Office of the Dean of the Faculty
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2106

July 17, 1979

Michael A. Lamastra
License Management Branch
Division of Fuel Cycle and Material Safety
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

REFER to Control No. 98412

Dear Mr. Lamastra:

This letter contains the additional information which you requested so that the review of Mount Holyoke College's application (dated January 25, 1979) for renewal of Material License No. 20-01677-02 may be continued. The information is presented in the following sections which are numbered with the same numbers as the requests made in your letter dated June 5, 1979.

1. The Radiation Safety Committee of Mount Holyoke College will follow the criteria specified in part b of Section 33.15, Requirements for the issuance of a Type C specific license of broad scope, of 10 CFR Part 33 in approving new users.

2. The following radiation safety instruments are presently used:

Type, Manufacturer, Model	Number Available	Radiation Detected	Sensitivity Range
a. Deep well NaI photomultiplier detector with Canberra 800 Series logic circuits and GR counter.	1	γ	better than 10^{-4} μcuries
b. Liquid Scintillation Counter, Nuclear Chicago 7850	1	α, β, γ	$0 \rightarrow \infty$
c. Liquid Scintillation System, Beckman Model LS 100C	1	α, β, γ	$0 \rightarrow \infty$
d. Geiger Counters, various makes	5	β, γ	useful range for laboratory monitoring
e. ZnS (Ag) screen with photomultiplier, Tracerlab P200	1	α	100% efficiency for >4 Mev α particles

3. Use of phosphorus - 32

Each specific research protocol involving P-32 will be approved by the Radiation Safety Committee before experiments begin. "Dry runs" may be requested by Radiation Safety personnel for their evaluation. At a minimum protocols will include:

a. All radioisotopes shall be handled under conditions which maintain radiation exposure within permissible limits and prevent contamination.

b. A "hot" area will be designated for P-32 use only. All laboratory personnel will be notified of the area's use. The user shall use plastic backed absorbent paper on the bench top, label all possibly contaminated equipment with radioactive material tape, and post a Caution Radioactive Materials sign.

c. Film badges (body and ring) will be used by all laboratory personnel working with millicurie quantities of P-32. Ring badges will be worn under the disposable plastic gloves. (See Section No. 13 below on film badge service).

d. Disposable gloves will be used with all P-32 procedures to avoid skin contact. Two pairs of gloves will be used. The inner gloves must be kept clean and when the user leaves the immediate work area the outer gloves will be removed and disposed of properly into radioactive waste.

e. All laboratory personnel using radioisotopes shall wear lab coats. Lab coats used for P-32 work shall remain in the P-32 work area to eliminate the spread of possible contamination.

f. Shielding materials of low density are to be used (e.g., plastic, water, etc.) when working with or storing millicurie amounts of P-32. High density materials produce bremstrahlung radiation (i.e. x-rays) when hit with the high energy P-32 beta particles.

g. The upper body will be protected from chemical splash and unnecessary radiation by using lucite shielding at "Hot" work areas.

h. After the experimental procedure is completed all P-32 work areas will be monitored thoroughly with a properly calibrated radiation survey meter (See Section No. 14 on survey instrument calibration procedures). All contaminated areas showing greater than 100 counts per minute above background shall be cleaned. (See Section No. 9 on emergency procedures for minor spills).

i. Storage and transfer of all labeled radioactive material shall be done with secondary containment. For example, centrifuge vials with radioactive material must be carried in another small plastic secondary container that can be closed and secured to eliminate contamination if accidentally dropped.

j. P-32 waste will be isolated in properly labeled radioactive waste containers. Transfer of "Hot" waste requires double bagging or use of other types of secondary containers of equal or greater integrity.

k. Because the P-32 beta particle is of such an energy that it is not appreciably attenuated by a few centimeters of air laboratory personnel shall not handle unshielded open containers of this material. (Dose rate at the surface of a 1 ml solution containing 1 mCi of P-32 is 13 Rem/minute). (Note Table listing maximum range of P-32 beta particle in various materials).

l. No eating, drinking, or smoking will be allowed at any laboratory utilizing radioisotopes.

4. Bioassay program for individuals using millicurie quantities of tritium or radioactive iodine.

All bioassays required for individuals using millicurie quantities of tritium or radioactive iodine will be performed for us by the Division of Environmental Health and Safety of the University of Massachusetts, Amherst, MA. according to their procedures (see Appendix I).

