ultimately more difficult to deal with. It will often be found that surfaces that have been kept moist are easier to clean.

The cleaning of contaminated glassware and tools should be done with great care by informed persons in a well-ventilated hood set aside in the laboratory for that purpose, or in special decontamination areas.

Glassware can be cleaned by any of the normal chemical or commercial cleaning agents suitable for radioactivity decontamination. Some chemical cleaning agents are concentrated nitric acid, ammonium citrate, pentasodium triphosphate and ammonium bifluoride.

If it is necessary to dismantle any equipment prior to decontamination procedures, careful monitoring should be carried out during the operation.

Metal tools and similar equipment may be washed with a detergent combined with brisk brushing to dislodge trapped contamination. Contamination resisting this treatment may be washed in stronger agents including dilute nitric acid or a 10% solution of sodium citrate or ammonium bifluoride. Other cleaning agents can be chosen based on the equipment's construction material and the likely chemical nature of the contaminant. Stainless steel could be treated with sulfuric acid or, as a last resort, hydrochloric acid.

If the decontamination causes any corrosion of the metal, future decontamination will be more difficult to remove and a coat of glossy paint on the decontaminated surface is desirable. Contamination prevention by the use of strippable coatings or plastic covers is useful. A coat of paint may provide adequate protection from weak emitters which prove resistant to decontamination.

The uptake of radioactive substances by glassware may be reduced by a preliminary treatment with the corresponding inactive chemical.

In some instances, immersion in solutions of the non-radioactive isotope of the contaminant may be tried, although this is a slow procedure.

The solutions used for cleaning should not be returned to the stock bottles between uses but considered liquid radioactive waste.

Laboratory equipment should be surveyed for residual contamination following decontamination procedures. If the residual contamination indicates that the level of activity remains greater than that specified as permissible, equipment should be labeled as radioactive and only used in the restricted area or should be regarded as radioactive waste.

2. Decontamination of Working Areas, Benches, and Other Surfaces

As soon as possible after contamination of working areas, benches, and other surfaces has occurred or has been detected decontamination should be carried out by suitably equipped and informed persons.

All surfaces should be cleaned by wet methods if possible, as the use of dry methods may create a dust hazard. For materials of porous construction which prove unsuitable for cleaning by wet methods, vacuum cleaning with proper filtration of the rejected air might be attempted; in any case, special precautions in using dry techniques are necessary.

Cleaning tools should be labeled as radioactive and assigned to the area in which the operations are being performed and not removed or used elsewhere without careful decontamination.

Paintwork can be cleaned with soap (or detergent) and water or, in extreme cases, removed with a paint remover. Polished linoleum or tile can be cleaned with soap and water, followed, if necessary, by the removal of the wax polish by means of a solvent.

If the contamination is by alpha or weak beta emitters, the radiation may be possibly controlled by painting over. The use of two coats with the undercoat in contrasting color is useful to indicate any wearing away of the protective coat. This method of contamination control should be used with caution with respect to future possible uses of the installation. Documentation of this procedure shall be fully described, provided to the RSO and retained until license is discontinued.

If after attempted decontamination adequate protection cannot be assured, the contaminated rooms or premises should be abandoned and contaminated removable objects disposed of in accordance with requirements. Access to these abandoned areas should be forbidden to unauthorized persons and such areas should be identified by an appropriate and recognizable warning sign.

3. Decontamination of Clothing or Similar Items

In any handling of contaminated clothing, appropriate precautions should be taken to prevent or control contamination of the worker and of the surrounding areas by the formation of aerosols. The sorting of contaminated garments will often need to be carried out in a fume hood. Care must be taken to prevent airborne contamination from clothing placed in storage.

Contaminated clothing and linen should not be released to public laundries without the approval of the RSO.

With short-lived radioactive contamination, storage is recommended until the activity has fallen to safe levels.

It is usually desirable to wash the contaminated clothing in specially provided areas where decontamination can be monitored. Personnel in charge of these facilities should be provided with protective coats, goggles and suitable gloves.

Contaminated garments should be segregated into batches of differing degrees of activity to avoid cross-contamination.

Routine washing of moderately contaminated clothing may be carried out using a standard detergent (chosen on the basis of economy) for the soap and avoid specialty detergents that may fix the activity in the fabric.

Clothing with resistant contamination of high levels of activity is dealt with by longer periods of washing and especially by repeated rinses.

