COBY COLLEGE
RADIATION SAFETY PROGRAM
(RSP)
The RSP will be reviewed annually to update personnel information as needed and make required regulatory changes. The plan will also be reviewed if a personal exposure or emergency response indicates deficiencies in the plan.

<table>
<thead>
<tr>
<th>REVISION</th>
<th>DESCRIPTION OF CHANGE</th>
<th>REVISION EFFECTIVE DATE</th>
<th>REVISION COMPLETED BY: NAME / COMPANY</th>
<th>MANAGER APPROVAL / DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>• Initial plan under previous EHS Director</td>
<td>12/2009</td>
<td>Bruce McDougual / Colby College</td>
<td>Mark Crosby</td>
</tr>
</tbody>
</table>
| B        | • Updated AU list to reflect current staff  
          • Added revision history  
          • Removed use of badges/rings as exposure is well below threshold  
          • Removed all isotopes except P-32 | 9/2014 | Wade Behnke / Colby College | Mark Crosby |
| C        | • Updated AU and RSC list to reflect current staff  
          • Removed mandatory RSC meeting requirement  
          • Removed listed survey equipment no longer on campus (LSC)  
          • Removed “Type C” reference Section V  
          • Revised format to CEHSPPP style | 9/2018 | Wade Behnke / Colby College | Mark Crosby |
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I. PURPOSE

The rules and regulations contained in this document have been established for the following purposes:

1) To provide for the protection of Colby College’s students, staff, and of the general public against radiation hazards associated with the college’s possession, use, transportation and disposal of radioactive materials.

2) To provide for Colby College’s compliance with applicable regulations of federal, state and local agencies.

II. ORGANIZATION OF THE COMMITTEE

The Radiation Safety Committee is presently composed of the following members:

CHAIRMAN    Wade Behnke, MPH, Radiation Safety Officer
SECRETARY    Jason Fish, Academic Environmental Safety Specialist
              Julie Millard, Ph.D., Dept. of Chemistry - AU
              Gordon Cheesman, Associate Director of Physical Plant
              Kevin Rice, Ph. D., Department of Chemistry – AU
              Lisa Lessard, Teaching Assistant Department of Physics

*AU- Authorized User

III. DELEGATION OF AUTHORITY

The Radiation Safety Committee receives its authority from the President of the College. The Committee is charged with the following responsibilities:

1) Establish policies regarding radiation protection at Colby College.

2) Provide direction and advice to the Radiation Safety Officer on matters regarding radiation safety.

3) Receive, review, and act on all applications for the use of radiation sources at Colby College.

4) Receive and review periodic reports from the Radiation Safety Officer on monitoring contamination.

5) Review instances of alleged infractions of use and safety rules with the Radiation Safety Officer and the responsible individuals.
6) Providing radiation safety education programs for students using radioactive material.

In carrying out these responsibilities, the Radiation Safety Committee conducts a program of review and evaluation of proposals for use of radionuclides, and continuing surveillance of the use of such materials with a view to maintaining standards of safe handling practice.

The Committee will meet as needed to review new research and new authorized users. The secretary will maintain permanent records of the Committee proceedings. A quorum for the purpose of conducting business shall be three committee members.

IV. RADIATION SAFETY OFFICER

The Radiation Safety Officer operates under the authority of the Radiation Safety Committee. They are in charge of the College’s Radiation Safety Program, and may delegate as necessary, the responsibilities for the following:

1) Implementing policy decisions of the Radiation Safety Committee and insuring compliance with regulatory agencies.

2) General surveillance of all radiation safety activities and environmental monitoring.

3) Furnishing consulting services to personnel at all levels of responsibility on all aspects of radiation protection.

4) Establishment of procedures for purchase, receipt and shipment of all radioactive materials coming to or leaving Colby College.

5) Radioisotope laboratory inspection, radiation surveys and area monitoring as necessary.

6) Supervision and coordination of the waste disposal program, including the processing, storage and disposal of radioactive waste and the keeping of required records.

7) Storage of radioactive materials not in current use, including wastes.

8) Supervising the leak testing of sealed sources and maintaining required records.

9) Maintaining an inventory of all radioisotopes at Colby College and limiting quantities of radionuclides to amounts authorized by the license.
10) Supervision of corrective action following radiation incidents and supervision of special decontamination procedures.

V. SMRRRP BYPRODUCT MATERIALS LICENSE

Colby College currently holds a Specific License of limited Scope. Isotopes, their forms, and possession limits to be included in this limited scope are:

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Form</th>
<th>Possession Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>32-P</td>
<td>In all forms</td>
<td>10mCi</td>
</tr>
</tbody>
</table>

This license covers all uses of State of Maine regulated radioactive materials at the institution, giving full responsibility for control and proper use of such materials to the Colby College Radiation Safety Committee. This license covers receipt, acquisition, ownership, possession, use and transfer of any chemical or physical form of byproduct material specified in the license for authorized purposes. Byproduct material shall be used by, or under the supervision of individuals, designated by the Colby College Radiation Safety Committee. This license also specifies a list of conditions of approval, all of which must be continually satisfied in the conduct of work involving radioactive materials. One such condition is that the rules and regulations specified in State of Maine Rules Relating to Radiation Protection (SMRRRP), Part D, “Standards for Protection Against Radiation” are satisfied. Compliance with these conditions and regulations is included in the responsibilities of the Radiation Safety Committee.

VI. AUTHORIZED USERS

A policy of “authorized users” has been adopted within the Radiation Safety Committee’s rules whereby only persons licensed by the local Committee may be “designated” as outlined in section V above.