5. & 6. Procedures for ordering, receiving and safely opening packages of radioactive materials according to Sections 20.105 and 20.205 of 10 CFR Part 20.

Orders for radioactive materials cannot be placed without the approval of the Dean of the Faculty, or in her absence by the Radiation Protection Officer, who must insure that the requested materials and quantities are authorized by the license and that possession limits are not exceeded.

During normal working hours packages of radioactive materials will be delivered to the Dean of Faculty's office which will notify the person who ordered the material. This person will, while wearing gloves, monitor the package before opening and monitor the packing material for contamination after opening. Because use of radioisotopes occurs only in the Biological Sciences, Chemistry and Physics departments, and because only a small number of faculty members in these departments use radioisotopes, this procedure for receiving them is practical and effective. The specific statement "Do not ship on Friday" will be placed on purchase orders because ordinarily deliveries are not accepted on Saturday or Sunday.

7. Training of personnel who work in or frequent a restricted area.

Once a year students and laboratory technicians who use radioisotopes or who are in restricted areas will attend a one-hour seminar presented by the Radiation Protection Officer of the University of Massachusetts, Amherst, Massachusetts who is also a member of the Mount Holyoke College Radiation Safety Committee. The seminar will cover safehandling and disposal of radioactive material and genetic effects of radiation. Each person who works with radioactive materials receives a copy of General Rules for the Safe Handling of Radioisotopes (see Appendix II).

Housekeeping and animal care personnel are instructed individually about appropriate procedures to be used in and around restricted areas.

8. Rules for the safe use of radioactive materials (to be posted in each laboratory in which such materials are used).

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

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

c. Monitor hands and clothing for contamination after each procedure or before leaving the area.

d. Do not eat, drink, smoke, or apply cosmetics in any area where radioactive material is stored or used.

e. Personnel monitoring devices (see Section 13 below).

f. Dispose of radioactive waste only in specially designated receptacles.

g. Never pipette by mouth.

h. Confine radioactive solutions in covered containers plainly identified and labeled with name of compound, radionuclide, date, activity, and radiation level, if applicable.

i. Always transport radioactive material in shielding containers.

9. Emergency procedures.

Minor spills.

a. If spill is liquid, and the hands and clothing are protected, right the container, if possible, to minimize spillage.

b. If spill is on the skin, flush thoroughly with water.

c. If spill is on clothing, discard outer or protective clothing at once.

d. Radiation safety procedures (Section 15 b. below) require the use of plastic backed absorbent paper or appropriate metal or glass trays on all bench surfaces; this should be sufficient to contain most all lab bench spills (typically life science volumes containing radioactive materials are 10 ml or less). A floor spill of this nature will be contained with paper towels and/or "kitty litter" which will be available in all labs utilizing radioisotopes.

e. Final decontamination of contaminated surfaces will be accomplished with foaming cleaner containing 3% sodium EDTA.

f. Notify Radiation Protection Officer about incident.

Major spills.

a. Same procedures as for Minor spills up to letter d.

b. If external radiation levels are high, evacuate exposed personnel from accident scene and assure that they remain confined until monitored.

c. Notify Radiation Protection Officer as soon as possible; do not leave scene of accident; call for assistance; do not allow any personnel not involved to enter.

d. Use absorbent material (kitty litter) to contain spill. If spill is too large for this, wait at accident perimeter for assistance.

e. Decontamination of contaminated surfaces will be accomplished with floor washing detergent containing 3% EDTA.

10. Use of radioactive materials in animals.

a. Animal facilities for radioactive isotope studies.

In addition to the regular animal rooms, there is a special isolation room with cage racks, watering and feeding facilities, and a large deep stainless steel sink for washing cages. This room is not used for routine animal housing, so is well-adapted for use in radioactivity experiments. None of our animal experiments involve more than a few microcuries of C-14 or tritium, so there is no need for special radiation protection. The regular animal caretaker does not tend the animals housed in this room, so the care is under the direct control of the experimenters.

b. Safety instructions for animal caretaker.

Animals used for radioisotope experiments are housed in a special isolation animal room, and are not taken care of by the animal caretaker. The individual instructor is responsible for the care of all animals so used. This responsibility may be

deligated to properly instructed students but the instructor closely observes that proper procedures are followed. The only animals used in experiments involving radioisotopes are rats and mice. Disposal of animal waste and carcasses is by incinceration. Cage cleaning is carried out under the supervision of the Biological Sciences department's representative on the Radiation Safety Committee. It is done in the special animal room.