Rubber gloves and other rubber goods and plastics usually decontaminate readily. Such items should first be washed with an ordinary laundry formula. If this does not prove effective, rubber items can be washed in dilute nitric acid or agents chosen in the light of the nature of the contamination. This should be followed by a wash using scouring powder and thorough rinse in running tap water.

If the clothing or similar items cannot be decontaminated to a safe level, they should be regarded as radioactive waste.

All materials generated from decontamination procedures shall be considered radioactive waste and treated as such.

7.5 Fire, Explosion or other Major Emergency

Workers will follow normal evacuation procedures, fire department and other safety officials will be notified. Fire fighters will be notified of where the radioactive materials are located or stored. The RSO will provide advice, as needed, to the firefighters on how best to avoid risk and creating contamination. The Incident Commander, normally the fire department person in charge of the response to the incident, will take charge of directing all response. Generally, contamination surveys will be conducted of the area to note if any contamination did occur, before emergency personnel will enter the area in which radioactivity was present. Surveys will be done on fire personnel and their equipment. Decontamination will occur as needed. The RSO will assist, as needed, with the decontamination of personnel or equipment. Bioassays will be considered when radioactive material may have penetrated the skin, been inhaled, or ingested. The DEQ will be notified about the incident.

8.0 REGISTRATION AND EXEMPTIONS

8.1 Registration

If not required to be listed on the CHS limited scope license the RSO shall register non-exempt radiation material; that is accelerator produced, naturally occurring or generally licensed; in use with DEQ within 30 days after receipt of the source. The registration shall be submitted on a form provided by the DEQ entitled “Registration of Users of Radioactive Materials” that describes the radioactive material, location and use. The registration shall also give the name and address of the user, and the name and a brief statement of the qualifications of the Radiation Safety Officer.

Acknowledgment of registration shall not imply the DEQ’s approval or disapproval of the conditions described in the registration.

8.2 Exemptions

The following materials, machines, conditions, and individuals are exempt from these regulations:

- Radioactive materials of an equivalent specific radioactivity not exceeding that of natural potassium. (10^{-9} curies per gram of potassium)

- Concentrations or quantities of radioactive materials not exceeding the amounts specified in 10 CFR 30.70 or 10 CFR 30.71, respectively, providing the user does not possess more than 10 such quantities, and also providing the dose rate to the whole body at the point of nearest approach to such radioactive materials does not exceed 0.5 rem per year. The manufacturer of sealed sources shall not be exempt.

- Domestic television receivers, providing the dose rate at five cm from any surface is less than 0.5 rem per hour.

- Other electrical equipment that produces radiation incidental to its operation for other purposes, providing the dose rate to the whole body at the point of nearest approach to such equipment when any external shielding is removed does not exceed 0.5 rem per year. The production testing or factory servicing of such equipment shall not be exempt.

- Radiation machines which cannot be used in such manner as to produce radiation. (For example, X-ray machines in transport or electrical equipment in storage.)

- Other sources of radiation that the DEQ finds should be exempted provided such exemptions are consistent with nationally recognized standards.

9.0 REFERENCES

- Instruction Concerning Prenatal Radiation Exposure, http://pbadupws.nrc.gov/docs/ML0037/ML003739505.pdf

- Standard: Title 252. OK Department of Environmental Quality; Chapter 410. Radiation Management, http://www.deq.state.ok.us/rules/410.pdf

- Standard: NRC Regulations 10 CFR Part 19--Notices, Instructions and Reports to Workers: Inspections and Investigations, http://www.nrc.gov/reading-rm/doc-collections/cfr/part019/

- Standard: NRC Regulations 10 CFR Part 20--Standards for Protection Against Radiation,

http://www.nrc.gov/reading-rm/doc-collections/cfr/part020/

- NRC (Nuclear Regulatory Commission) Guide, NUREG-1556, Vol. 7
  http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1556/v7/index.html

- General Radioisotope Safety Procedures

Appendix A

Radiation Users Safety and Log Forms

RADIATION LOG CONTENTS (contents and instructions are required, however format may be determined by radiation users)

The authorized user shall be responsible to ensure that the log is correct and current.