Authorized user candidates must make a formal application (Appendix Item 1) to the Committee. Those who qualify with regard to experience and who have successfully fulfilled all committee requirements will be granted permission to use radioisotopes on their own responsibility at Colby College. Only authorized users are allowed to requisition byproduct materials. Each authorized user is directly responsible for the safe use of the material and for the qualifications of those who use the material under his/her supervision.

Each project in which radioactive materials are used at Colby College must have one such authorized user who is a TA or has full faculty rank. Non-staff personnel may not be charged with the prime responsibility for radiation safety in the project.
VII. RESPONSIBILITIES OF AUTHORIZED USERS

Each authorized user under whom radioisotope work is being conducted is responsible for the following:

1) Adequate planning of experiments and determination of the type and quantity of radiation or radioactive material to be used. This determination will generally give a good indication of the safety measures required. Experimental procedures must be well outlined to allow adequate review of safety precautions. Where possible, a cold run using the planned procedures is recommended to avoid unforeseen safety problems. In any situation where there is appreciable radiation hazard, the Radiation Safety Officer shall be consulted before proceeding.

2) Instructing personnel and students for whom they are responsible in the use of safe techniques and on the application of approved radiation safety practices.

3) Providing the Radiation Safety Officer with up-to-date data as necessary, relative to the areas in which radioactive materials are stored or handled.

4) Notifying the Radiation Safety Officer of any changes in the listing of personnel or students who may be handling radioactive material or who may be exposed to ionizing radiation during the course of their work or studies.

5) Maintaining an adequate inventory of the amount of radioactive material under his/her control at any one time, and establishing an adequate system to insure that he/she does not possess more than that quantity of material for which he/she is authorized.

6) Ensuring that radioactive material is disposed of only by authorized means.

7) Using the radioactive material for which he/she is licensed only for those uses specifically authorized.

8) Informing the Radiation Safety Officer in writing of changes in procedure which may increase the probability of radiation exposure or laboratory contamination.

9) Establishing appropriate procedures to insure that radioactive materials are properly labeled.

10) Establishing that radioactive materials are properly controlled within his/her project, and that they are properly stored at the end of each work day.
11) Assuring that the laboratory is equipped with adequate survey and/or monitoring equipment to aid in the safe handling of radioactive material, and performing routine surveys of work areas as necessary.

12) Ensuring that service personnel are not permitted to work on equipment, hoods or sinks in radioactive materials use areas without the presence of a knowledgeable member of the laboratory staff to provide specific information.

13) Complying with proper procedures for termination of employment or termination of work using radioactive materials. The authorized user must return to the Radiation Safety Officer all radioactive materials, including waste, assigned to him/her under the license. Particular care should be exercised to see that specialized equipment such as survey instruments and shielding materials are returned to the Radiation Safety Officer. A final termination survey is also necessary.

14) Ensuring that the following individual user responsibilities are discharged by those under their control.

**VIII. RESPONSIBILITIES OF INDIVIDUAL USERS**

Each individual registered (using Appendix Item 2) as a radiation worker is responsible for:

1) Keeping his/her exposure to radiation as low as possible, and specifically below those levels outlined in section XVI, "Control of Radiation Exposure". Air and water concentrations shall be maintained below the levels listed in SMRRRP Part D, "Standards for Protection Against Radiation".

2) Utilizing all appropriate protection measures such as:
   a) Wearing protective clothing whenever contamination is possible and not wearing such clothing outside the laboratory area.
   b) Wearing gloves.
   c) Using protective barriers and other shields when indicated.
   d) Using mechanical devices when appropriate to reduce exposure.
   f) Performing radioactive work within confines of an approved hood or glove box unless serious consideration has indicated the safety of working in the open.

3) Not eating, drinking or smoking in areas where unsealed radioactive materials are being used, handled, transferred or stored. Refrigerators may not be used jointly for food and/or beverages and radioactive materials.
4) Maintaining good personal hygiene. Do not work with radioactive materials if there is an open or unprotected break in skin below the wrists. Wash hands and arms thoroughly after working with radioactive materials. Hands, shoes, and clothing should be surveyed and decontaminated as necessary before leaving the laboratory.

5) Checking periodically for contamination in the immediate areas in which radioactive materials are being used (hoods, benches, etc.). A log record should be maintained of these surveys including results that are entirely negative. Any minor contamination observed should be decontaminated, larger amounts of activity found should be de-contaminated under supervision of the Radiation Safety Officer.

6) Keeping the laboratory neat and clean. The work area should be free from equipment and materials not required for the immediate procedure. Keep or transport materials in such a manner as to prevent breakage or spillage (double container) and to insure adequate shielding. Wherever practical, keep work surfaces covered with absorbent material, preferably in a tray or pan, to limit and collect spillage in case of accident.

7) Label and isolate radioactive waste and equipment, such as glassware, used in laboratories for radioactive materials. Once used for radioactive substances, equipment should not be used for other work, and should not be permitted to leave the area until demonstrated to be free of contamination.

8) Requesting Radiation Safety Officer supervision of any emergency repair of contaminated facilities or equipment by shop personnel or commercial service contractors.

9) Reporting accidental inhalation, ingestion or injury involving radioactive materials to his/her supervisor and the Radiation Safety Officer, and carrying out their recommended corrective measures. The individual shall cooperate in any and all attempts to evaluate his/her exposure.

10) Carrying out decontamination procedures when necessary, and for taking the necessary steps to prevent the spread of contamination to other areas.

11) Prompt compliance with requests from the Radiation Safety Officer concerning body burden measurements and the submission of bioassay samples.