11. The Division of Environmental Health and Safety of the University of Massachusetts, Amherst, Massachusetts will survey laboratories at Mount Holyoke College which use radioactive materials in accordance with the acceptable guidelines outlined in "Methods and Frequency for Conducting Surveys".

12. Incineration of radioactive waste.

    Incineration of radioactive waste containing tritium and carbon-14 exceeding 500 microcuries total per year will not be carried out. See Item 14 b, page II-A of our application, dated January 25, 1979, for renewal of Material License No. 20-01677-02 for procedures used in waste disposal by incineration.

13. For personnel monitoring we will utilize whole body and ring film badges as appropriate to protocol when necessary. These will be provided by Landauer Co., Chicago, Illinois on a monthly basis.

14. All survey instruments used during laboratory surveys are the property of the Division of Environmental Health and Safety; University of Massachusetts. They are all calibrated quarterly on at least 2 points per scale at approximately 1/3 and 2/3 of full scale. All of Mount Holyoke College's portable survey instruments will also be calibrated by the Division of Environmental Health and Safety.

15. a. The Radiation Safety Committee of Mount Holyoke College will meet at least once in each calendar quarter.

    b. Criteria for approving laboratories using or storing radioactive material.

    All labs using radioactive materials are typical science teaching labs containing fume hoods, sinks, refrigerator/freezers, centrifuges, incubators, lab benches, etc. At any one time any or all labs authorized by the Radiation Safety Committee may use and/or store authorized types/quantities of radioactive material. The Radiation Safety Committee will approve each request to use radioactive material according to the following criteria:

    A. PROPER MARKING OF LABORATORIES, AREAS AND EQUIPMENT

    1. A "Caution Radioactive Materials" sign must be conspicuously posted on the doors to laboratory areas where radioactive materials are being used or stored. The name and home phone number of the individual responsible for the posted area

shall be shown in the designated place on the sign in order to facilitate contact in case of emergency. The supervisor shall be responsible for seeing that the posted information is current. The signs must not be removed from any room except by Radiation Safety personnel following an inspection survey.

2. Storage areas shall be conspicuously marked with a "Caution Radioactive Materials" sign. In addition, containers in which materials are transported or stored shall bear a durable, clearly visible label bearing the words "Caution Radioactive Materials." This label shall also state the quantities and kinds of radioactive materials in the containers and the date of measurement of the quantity.

3. Radiation areas in the laboratory, i.e., areas where radiation levels might expose individuals to 5 millirem in any one hour; or in any five consecutive days, a dose in excess of 100 mrem, shall be posted with the sign "Caution Radiation Area."

4. All equipment contaminated with radioactive material shall be marked with signs, decals, or other conspicuous means. Labelling shall not be required for laboratory containers such as beakers, flasks, and test tubes, used transiently in laboratory procedures during the presence of the user.

5. All signs referred to in this part are available from the Environmental Health and Safety Office.

B. SHIELDING OF SOURCES

1. Radioactive sources or stock solutions in the laboratory shall be shielded in such a manner that the radiation levels in any occupied area will not expose individuals in the area to more than 100 mrem in any five consecutive days.

2. Various shielding materials are available on loan from the Environmental Health and Safety Office.

C. AEROSOLS, DUSTS AND GASEOUS PRODUCTS

1. Procedures involving aerosols, dusts or gaseous products, or procedures which might produce airborne contamination shall be conducted in a hood, dry box, or other suitable closed system. When using carrier-free radioiodine, the containment structure will incorporate charcoal filters in order to meet all applicable release requirements.

2. All releases from such systems shall not exceed the maximum permissible concentration in air for the nuclide in question. See Appendix B, Tables I and II of 10 CRF 20 for appropriate values. However, where practical, traps should be incorporated in the experimental set-up to insure that environmental releases are as low as possible.

3. Radioactive gases or materials with radioactive gaseous daughters must be stored in gas-tight containers and must be kept in areas having approved ventillation.

4. Hoods to be used for radioisotope work should be tested by the Environmental Health and Safety Office, to insure that they meet minimum requirements for air velocity at the face of the hood, i.e., 100 lfm.