Section 1 – Authorized User Approval
- RS-3 Radiation Authorized User Application
- Authorized User Approval Letter

Section 2 – Current Projects
- RS-1 Radiation Material Project Use Approval Forms
- RAM User Approval Letter

Section 3 – Use Facilities
- RS-2 Restricted Area Approval Request
- Restricted Area Diagram (label all radiation use, storage areas, safety features and number all areas to be routinely surveyed for contamination)

Section 4 – Material Orders and Use Records
- RS-5 Radiation Materials Order Form*
- Receipt Copy
- RS-6 Radiation Materials Receipt Report
- RS-7 Radiation Materials Accountability Record

Section 5 – Isotope Frequency Contamination Surveys
- RS-9 Radiation Contamination Survey Form (survey frequency determined by isotope and amount used)
- In Storage, Not in Active Use documentation; Contamination Survey every 6 Months

Section 6 – Notification from New Radiation Workers
- RS-10 Authorization for Releasing Radiation Exposure Information

Forms: http://www.healthsciences.okstate.edu/research/osuchs/forms.php

(*note: Complete RS-5 Radiation Materials Order Form online form using the "submit" button or complete the "fill-in" format and submit electronically or by campus mail to the Radiation Safety Officer, Research Office, laurie.stclair@okstate.edu,who will order materials. The RS-9 Radiation Contamination Survey Form also has a form where the "submit" button may be used of the person completing the form may use the "fill-in" format.

Send remainder "fill-in" copies upon completion to the Radiation Safety Officer, Research Office, laurie.stclair@okstate.edu, (561-1403)

OKLAHOMA STATE UNIVERSITY
CENTER FOR HEALTH SCIENCES
1111 West 17th Street
Tulsa, OK 74107

Do not write in this space
Project Authorization #
_____

Renewal Date
_____

RADIATION MATERIAL PROJECT USE APPROVAL
(COMPLETE, OBTAIN DEPARTMENT CHAIR SIGNATURE; THEN SEND TO RADIATION SAFETY OFFICER)

New ☐ Modification ☐ Annual Review Date _____ Renewal (3yrs) ☐

Title of Project: _____

Authorized User: _____ Department: _____
Personnel: Training:

Start Date: _____ Completion Date: _____

Material Used: _____ Isotope: _____

Location: _____

Specific application of compound(s) (attach brief description of project and requirements for safe use)

Range of radioactivity used in each experiment: _____

Method of contamination survey _____ Frequency _____

Method of disposal for each type of waste _____
(if needed, attach information on each type of waste generated and procedure for disposal)

Maximum amount of material possessed at any one time: _____

When approved, place Project Authorization # above on all further radiation safety forms

SIGNATURE SECTION

APPROVED _____ Date _____
Department Chair

APPROVED _____ Date _____
Radiation Safety Officer

APPROVED _____ Date _____
Chemical Hygiene and Radiation Use
Committee Chair

Return copy to Authorized User

OKLAHOMA STATE UNIVERSITY
CENTER FOR HEALTH SCIENCES
1111 West 17th
Tulsa, OK 74107

RS Authorization #

RESTRICTED AREA APPROVAL REQUEST

(COMPLETE ONLY FOR NEW RESTRICTED AREA OR WHEN AREA CONFIGURATION, EQUIPMENT, ETC. HAS CHANGED; OBTAIN DEPARTMENT CHAIR SIGNATURE; THEN SEND TO RADIATION SAFETY OFFICER)

Department _____ Room number _____

Responsible Authorized User _____

Staff member in charge of restricted area _____

Attach Scaled Diagram of Restricted Area Room (designate: 1. radiation use and storage areas, 2. label by location and number where contamination swipes are taken, 3. relationship between restricted areas and non-restricted areas, 4. shielding and other safety equipment, 5. types of waste accumulation areas, 6. radiation effluent disposal sink, 7. area for coats, personal items)

Type Floor Covering _____

Walls and Ceiling (Paint or Coating) _____

Bench Top Material _____

Hood needed? ___yes ___ no; If Yes: Flow Rate with sash open _____fpm

Describe safety features of hood _____

Describe RAM effluent release sink _____

Describe RAM waste containment _____

Number of persons normally working in area _____

Educational level of persons in area: ___ undergrad; ___ grad;
___ technician, ___ postdoc or faculty

Are all personnel working in this room approved radioisotope workers? _____ yes _____ no

Is this room also used for study/office area for research personnel? _____ yes _____ no

List Monitoring Devices Located in Restricted Area (make, model, type, range):

Special handling equipment (shielding, covering, glove boxes, etc.):

Additional comments, remarks, and safety precautions:

SIGNATURE SECTION:

APPROVED _____ Date _____
Department Chair

APPROVED _____ Date _____
Radiation Safety Officer

APPROVED _____ Date _____
Chemical Hygiene and Radiation Use Committee Chair

Return copy to Authorized User

OKLAHOMA STATE UNIVERSITY
CENTER FOR HEALTH SCIENCES

1111 West 17th
Tulsa, OK 74107

RADIATION AUTHORIZED USER APPLICATION

(COMPLETE, OBTAIN DEPARTMENT CHAIR SIGNATURE; THEN SEND TO RADIATION SAFETY OFFICER)

STATEMENT OF TRAINING AND EXPERIENCE

Name _____ CWID # _____

Department _____ Date _____

Planned Isotope(s) Use _____ Max. Amount at any one Time _____

TYPE OF TRAINING

(Indicate yes or no in columns I and II. If "yes" is indicated in either column, complete columns III and IV).