IX. APPLICATION FOR PERMISSION TO USE RADIOISOTOPES

Each proposed use of radioisotopes must be applied for by an authorized user through the Radiation Safety Committee. This is accomplished by submitting an
Application for Permission to Use Radioactive Materials (Appendix Item 2) which provides a written protocol of the experiment and its methodology. Included are descriptions of the facilities, equipment and training of various users. The application is submitted to the Committee through the Radiation Safety Officer, reviewed by the Committee and appropriate action taken in regard to the proposed use. Each approval is issued for a period of not more than 3 years. Application for renewal should be submitted at least 30 days prior to expiration of the approval. Records of these proposed uses will be maintained for inspection for the duration of the Maine Radioactive Materials license.

X. AMENDMENTS TO ESTABLISHED RADIOISOTOPE USE

Application for amendment to an approved application should be made in writing to the Radiation Safety Committee for any change in responsible personnel, use or procedure mentioned in the original application. Applications involving major changes require the completion of a new application form. Minor changes involving personnel or minor procedural changes may be requested by letter. However, any amendment, regardless of its magnitude must be requested in writing to the Radiation Safety Officer. The Radiation Safety Officer should be informed in writing of any change in the employees of a project working with radioisotopes.

XI. PROCUREMENT AND INVENTORY

A) Ordering - Authorized Users may order those radioactive materials for which they are authorized through their department purchasing personnel and informing the Radiation Safety Officer in writing with the specifications of the order, isotope and amount on hand.

B) Receipt - When the shipment is received, the authorized user who ordered the material will check it for content, monitor it for radiation level, and check for contamination. The authorized user is required to keep an accurate record of each shipment, while it is in his/her possession, and thereby maintain the possession limits for the approved applications assigned to them. Final disposal of all radioisotope containers is to be through the Radiation Safety Officer or AU.

C) Transfer - (Internally) To transfer radioisotopes between authorized users the Radiation Safety Officer or designee must be informed in writing. Transfers may only be made to other authorized users with approvals for the possession and use of the radioisotope involved. No requisition is required for the transfer of radioisotopes in the amounts listed in SMRRRP Part C, Schedule B.

For example, the following radioisotopes may be transferred without a requisition:

1 uCi of: 32p,
This exemption does not apply to isotopes coming into Colby College. All isotopes in any quantity obtained from outside Colby College must be ordered as indicated in A above.

D) Possession Limits - Each approved request includes a maximum possession limit for the radioisotopes covered in the application. This limit is the maximum which may be possessed by the authorized user for the proposed project and must be adhered to by the user. Radiation Safety Committee processing of the application includes comparison of the possession limit requested, plus that previously assigned to other projects, with the SMRRRP imposed possession limit for that isotope for Colby College as a whole. Observance of such assigned possession limits by all users is essential to insure compliance with the SMRRRP overall limit. Inventory records maintained by the authorized user should readily yield information on adherence to possession limits. The user is reminded that all radioactive waste generated must be considered in this inventory until it is transferred to Radiation Safety Officer or his/her designee’s control.

XII. STORAGE

To ensure the security of radioactive materials in use at Colby College, each project stores its own radioisotope stocks in a designated place under lock and key. These storage areas may or may not be shielded depending on the amount and type of activity to be stored there. The authorized users are responsible for all radioactive materials charged to their care. He/She is to provide Radiation Safety Officer or designee with a duplicate key and a list of the individuals with approved access to the materials. The authorized user is further responsible for informing these individuals concerning storage regulations and for keeping the list up to date. Each storage area should have a single key, which is kept in a place known to the users but not public. The storage area is to be kept locked and the key kept in its place at all times except when an isotope withdrawal is being made.

XIII. MONITORING

Projects using millicurie amounts of radioisotopes are monitored weekly by the Radiation Safety Officer, his/her designee, or the AU. Projects using less than millicurie amounts may be monitored less frequently but at least monthly by the AU. A record of this monitoring is kept by the Radiation Safety Officer, their designee, or the AU. Unusually high results or a spill area uncovered in such monitoring will be communicated to the authorized user of the project and decontamination will be performed. A summary of the results of the monitoring is reported to the Radiation Safety Committee as required. Included in this report will be specific coverage of any accidents or violations.
The above described monitoring program is designed to provide only a broad overview with respect to radiation monitoring. It provides for routine monitoring by a person of the project at intervals that would presumably catch any serious spread of contamination or loss of activity before the consequence becomes serious. The program is intended as a supplement to the radiation monitoring that is required of any individual working routinely with radioactive material. It is the prime responsibility of the project personnel to provide whatever monitoring is necessary on a day to day or hour to hour basis depending entirely on the procedures involved and the radioisotopes being handled at the time. These individual project records of monitoring will be periodically audited by the Radiation Safety Officer.

Each authorized user must assure that appropriate equipment is available during the course of his/her project work to conduct such surveys and they are to be conducted at a frequency that is commensurate with the level of activity being handled in the project. Following is a detailed outline of what is expected in this regard:

**A) Projects in which millicurie amounts of gamma-emitting or hard beta-emitting radionuclides are routinely handled will be surveyed daily by the responsible individual.** The surveys will include a check to be sure that radionuclides are properly identified and secured from unauthorized persons, that areas in which gamma or high energy beta-emitting materials are handled are contamination free (GM survey meter measurements) and that major equipment necessary for the handling of such material (hood, etc.) is functioning. The performance of each such survey shall be permanently logged by a simple statement that the survey was made, by whom, and the listing of unusual findings.

**B) Additional surveys shall be made as necessary, following any unusual procedure or incident in the laboratory which may have resulted in unusual external radiation or contamination levels.** Excessive contamination levels (more than 100 dpm/100 cm²) shall be brought to the attention of the Radiation Safety Officer and the area in question shall be decontaminated and resurveyed. Action levels for removable surface contamination are outlined in TABLE 1.