D. WORK SURFACES

All work areas (bench tops, hood floors, etc.) as well as storage areas and areas adjacent to permanent set-ups and sinks should be covered at all times with stainless steel or plastic trays, uncracked glass plates, or other impervious materials. For some purposes a plastic-backed absorbent paper will be satisfactory. However, if such paper is used, it should be discarded frequently to prevent active material from dusting off the surface.

E. REMOVAL OF EQUIPMENT FROM THE LABORATORY

Once used for radioactive substances, equipment shall not be used for other work, or sent from the area to central cleaning facilities, repair shops, surplus, or returned to the source of supply, until demonstrated to be free of contamination.

F. REPAIR AND MAINTENANCE OF EQUIPMENT IN THE LABORATORY

Equipment to be repaired by shop and maintenance personnel, or by commercial service contractors, shall be demonstrated to be free of contamination prior to servicing. If it becomes necessary to make emergency repairs on contaminated equipment, the work will be supervised by a member of the Environmental Health and Safety staff, who will assure that the necessary safeguards are taken. It is the responsibility of the laboratory personnel to request this supervision from the Environmental Health and Safety Office.

G. HOUSE VACUUM LINES

House vacuum lines are vulnerable to contamination. If house vacuum lines are to be used, the withdrawn gas must be demonstrated to the Environmental Health and Safety Office to be free of radioactivity. It is advisable to use a separate vacuum pump exhausting into a hood.

Please let me know if additional information is needed.

We wish to amend our application for renewal of Material License No. 20-01677-02 with respect to the Cesium-137 sealed source. We ask

that the required leak test be carried out before the source is used and not while it is in storage. We request this because the source is typically used only once a year.

We also wish to inform you that the Radiation Protection Officer of the University of Massachusetts, Amherst, Massachusetts is a member of the Mount Holyoke College Radiation Safety Committee. He joins the Dean of the Faculty, the Director of Physical Facilities and a faculty member from each of the departments in which work with radioactive materials is carried out.

Sincerely yours,

Emily L. Wick

Emily L. Wick
Dean of the Faculty

Attachments - Appendix I
Appendix II

APPENDIX I

Division of Environmental Health and Safety,
University of Massachusetts, Amherst, Massachusetts

Bioassays will be required of all researchers using H^3 and/or I^{125} according to the following:

1. Occasional use of 10 mci or more of H^3 labelled compounds or 100 mci or more of other uncontained forms of H^3 labelled material will require a bioassay within 48 hours after completion of the work. Continuous use requires weekly biassays.
2. Occasional use of carrier-free I^{125} for iodination requires thyroid counting at 48 hours after completion of the work. Continuous use requires weekly thyroid checks.
3. Bioassays for uptakes of other radioisotopes will be done for cause (to be determined by Radioisotope Use Committee prior to research authorization).

The tritium bioassay procedure will consist of:

1. 24 hour composite urine samples will be requested and collected by EH&S personnel.
2. Calibrate Liquid Scintillation Counter.
3. 1 ml of tap water, in 10 ml Aquasol, will be used for the background count.
4. 1 ml of urine into 10 ml Aquasol and count 10 minutes in LSC. Record counts.
5. Add 100 of toluene (H^3), 2 X 10^4 dpm/100 calibration solution to a second vial containing 1 ml urine and 10 ml Aquasol and count 10 minutes in LSC. This permits accurate computation of counting efficiency even in the presence of quenching.

Calculations: $\text{eff} = \dfrac{\text{cpm of spiked sample}}{2 \times 10^4 \text{ dpm of spiked sample}}$

$\dfrac{\text{non-spiked sample count - background count}}{\text{efficiency}}$ = dpm of urine sample

$\dfrac{\text{dpm of urine sample}}{2.22 \times 10^3 \text{ dpm/nCi}}$ = activity (nCi)/ml

activity X 43,000 ml/std man body fluid - Body Burden (nCi)

For I^{125} thyroid counting, researchers will be counted at Mount Holyoke College at the appropriate time following the experiment. Two minute thryoid counts will be performed using an external scintillation probe/single channel analyzer system (see attached Procedure/Calculation Worksheet and Sensitivity Calculation Sheet).