	I Formal Course	II On the Job	III Where Trained	IV Duration of Training
a) Principles and Practices of Radiation Protection				
b) Radioactivity measurements, monitoring techniques, and instruments				
c) Mathematics and calculations basic to the use and measurement of radioactivity				
d) Biological effects of radiation				

Note: use additional pages as necessary

FORMAL COURSES

(If you indicated "yes" in Column I for any of the items above, please list all courses completed pertaining to the use of radiation or radioactive materials, atomic and nuclear structure, radiochemistry, radiation biology, nuclear engineering, etc.).

Date	Title of Course	Where Trained	Course Content	Duration

EXPERIENCE
(List actual use of radioactive materials, details of formal laboratory courses, or on-the-job training).

Isotope	Maximum Amount	Where Experience Gained	Duration	Type of Use

ADDITIONAL COMMENTS OR REMARKS:

SIGNATURE SECTION:

APPROVED _____ Date _____
Department Chair

APPROVED _____ Date _____
Radiation Safety Officer

APPROVED _____ Date _____
Chemical Hygiene and Radiation Use Committee Chair

OKLAHOMA STATE UNIVERSITY
CENTER FOR HEALTH SCIENCES
1111 West 17th
Tulsa, OK 74107

Project Authorization # _____

RADIATION MATERIALS ORDER FORM (Complete, send to Radiation Safety Officer to procure)

NOTE: BEFORE ORDERING RADIATION MATERIALS: 1) THE AUTHORIZED USER AND ALL LABORATORY RADIATION WORKERS MUST BE CURRENT ON RADIATION SAFETY TRAINING (required 40 hour initial and annual refresher), 2) PROJECT AUTHORIZATION MUST BE APPROVED BY THE CHEMICAL HYGIENE & RADIATION USE COMMITTEE AND REVIEWED ANNUALLY.

Date: _____ Use Location: _____

Authorized User and Title: _____

Order Contact Person and Phone #: _____

All of the following requirements are met:

Radiation users current with training	yes	no
Project authorization approval current	yes	no
Log book complete	yes	no
Contamination surveys current	yes	no

Product Name: _____ Product #: _____

Isotope: _____ Activity (mCi/ml): _____ Total Activity (mCi): _____

Account # (to be charge to):_____ Supplier: _____

Receiving Instructions for order (package must be surveyed within 3 hrs. of receipt, results documented on form RS-6 Radiation Materials Receipt Report). If difficulties are anticipated, contact the Radiation Safety Officer.

CHS Lab Contact Name _____

Phone (1) _____ Phone (2) _____ Phone (3) _____

CHS Lab Contact Name _____

Phone (1) _____ Phone (2) _____ Phone (3) _____

Comments:

OKLAHOMA STATE UNIVERSITY CENTER FOR HEALTH SCIENCES

Project Authorization # _____

1111 West 17th
Tulsa, OK 74107

RADIATION MATERIALS RECEIPT REPORT

(COMPLETE AND SEND A COPY OF REPORT AND ISOTOPE RECEIPT TO THE RADIATION SAFETY OFFICER, PLACE ORIGINAL IN RADIATION LOG)

(The package must be inspected upon arrival and surveyed within 3 hours of receipt)

Date Received: _____ Authorized User: _____

Package type: Exempt __ Radioactive I __ Radioactive II __ Radioactive III __
(check one)

Package Received by: _____ Isotope: _____

Activity (mCi/ml): _____Total Activity (mCi): _____

Lot#/Batch#: _____ Date on Isotope Container: _____

Product Name: _____

Condition of Container: Leaking __ Major damage __ Minor damage __ No damage __ (check one)

Date and Time of Survey: _____

Type of Survey: Wipe test (^{3}H, ^{14}C) __ Radiation Meter (higher energy isotopes) __
(check one)

Location	Reading: DPM/100cm^2 __ mR/hr __ (check one)	Comments: e.g. crushed, broken, decontaminated
Background/Blank		
Outside of Box		
Inside of Box		
Radioisotope packaging		