A log book containing the on-going data for each of these surveys shall be available for review by the Radiation Safety Officer during his routine surveys of radioisotope use areas, and for review by SMRRRP compliance inspectors during their inspections. The authorized user of the project shall ascertain that the necessary survey equipment is available to perform the required procedures and that a specific individual is assigned the tasks. The Radiation Safety Officer is available to assist in setting up an appropriate survey program for each project.
ACTION LEVELS FOR REMOVABLE SURFACE CONTAMINATION

<table>
<thead>
<tr>
<th>Type of Surface Emitters</th>
<th>Alpha Emitters</th>
<th>Beta or X-ray</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(uCi/cm²)</td>
<td>(uCi/cm²)</td>
</tr>
<tr>
<td></td>
<td>(dpm/100cm²)</td>
<td>(dpm/100cm²)</td>
</tr>
<tr>
<td>Unrestricted areas</td>
<td>10⁻⁷</td>
<td>10⁻⁶</td>
</tr>
<tr>
<td>Restricted areas</td>
<td>10⁻⁶</td>
<td>10⁻⁵</td>
</tr>
<tr>
<td>Personal clothing worn</td>
<td>10⁻⁷</td>
<td>10⁻⁶</td>
</tr>
<tr>
<td>only in restricted areas</td>
<td>10⁻⁶</td>
<td>10⁻⁵</td>
</tr>
<tr>
<td>Skin</td>
<td>10⁻⁶</td>
<td>10⁻⁵</td>
</tr>
</tbody>
</table>

*Note Colby College currently does not perform research using Alpha emitters*

Averaging is acceptable over non-living areas of up to 300 cm² or, for floors, walls and ceiling 100 cm². Averaging is also acceptable over 100 cm² for skin or, for the hands, over the whole area of the hand, nominally 300 cm².

**XIV. WASTE DISPOSAL**

Disposal of all radioactive waste is managed by the Radiation Safety Officer or his designee. Work areas where radioactive waste materials are generated are equipped with radioactive waste containers which are clearly marked with the radiation blossom. These receptacles are emptied solely by individuals directly involved with the project work as necessary, or as the radiation levels become significant. All waste material that is contaminated with radioisotopes at any level should be disposed of as radioactive waste.

Pertinent information to ensure that the volume of low level radioactive waste is minimized and that such waste is processed into acceptable chemical or physical form prior to ultimate disposal is provided to personnel during initial and refresher training. Material must not be put into radioactive waste collection containers if there is a possibility of a chemical reaction during storage or shipment that may cause the release of radioactive gases, fire or explosion. Volatile or potentially volatile radioactive wastes should be appropriately treated with strong alkali, detergent or acid whenever possible to render radioactive material non-volatile.

As any receptacle is being filled, records must be kept of the date, isotope and quantity being placed in the containers. The procedures for disposal of the various types of radioactive waste generated are as follows:
**DRY SOLID WASTE**

**A) This category forms the bulk of radioactive waste generated at Colby College.** Due to increasing restrictions on low level radioactive waste disposal, we have obtained permission to segregate and store for decay to background, wastes with half-lives of less than 100 days. Waste segregated and stored for this purpose will be carefully monitored after storage for at least 10 half-lives before being disposed of as part of the normal sanitary waste stream.

Monitoring will be done:

- in a low background area
- with a low level GM type survey meter appropriate for contamination surveys, using the most sensitive scale
- with all shielding removed

Permanent records will be kept of all such monitoring, which will also serve to assure that radioactive labels have been properly obliterated or removed.

The storage areas for decay will be under the control of the Radiation Safety Officer or his/her designee and be properly secured from unauthorized access. The containment vehicles for this waste will be standard DOT 7A 55 gallon drums with plastic liners. All drums stored in this way will be clearly identified, dated and properly cataloged. To insure the safety and integrity of the storage process, these materials will be monitored and controlled at all times. Periodic surveys will be done and recorded to ensure that radiation exposure levels do not present a hazard.

**LIQUID WASTE**

Radioactive waste materials which are soluble or dispersible in water may be disposed of in the sewage system in amounts and concentrations conforming on a Colby College wide basis to SMRRRP regulations. Only designated sinks/drains may be utilized for this disposal.

**Table 2.**

The following table outlines disposal limits for Colby College. Calculations based on $6.22 \times 10^8$ ml/day average sewage system effluent rate. The table outlines representative disposal limits for some commonly used radioisotopes based upon the Colby College sewerage system and applicable SMRRRP regulations.
Overall release will be evaluated by the principle of:

\[
\frac{C_A}{MPC_A} + \frac{C_B}{MPC_B} + \frac{C_i}{MPC_i} = 1
\]

in accordance with SMRRRP Sec. D, App. B, Table II, Column 2.

No more than 5 times the amount of material specified in TABLE 2: column 3 (calculated ALARA fraction uCi/day) will be disposed of in any one day. The quantity of radioactive material released in any one month, if diluted by the average monthly quantity of water released, will not result in an average concentration exceeding 10% of the limits specified in with SMRRRP Sec. D, App. B, Table II, Column 2. The gross quantity of 32p released into the sanitary sewer system will not exceed 1 Curie per year. Records will be maintained of all such disposal, indicating dates, isotope and quantities.

D) Disposal of larger amounts, or liquids that are not soluble in water must be done under the supervision of the Radiation Safety Officer or his/her designee. Insoluble or high level liquid waste should be neutralized (pH6.5-7.5), collected in inert polyvinyl chloride containers and the Radiation Safety Officer notified. Contents of polyvinyl chloride bottles should be liquid only. Bottles should be stored in plastic dishpans or metal trays lined with absorbent material to catch spillage or leakage. This material will ultimately be stored for decay and appropriate disposal or solidified and shipped to a licensed disposal site.

E) Excess or Unwanted Isotopes and Sources - The Radiation Safety Officer or his/her designee must be contacted for disposal of unwanted isotopes or sources to arrange appropriate disposal.

XV. CONTROL OF RADIATION EXPOSURE

Colby has completed historic evaluations using various types of monitoring badges and determined that unmonitored individuals are not likely to receive, in one year, a radiation dose in excess of 10% of the allowable limits. In the event of a new

<table>
<thead>
<tr>
<th>ISOTOPE</th>
<th>SMRRRP Part D, App. B, Table II, Column 2</th>
<th>Calculated MPD uCi/day</th>
<th>ALARA Fraction 10% uCi/day</th>
<th>ALARA Fraction 10% mCi/month(30d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>32p</td>
<td>9E-6</td>
<td>5.59E+3</td>
<td>5.59E+2</td>
<td>1.67</td>
</tr>
</tbody>
</table>
process or procedure outside the scope of the previous evaluations, Colby will monitor individuals in accordance with the NUREG criteria for occupational dose.

Under all circumstances exposure to ionizing radiation shall be kept at the lowest practical level. The external and internal total exposure from sources of radiation shall be controlled in such a way as to assure that no individual shall receive a total dose in excess of the following values:

A. Maximum permissible doses for persons who are registered as radiation workers:

<table>
<thead>
<tr>
<th>MREMS PER CALENDAR YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole body; head and trunk:</td>
</tr>
<tr>
<td>active blood forming organs; or gonads</td>
</tr>
<tr>
<td>Extremities</td>
</tr>
<tr>
<td>Skin of whole body</td>
</tr>
<tr>
<td>Lens or eyes</td>
</tr>
</tbody>
</table>

B. Maximum permissible doses to pregnant workers with respect to the fetus shall be no more than 500 millirem per gestation period.

C. The above values are in addition to natural background radiation exposure and to radiation administered for medical reasons. Internal exposure is controlled by minimizing airborne release of radionuclides through the proper utilization of hoods, closed reaction systems, temperature control, mechanical pipetting devices and/or any such appropriate mechanism. The Radiation Safety Committee, in its review of applications for use, may require that the Hot Lab be used for other procedures as safety and control considerations dictate. Personnel required to use the Hot Lab, wear protective lab gowns and gloves. Hot Lab work areas are surveyed after each use.

The Radiation Safety Officer shall be notified immediately of any of the following circumstances is known or suspected to have occurred:

| a) Exposure to external radiation in excess of the maximum permissible exposure values stated above. |
| b) Exposure to inhalation, ingestion, or accidental injection of radioactive materials. |
| c) Accidental release of radioactive materials into the campus atmosphere, drains or ventilation systems or onto surface. |

**XVI. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS**

**OCCUPATIONALLY EXPOSED WORKERS:** It is the responsibility of the authorized user to provide instruction for those employees or students under his/her control, in
the use of radiation safety techniques, in the application of approved radiation safety practices, and to insure attendance at required radiation safety lectures. The Radiation Safety Officer or AU provides instruction that fulfills initial and annual refresher requirements for radiation safety education or whenever there is a significant change in duties, regulations, or the terms of our Maine Radioactive Materials license. Topics covered are outlined below:

(1) characteristics of ionizing radiation  
(2) radioactive contamination  
(3) radiation dose - equivalent limits  
(4) background radiation  
(5) acute and chronic radiation effects on man, including the effects on fetuses  
(6) modes of exposure-internal, external  
(7) estimation of dose equivalent  
(8) basic protective measures-time, distance, shielding, contamination control, protective clothing, work place design  
(9) responsibilities of employees, students and of the college  
(10) interaction with Radiation Safety Officer  
(11) warning signs, labels  
(12) radiation monitoring programs and procedures  
(13) emergency procedures

OCCASIONALLY EXPOSED WORKERS: Individuals who do not routinely work with radioactive material but whose duties may bring them into areas where radiation exposure may occur, are given radiation safety instruction specific to their circumstances on an annual basis.

STUDENTS, VISITING PROFESSIONALS: Students engaged in educational or training activities are given appropriate radiation education prior to being permitted to work with radio-active materials. Visiting scientists working at Colby College for an extended period of time will be trained in a manner comparable to regular employees.

XVII. TRANSPORTATION OF RADIOACTIVE MATERIAL

The Colby College Maine Radioactive Materials License will include no provision for the transportation of radioactive material out of the Colby College premises. Under no circumstances should any user pick up radioactive material from a supplier, return an improper shipment to the supplier, borrow radioactive material from another Maine Radioactive Materials licensee in the area, or in any way transport radioactive material in his private vehicle. Such transportation of material must be by authorized transportation agencies and in compliance with Department of Transportation regulations. Should such transportation become necessary, contact the Radiation Safety Officer for assistance. The transportation of radioactive materials within the
campus facilities (hand carrying from laboratory to laboratory) shall be done in such a manner as to assure a minimum chance of contamination. All materials must be doubly contained, and must never be left unattended. Under no circumstances should the dose rate on the surface of the container being carried exceed 100 millirem/hour, not should the dose rate one meter from the surface of the carrying container exceed 10 millirem/hour.

**XVIII. CAUTION SIGNS AND LABELS**

Each laboratory or work area storing or using radioactive material shall be posted with appropriate signs, in conformity with 10-144A CMR(June 1, 2003)D.27-30. These postings shall be installed or removed only by or with the approval of the Radiation Safety Officer. Additionally, the authorized user of each project should post each laboratory or work area with sufficient emergency notification information so that a knowledgeable member of the project staff could be contacted in the event of an emergency during non-working hours. (Section XXI)

Each container in which radioactive material is to be stored for a period of time must be labeled in conformance with appropriate federal regulations. Specifically, the label must contain the words “Caution, Radioactive Material” along with information regarding the quantity, kind of radioactive material in the container, and date of assay. Labeling is not required for laboratory containers such as beakers, flasks, and test tubes used transiently in the laboratory in the presence of the user.