CHS: activity over 20 mR/hr on contact or 1 mR/hr at 1 meter requires decontamination.
CHS: activity over 200 DPM/100 cm^2 minus background requires decontamination, area with activity > 1000 DPM/100 cm^2 minus background is classified as a contamination area, contact RSO.
DPM = (CPM - background CPM) ÷ Efficiency

Radioactive Material placed in (lab and specific location): _____

Information transferred to RS-7, 'Radiation Materials Accountability Record' yes __ no __
(check one)

Signature & Print Name of Person Surveying: _____

OKLAHOMA STATE UNIVERSITY
CENTER FOR HEALTH SCIENCES
1111 West 17th
Tulsa, OK 74107

Project Authorization # _____

RADIATION MATERIALS ACCOUNTABILITY RECORD

Date Received: _____ Authorized User: _____

Isotope: _____ Activity (mCi/ml): _____ Total Activity (mCi): _____

Specific Act.(Ci/mmol): _____ Lot#/Batch#: _____

Date on Container: _____ Calibration Date: _____

Product Name:_____ Physical Form: _____

Supplier: _____ Decay Date (calc.): _____

Location (s): Stored _____ Used _____

Prepared _____ Counted _____

Other Use Location Area:

Results:

The total contents of the above shipment have been disposed of in manner indicated on the reverse side or page two of this form.

_____ _____
Responsible Individual Date

(Sign when shipment is expended and return copy of form to RSO, Research Office)

Date Used	Amount Used (in μCi)	Amount Remaining (in μCi)	Date Disposed	Amount of Activity Disposed – indicate in this section when disposed or removed from laboratory by RSO to be disposed (in μCi)					
				Sewer	Decayed	Solid (shipped)	Liquid (shipped)	Other-Explain	User Initials

OKLAHOMA STATE UNIVERSITY
CENTER FOR HEALTH SCIENCES
1111 West 17th
Tulsa, OK 74107

Project Authorization #

RADIATION CONTAMINATION SURVEY FORM

Authorized User: _____ Date: _____

Laboratory: _____

Survey Instrument Used (Make and Model): _____

_____

If Meter Used: Battery Check _____

Calibration Date _____

Activity (mCi/ml): _____ Isotope: _____

Refer to lab diagram for areas to be surveyed (copy must be attached or placed in Log)

Location area / description	Distance(M) or size of area (cm^2)	Activity (mR/hr or DPM*)
1. Background/Blank		

CHS: activity > 20 mR/hr on contact or 1 mR/hr at 1 meter requires decontamination.
CHS: activity > 200 DPM/100 cm^2 minus background requires decontamination, area with activity > 1000 DPM/100 cm^2 minus background is classified as a contamination area, contact RSO.
***DPM = (CPM - background CPM) ÷ Efficiency**

Attach description of corrective action taken for excessive exposure rates. If sending attachments, print form and send together.

Signature & Printed Name of Person Surveying: _____

OKLAHOMA STATE UNIVERSITY
CENTER FOR HEALTH SCIENCES
COLLEGE OF OSTEOPATHIC MEDICINE

1111 West 17th
Tulsa, OK 74107

AUTHORIZATION FOR RELEASING RADIATION EXPOSURE INFORMATION

TO:

FROM:

ADDRESS:

DATE:

You are hereby granted permission to make available to the person I have indicated below, any or all information concerning my radiation exposure history as developed while I was employed or assigned at _____
during the period from _____ to _____.
You are further authorized to include in your transmittal to said person, any or all information concerning my radiation exposure history acquired by you from other persons, employers or agencies if such records are in your possession.

Please transmit my radiation exposure record to:

Radiation Safety Officer
Research Office
Oklahoma State University
Center for Health Sciences
1111 West 17th
Tulsa, OK 74107