**XIX. LEAK TESTING OF SEALED SOURCES**

Each sealed source containing byproduct material (other than tritium) with a half-life greater than thirty days shall be tested for contamination and/or leakage upon receipt, prior to use. Such sources will be maintained according to the following rules:

- a) Tests for leakage and/or contamination at intervals not to exceed six months.
- b) Tests for leakage will be performed by the individual responsible for acquiring the sealed source, or in the case that person is not qualified to test for leakage, by the RSO or his designee.
- b) Tests shall be capable of detecting the presence of 0.005 microcuries of removable contamination.
- c) Test wipings shall be taken from the sealed source or from the surfaces of the device in which the source is mounted or stored and on which one might expect contamination to accumulate. The test wipings will then be analyzed in a scintillation counter.
- d) Alpha sources shall be tested at intervals not to exceed three months.
e) Results of tests shall be recorded and maintained by the individual responsible for acquiring the sealed source for at least one year. The records shall be made available upon request for inspection by the RSO or State of Maine.

If the required tests reveal the presence of 0.005 microcuries or more of removable contamination, the Radiation Safety Office will notify the licensee in charge of the source and immediately withdraw the source from use, and shall cause it to be decontaminated and repaired, or to be disposed of in accordance with the Radiation Safety Committee regulations.

Exceptions to Leak Test Requirements

No leak tests are required for the following:

| a) Sealed sources containing tritium. |
| b) Sealed sources containing byproduct material with a half-life of less than thirty days. |
| c) Any sealed source that contains 100 microcuries or less of beta and/or gamma emitting material or 10 microcuries or less of alpha emitting material. |
| d) A sealed source that is stored and not being used; such sources shall however be tested for leakage prior to any use or transfer unless they have been leak tested within six months prior to the date of use or transfer. |

There are currently no sealed sources on campus that are required to be leak tested and it is anticipated there will continue to be none.

XX. EMERGENCY PROCEDURES

A) MINOR SPILLS

1) Notify persons in the area that a spill has occurred;

2) Cover the spill with absorbent paper to prevent spreading of radioisotopes;

3) Clean up spill, using disposable gloves and tongs or with dressing forceps by careful placement of absorbent paper in plastic bags. Dispose of clean up materials in appropriate radioactive waste container;

4) Survey clean-up area, clothing, shoes and hands with low-range GM survey meter or by filter paper wipes and appropriate beta or gamma counting;
5) **Wash** hands after clean-up and report the incident to the Radiation Safety Officer.

**B) MAJOR SPILLS**

1) **Notify** all persons not involved in the spill to clear the area;

2) **Cover** spill with absorbent paper, confine the movement of all personnel potentially contaminated to prevent the spread and notify the Radiation Safety Office.

3) **Shield** the spill but only if it can be done without further contamination or significantly increasing radiation exposure.

4) **Close** the room and **prevent** personnel entry;

5) **Remove contaminated clothing** and save for evaluation by the Radiation Safety Office, and;

6) **Thoroughly wash** all areas of skin that were potentially or actually exposed to the radioisotope spill.

These procedures have been posted in all areas where isotopes are used or stored. Contact personnel and telephone numbers are included with these postings for after hours emergencies.

**EMERGENCY CONTACTS**

Laboratory Supervisor:      Office_________________ Home_________________
                            (numbers posed outside lab door)

Radiation Safety Officer:   207-859-5504

After Hours:  Wade Behnke (RSO)  207-861-1572
              Security              207-859-4000

**XXI. REFERENCES**

- Reports of the National Council on Radiation Protection and Measurements:
ITEM 1. CHANGES IN PROCEDURE

Colby College will adhere to the rules and procedures outlined in this application for a Specific License of Limited Scope. The following changes may be made without prior notification to the State:

a. changes dictated by SMRRRP rule changes.
b. changes in internal management forms.
c. changes in contractors for bioassay, waste disposal services or for servicing and calibrating personnel dosimeters, survey equipment and counting instruments.
d. references to particular pieces of survey equipment, counting instruments and calibration sources, when replaced by like or more effective substitutes.

ITEM 2. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED

Licensed byproduct materials will be used for educational and basic scientific research purposes.

ITEM 3. INDIVIDUALS RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE

RADIATION SAFETY COMMITTEE:

CHAIRMAN    Wade Behnke, MPH, Radiation Safety Officer
SECRETARY    Jason Fish, Academic Environmental Safety Specialist

Radiation Safety Program
Colby College
5500 Mayflower Hill
Waterville ME 04901
Background and experience of Radiation Safety Committee Members: Training logs, applications and approval for use of radioisotopes are kept by the RSO and are available upon request to members of the RSC and outside investigators.

ITEM 4. FACILITIES AND EQUIPMENT

Throughout most of the complex covered by this license, standard laboratory facilities and equipment are in use and provide adequate controls. Studies not designated to be performed in the Hot Lab may be conducted in the laboratory of individual investigators. Laboratories are equipped with sinks, stand-up and sit-down workbenches, refrigerators, etc. and either have standard laboratory fume hoods or ready access to a fume hood. Refrigerators and freezers associated with individual laboratories are authorized for storage of radioisotopes in accordance with Radiation Safety Committee approved possession limits and storage regulations.

Radioisotope Hot Laboratory - Keyes Rm. 303A and 309

Rooms 303A and 309 in the Keyes Building have been designated as Colby’s radioisotope hot labs. Keyes building is located in the science complex which includes the Arey, Seeley G. Mudd, and Keyes Building and the F. W. Olin Science Center. The labs are located on the third floor of the building and is well situated to control unnecessary traffic (see floor plans #1 and #2) Radioisotope use is restricted to these laboratories and all users are given a copy of the rules for hot lab use (appendix item #7).

The floors of the hot labs are epoxy coated concrete, all walls are sealed concrete block. Workbench and counter areas are stainless steel. A lockable refrigerator-freezer is available for isotope storage in each hot lab. Additional small equipment and supplies, i.e. pipettors, vial racks etc., have been dedicated for use in the hot labs. Ludlum model #3 survey meters with pancake probe have also been permanently assigned to these rooms. Local exhaust ventilation is provided by a fume hood. The hood has dedicated stainless steel ducting to the roof of the Keyes Building, with its exhaust port located for optimum entrainment of exhausted materials and isolation from air intake ports. Face velocity is maintained at 100-125 linear feet per minute and certified at minimal six month intervals. The hoods are tested by Colby College maintenance staff biannually.
The Hot Labs are a controlled access facility, keys/entry will be managed by the Radiation Safety Officer or his/her designee. Regular security rounds of the Campus Security include door checks of the Hot Lab and Waste Processing/Storage area.

Radioactive Waste Processing and Storage Area

Although some aspects of waste processing and short-term storage may occur in the Hot Lab or working laboratories, all long-term storage, storage for decay, final processing for decay, and final processing for off-site waste shipments will be carried out in the Waste Processing/Storage Facility located on the ground floor of Keyes Building. This room is centrally located for internal access from all three buildings in the science complex.

This room has a cast in place concrete on grade floor that is sealed. The wall construction is concrete masonry units and the door is metal with a metal frame. The door is a routine checkpoint for in house security rounds. It is not anticipated that any additional shielding will be necessary for the intended use, radiation levels in adjacent unrestricted areas will not exceed the requirements of 10-144A CMR(June 1, 2003) D.53.A.3.b and will be monitored weekly to document compliance. A GM survey meter is dedicated to this facility.

This area is properly ventilated with a fan system operating at 400 cfm. Access is restricted to the Radiation Safety Officer or his/her designee and registered radiation workers under his control. Keys to the facility are under strict control of the Radiation Safety Officer or his/her designee. There is no history of flooding problems in this room which was formerly used to store D.E.A. controlled substances.

Survey Meters

1. Ludlum Model 3 SN 47539 with Model 44-9 detector probe SN PR 34137. 0-5K CPM (X0.1; X100; X1K Multiplier ranges)
2. Ludlum Model 3 SN 47551 with Model 44-9 detector probe SN PR 34134. )-5K CPM (X0.1; X10; X1K Multiplier ranges)
3. Ludlum Model 3 SN 47xxx with Model 44-9 detector probe SN PR 34134. )-5K CPM (X0.1; X10; X1K Multiplier ranges) **In storage

Additional survey instruments may be purchased by Authorized Users for their individual work areas as required by the Radiation Safety Committee. Arrangements have been made with the manufacturers of the above equipment to provide calibration services on an annual basis and after any service work. The same calibration schedule will be followed for any new instrumentation added to the program. Scheduling and documentation of calibrations will be managed by the Radiation Safety Officer and pertinent information posted on the instruments.
APPENDIX 1: APPLICATION FOR AUTHORIZED USER STATUS

This form must be complete before a Colby College employee may become an Authorized User of radioactive material for research.
Colby College
APPLICATION FOR AUTHORIZED USER STATUS
(TRAINING + EXPERIENCE)

(To be submitted to the Radiation Safety Officer/Radiation Safety Committee)

1. Name of Applicant________________________Position________________________

2. Proposed work location____________________Date of Application____

3. Has the applicant been licensed previously for use of radioactive material?  
   Yes/No
   If so, by what institution or agency?______________________________

4. Type of Training Where trained Duration of On the Job Formal
   training (circle) Course

   a. Principles and practices of radiation protection  
      Yes/No  Yes/No

   b. Radioactivity measurement standardization and monitoring techniques and instruments  
      Yes/No  Yes/No

   c. Mathematics and calculations basic to the use and measurement of radioactivity  
      Yes/No  Yes/No

   d. Biological effects of radiation  
      Yes/No  Yes/No
5. Experience with Radiation. (Actual use of radioisotopes or equivalent experience)

<table>
<thead>
<tr>
<th>Isotope of Study</th>
<th>Max Amount</th>
<th>Institution</th>
<th>How long</th>
<th>Type</th>
</tr>
</thead>
</table>

Signature of Applicant __________________________ Date __________

( ) Protocols submitted _______________ Date __________

( ) Committee Approval _______________ Date __________

RSO or Chairman

This Section to be completed by the Colby College Radiation Safety Officer

1. Training: Lecture______________ Interview______________
   (date) (date)

2. Instructional material supplied: __________________________

3. Personnel dosimetry assigned (type): __________________________

4. Bioassays required: (type and frequency):
5. Medical examinations required and/or requested:

6. Comments on past occupational exposure and history:

7. Requests for past records (name, address and date)

__________________________  ______________________________
Signature of RSO                  Date

__________________________  ______________________________
Termination Data:                  Badge# ______

1. Summary of radiation exposure during employment at Colby College:

2. Comments:

__________________________  ______________________________
Signature of RSO                  Date
APPENDIX 2: APPLICATION FOR PERMISSION TO USE RADIOACTIVE MATERIALS

The application must be completed and reviewed by the RSO and RSC before research involving radioactive materials may be conducted at the College.
Name:__________________________________________________________

Staff Position:_________________________________________Tel. No._________

1. Describe purpose(s) for which radioactive material will be used.

Outline Procedures involved in the use of this material:

<table>
<thead>
<tr>
<th>Radioactive Material</th>
<th>Requested Possession Limit (mCi)</th>
<th>Chemical and/or Physical form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max on hand at any one time</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Outline Procedures involved in the use of this material:
Material will be stored at: Building___________ Room ______

Material will be used at: Building___________ Room_______

3. Is any of the radioactive material used as a label for potentially biohazardous materials, toxic chemicals or carcinogenic/mutagenic material?_______

If yes, explain below:

4. List equipment for handling isotope. (Note: dry smears, using filter paper and counted in a liquid scintillation counter, should be utilized in surveying work areas and equipment for radioactive contamination resulting from work with 14-carbon, 3-hydrogen and 35-sulfur.