Special instructions: _____

_____

_____

_____
Signature radiation worker

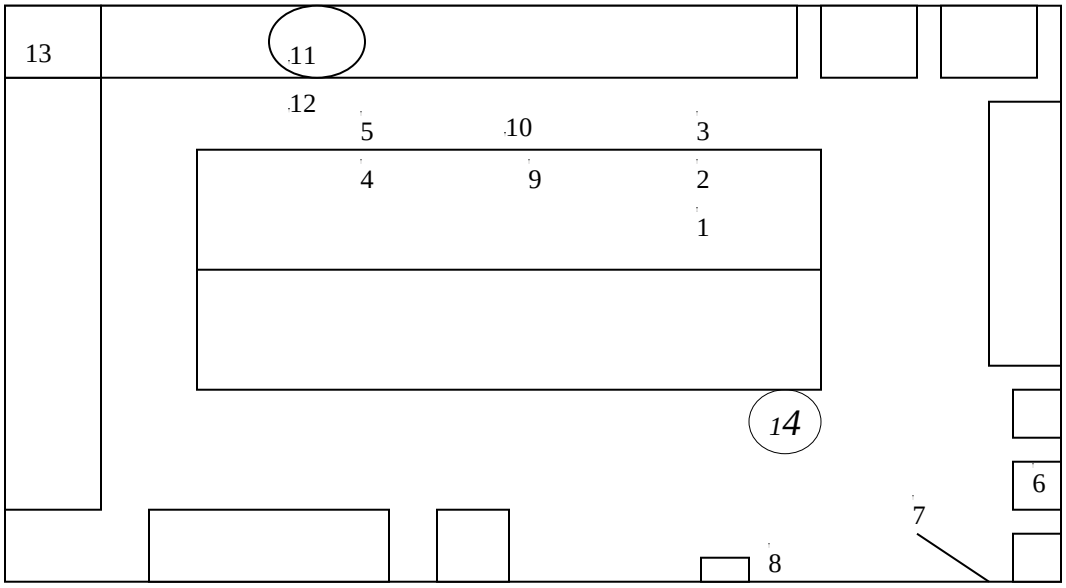
_____
Signature Radiation Safety Officer-OSUCHS

Appendix B

Restricted Area Diagram and Ventilation Schematic

GENERIC ROOM DIAGRAM

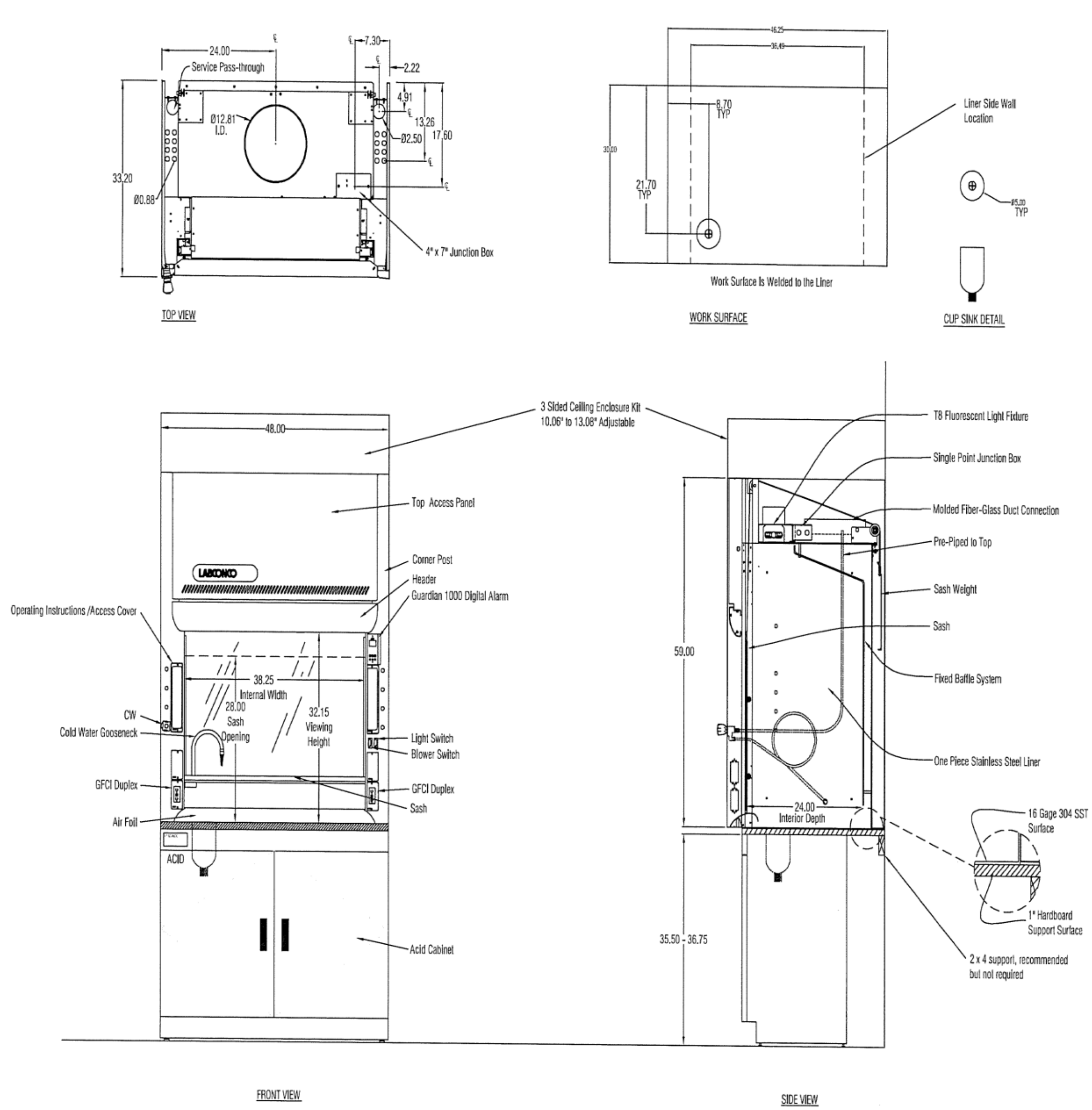
Requirements associated with diagram designations and approval of restricted areas can be found in the Radiation Safety Manual in section 2.5. "Approval of Restricted Areas".



Number	Area	Number	Area
1✧	Tissue Harvester	7	Door
2✧	Bench @ Harvester	8	Phone
3✧	Floor @ Harvester	9✧	Radioligand Work Area Plexi-glass Shielding
4✧	Bench @ Superfusion	10✧	Floor by Work Area
5✧	Floor @ Superfusion	11✧	RAM Disposal Sink
*6	Frig/Freezer Storage	12	Floor in Front of Sink
13✧	Waste Collection Dry and Liquid Separated	14	Coats, Personal Items

* Radioligand storage
✧ Radioligand work areas (restricted area)

Dimensions: Building A, single 180 ft^2, double 360 ft^2
Building E, single 780 ft^2, double 1500 ft^2



GENERAL DESCRIPTION

4' Protector Stainless Steel Radioisotope Hood
Model: 4882200-15575 Quantity: 1

Exterior Superstructure
* Double Wall Construction * 18 Gauge Cold Rolled Steel

Interior Superstructure
* Galvanized Steel (standard)

Left / Right Facia:
* Powder Coated Steel * Color: Glacier White

Liner Material
* One Piece 16 Gauge, Welded and Polished Type 304

Side Panels
* Both Sides * Removable * Color: Glacier White

Baffles
* Type 304 Stainless Steel
* Fixed

Interior Access Panels
* None

Corner Post with Access Covers
* Right and Left Sides
* 18 Gauge Cold Rolled Steel

Air Foil
* 16 Gauge Cold Rolled Steel * Powder Coat Finish

Sash
* Vertical Travel
* 3/16" Tempered Safety Glass
* Counter Weighted and Balanced
* 1 3/16" Pulley System
* PVC and Epoxy Coated Aluminum Sash Frame

Electrical Fixtures
* Fluorescent Light and Tubes w/ Switch
* Duplex, 115VAC / 60HZ / 20A/ GFCI, 2 Places

Alarm / Monitor
* Guardian 1000 Digital

Wiring
* Fume Hood Wired at Factory
* Electrical Service Connection made inside 4x7 Single Point Junction Box

VAV Preparations
* None Requested

Service Fixtures
* Labconco * Color-Coded Hooded Handle * Front Loading

Symbol	Service	Color
CW	Cold Water	Green

Plumbing
* Connections Made with Swagelock Compression Fittings
* Final connection by others
* Cold Water Gooseneck Piping is 3/8" Flexible Copper Tubing
* Service Fixtures Pre-Piped to Top of Hood

Work Surface
* Material: Type 304 Stainless Steel
* Includes Stainless Steel Cup Sink

Cabinets
* 48" Acid Cabinet, Poly Liner and filler # 9901000 Qty: 1
* Color: Glacier White

Accessories
* Ceiling enclosure, Front, 10.06-13.08" # 9852303 Qty: 1
* Ceiling enclosure, Left, 10.06-13.08" # 9833703 Qty: 1

Assembly and Crating
* Pre-Assembled
* Palletized

Room Number
* 415

SCALE: Scaled to fit

FUME HOODS for: OSU Tulsa CHS

Protecting your laboratory environment
LABCONCO

Labconco Corporation
8811 Prospect Avenue
Kansas City, Mo 64132-2696
(800) 821-5525
www.labconco.com