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hood</td>
<td>( )</td>
</tr>
<tr>
<td>Shielding</td>
<td>( )</td>
</tr>
<tr>
<td>Disposable Gloves</td>
<td>( )</td>
</tr>
<tr>
<td>G. M. Survey Meter</td>
<td>( )</td>
</tr>
<tr>
<td>Mechanical Pipeete</td>
<td>( )</td>
</tr>
<tr>
<td>Stainless Steel sink</td>
<td>( )</td>
</tr>
<tr>
<td>Shielded Storage Containers</td>
<td>( )</td>
</tr>
<tr>
<td>Access to beta or gamma counters</td>
<td>( )</td>
</tr>
<tr>
<td>Appropriate Warning Signs and Labels</td>
<td>( )</td>
</tr>
<tr>
<td>Waterproof-backed Absorbent Material for bench and floor covering</td>
<td>( )</td>
</tr>
<tr>
<td>Appropriate Monitoring Devices</td>
<td>( )</td>
</tr>
<tr>
<td>Handling Tongs</td>
<td>( )</td>
</tr>
<tr>
<td>Air Sampling Equipment</td>
<td>( )</td>
</tr>
<tr>
<td>Glove Box</td>
<td>( )</td>
</tr>
<tr>
<td>Lab Coats</td>
<td>( )</td>
</tr>
<tr>
<td>Other Special Equipment or Facilities:</td>
<td></td>
</tr>
</tbody>
</table>

5. Waste Disposal:
   a. Soluble low level liquid waste into sink in Bld./Rm.#____________________
b. Dry solid waste into labeled container in Bld./Rm.# ________________
c. Will there be other wastes generated (animals, insoluble liquids, scintillation fluids, etc.)? ______

If yes, outline description and disposal method below:

6. The following list of persons who will use or be exposed to radiation under this authorization, will receive instruction by the Authorized User or Radiation Safety Officer in the appropriate precautions to minimize exposure associated with the requested isotope.

Principal users: __________________________________________________________

Others: _________________________________________________________________

Signature below affirms that the Authorized User/Applicant has read and will comply with the Rules and Mode of Function of the Colby College Radiation Safety Committee.

_________________________  ________________________
Radiation Safety Officer Review  Date

_________________________  ________________________
Authorized User/Applicant Signature  Date
APPENDIX 3:  PROCEDURE FOR RECEIPT AND OPENING OF RADIOACTIVE MATERIAL SHIPMENTS

General instructions for opening packages of radioactive material deliveries.
PROCEDURE FOR RECEIPT AND OPENING OF RADIOACTIVE MATERIAL SHIPMENTS

1. All radioactive materials coming into Colby College will be addressed to the individual user.

2. Upon receipt, the Authorized User or a trained member of his staff will be responsible for opening the package and delivery to the lab.

3. Procedures for opening of packages:
   a. Use gloves to prevent contamination of hands.
   b. Visually inspect package for signs of damage, noting unusual conditions. (e.g. crushed, punctured, wet)
   c. Use survey meter to measure and record exposure rate at 1 meter and surface of package. If exposure rate > 10 mR/hr at 1 meter or 200 mR/hr at surface, take appropriate precautions and notify Radiation Safety Officer.
   d. Open outer package (following manufacturers directions, if supplied) and remove packing slip.
   e. Open inner package and verify that contents agree with those on packing slip. Compare requisition, packing slip and label on bottle.
   f. Check integrity of final source container, inspecting for breakage of seals or vials, loss of liquid, and discoloration of packaging material.

4. Monitor packing material and package for contamination before discarding:
   a. If contaminated, treat as radioactive waste.
   b. If not contaminated, obliterate radioactive labels before discarding as normal trash.
APPENDIX 4: RULES FOR HOT LAB USERS

General instructions for working in a hot lab to prevent exposure.
RULES FOR HOT LAB USERS

These general instructions for use of any designated Hot Lab facility are intended to minimize exposure of personnel using the Hot Lab and maximize efficient use of the facility. All laboratory workers or students working with radioactive materials must be familiar with these rules.

1. Only authorized personnel, i.e. those who have obtained permission to use radioisotopes through the Radiation Safety Committee, may use the Hot Lab facility.

2. Only specific work, previously approved by the Radiation Safety Committee may be conducted in the Hot Lab facility.

3. Keys to the facility are managed by the Radiation Safety Officer or his/her designee and distribution is limited to Authorized Users of radioactive materials at Colby College. No students will be issued keys, nor may they access the facility unless by permission of an Authorized User. Student activity in the Hot Lab will be supervised by an Authorized User at all times.

4. All individuals using the Hot Lab will follow the requirements outlined in the Colby College Rules and Mode of Functioning of the Radiation Safety Committee. Particularly those outlining personnel responsibilities, monitoring routines and specific safety and emergency procedures. The Radiation Safety Officer may post additional requirements as indicated by his authority.

5. All personnel working in the Hot Lab are required to wear a laboratory gown and disposable gloves.

General Laboratory Rules, Daily Laboratory Procedures, and Emergency Procedures are posted in the Hot Lab and kept current by the Radiation Safety Officer.
APPENDIX 5: FACILITY DIAGRAMS