No.	Date

Date: 05-30-2008
Drawing #: 4882200-15575
Drawn By: Luke Savage
Checked By:
Approved By:
Sheet No. 3 OF 4

LCC Order Number: 761152
Log Number: 813-08

Appendix C

Approved Radiation Monitoring Devices

Approved Radiation Monitoring Devices

Typical detector probes used with portable radiation survey instruments used to detect radioactive contamination

Detector	Radiation	Energy Range	Efficiency

GM Detectors ("Geiger-Muller")

1. End-Window GM Detector Probe
    a. Used for detection of medium to high energy beta radiation (responds best for ^{32}P).
    b. Least sensitive of all the types of detectors for detecting low levels of radiation.
2. Pancake GM Detector Probe
    a. Used for detection of medium to high energy beta radiation (best for ^{32}P, but also can detect ^{35}S, ^{45}Ca, ^{14}C and other medium-energy beta particles).
    b. Due to differences in their detectors surface area, the pancake detector has greater sensitivity for low levels of radiation than does the end-window detector.
    c. The enhanced sensitivity of this detector requires that it be used in areas with low levels of background radiation.

NOTE: The end-window and pancake GM detectors described are primarily considered to be beta radiation detectors. It should be noted that these detectors will detect some electromagnetic radiation (gamma and x-ray), however, they are extremely inefficient, and generally should not be used for this purpose.

Scintillation Detector

1. Sodium Iodide (NaI) Detector Probe
    a. This detector consists of a sodium iodide crystal and a photomultiplier tube. It is very fragile and sensitive to light.
    b. This detector is primarily used for detection of low-energy gamma and x-ray radiation. It is best used for detecting ^{125}I and ^{51}Cr, and to check for secondary x-ray production ("bremsstrahlung") when working with large amounts of high-energy beta emitters like ^{32}P.
    c. This detector is extremely sensitive, therefore it must be used in a low background area to obtain meaningful results. The NaI detector typically is only useful for the purpose of determining whether radiation fields or contamination above background levels is present on a surface or in a particular location. It should not be used to quantify an amount of radioactivity or to define the intensity of a particular radiation field (i.e., determine "exposure rate").
    d. The NaI detector can detect some beta radiation, but it is very inefficient at lower energies and is not normally preferred for beta surveys. (NOTE: If absolutely necessary, the NaI probe is acceptable to use when checking for ^{32}P contamination only).

Exposure Rate Meters	Gamma (γ), X-Ray	µR-R	N/A
Count Rate Meters			
GM	Alpha (α)	All energies (dependent upon window thickness)	Moderate
	Beta (β)	All energies (dependent upon window thickness)	Moderate
	Gamma (γ)	All energies	< 1%
NaI Scintillator	Gamma (γ)	All energies (dependent upon crystal thickness)	Moderate
Plastic Scintillator	Beta (β)	^{14}C or higher (dependent upon window thickness)	Moderate

Typical Survey Instruments[1] (Instruments used to measure radiological conditions at licensed facilities).

The specifications below will help authorized users choose the proper portable radiation detection equipment for monitoring radiological conditions.

Stationary instruments used to detect radioactive contamination with wipe, bioassay, and effluent samples:

Detector	**Radiation**	**Energy Range**	**Efficiency**
Liquid Scintillation Counter (LSC)*	Alpha (α)	All energies	High
	Beta (β)	All energies	High
	Gamma (γ)	All energies	Moderate
Gamma Counter (NaI)*	Gamma (γ)	All energies	High
Gas Proportional	Alpha (α)	All energies	High
	Beta (β)	All energies	Moderate
	Gamma (γ)	All energies	< 1%

[1] Table from The Health Physics & Radiological Health Handbook, Revised Edition, Edited by Bernard Shleien, 1992 (except for * items).

Appendix D

Sewage Output from CHS Laboratories

Appendix D "Sewage Output from CHS Laboratories"

Sewage Output Averages for
Oklahoma State University Center for Health Sciences
1111 West 17th Street

Approximate Monthly Average Sewage Output * =

1,477,674 gallons or
4.472E-5 milliliters

Sanitary sewer disposal of liquid radioactive waste, reference section 5.3, discusses the use of monthly average sewage output of the building(s) where the restricted laboratories reside to calculate amount of additional water necessary to dilute waste before disposal to the sanitary sewer, based on radioactive concentration limits of 10 CFR 20, App. B, table 3.

*Conservatively based on January, 2012 through December, 2012 water usage minus 15%