I^{125} THYROID COUNTING PROCEDURE AND CALCULATION

DATE:

RESEARCHER:

INSTRUMENT USED: A) Eberline Mini Scaler, model MS-2 with LEG-1 probe
B) H.V. @ 5 (approx. 750 v)
threshold @ 4.1 (22.5 Kev)
window @ 3.0 (37.5 Kev)
C) Calibration using cylindrical water phantom (15 cm X 17.5 cm)

Background = cts/min

.101 uci I^{125} Std. = cts/2 min

$$\text{eff} = \frac{\text{cpm/101 nci std.}}{224{,}220 \text{ dpm/101 nci std.}} =$$

RESULTS: Thyroid was counted for 2 minutes with the probe contacting neck just below the adam's apple, yielding _____counts.

CALCULATIONS: r_n = ——— − ——— = , where r_n = net counting rate

$$\sigma_n = \sqrt{\text{——— + ———}} = \text{, where } \sigma_n = \text{standard deviation}$$

$$t = \frac{r_n}{\sigma_n} = \text{, where t = test for null hypothesis}$$

$$\frac{r_n}{\text{eff}} = \text{———————} \div 2220 \frac{\text{dpm}}{\text{nci}} = \text{thyroid burden (nCi)}$$

CONCLUSION: ( ) 1. Since the above test shows that there are less than 2.55 standard deviations (2.55) in the net counting rate and within the 99% confidence limit, the null hypothesis is accepted and no activity is assumed present at this time.

( ) 2. Since the above test shows that there are more than 2.55 standard deviations in the net counting rate and outside the 99% confidence limit, the null hypothesis is rejected and activity is assumed present.

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CALCULATION OF LIMIT OF SENSITIVITY FOR I^{125} THYROID COUNTING WITH LEG-1 PROBE AT SURFACE OF NECK

Instrument Used: Eberline Mini Scaler (single channel analyzer) with LEG-1 probe at surface of phantom

typical bkg.- 480 cts/20 min

" I^{125} std.(101nci) - 11,731 cts/2 min

$$\text{eff} = \frac{5{,}866 \text{ cpm/101 nci std}}{224{,}220 \text{ dpm/101 nci std}}$$

$$= 2.6\%$$

Calculations:

$$r_n = \frac{L_s}{2} - \frac{480}{20}$$

$$\sigma_n = \sqrt{\frac{\frac{L_s}{2}}{2} + \frac{24}{20}}$$

find L_s when $t = \frac{r_n}{\sigma_n} = 2.55$ (or within 99% conf. level)

eq.1 $$r_n = 2.55\sigma_n = \frac{L_s}{2} - \frac{480}{20}$$

eq.2 $$\sigma_n = \sqrt{\frac{\left(\frac{L_s}{2}\right)}{2} + \frac{24}{20}}$$

$$L_s = 2(2.55\sigma_n) + 2\left(\frac{480}{20}\right) \quad \text{(transposing from eq.1)}$$

$$= 2(2.55\sigma_n) + 48$$

substituting: $$\sigma_n = \sqrt{\frac{\left(\frac{2(2.55\sigma_n) + 48}{2}\right)}{2} + \frac{24}{20}}$$

$$\sigma_n^2 = 1.275\sigma_n + 13.2$$

$$\sigma_n^2 = 1.275\sigma_n - 13.2 = 0$$

$$\sigma_n = \frac{-(-1.275) \pm \sqrt{(1.275)^2 - 4(1)(-13.2)}}{2(1)}$$

$$\sigma_n = \frac{1.2 \pm \sqrt{1.626 + 52.8}}{2}$$

$$= 4.326$$

$$\therefore L_s = 2(2.55)\ (4.326) + 48$$

$$= 22.06 + 48 = 70.06$$

$$\therefore r_n = \frac{70}{2} - \frac{480}{20} = 11$$

$$\therefore \frac{11 \text{ cpm}}{.026 \frac{\text{cpm}}{\text{dpm}}} = 423 \text{ dpm}$$

$$\frac{423 \text{ dpm}}{2.22 \frac{\text{dpm}}{\text{pci}}} = 190 \text{ pci}$$

190 pci = limit of sensitivity or smallest amount in thyroid detectable at 99% confidence level.

APPENDIX II

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GENERAL RULES FOR THE SAFE HANDLING OF RADIOISOTOPES

Due to their potential danger, radioisotopes must be handled with extreme care; not only during their usage, but also during their subsequent disposal. These are <u>some</u> of the fundamental safety rules which all students should observe:

1. Do not pipette radioactive solutions by mouth, and never eat or drink in the lab when isotopes are in use.

2. Avoid contact of radioisotopes with your skin, most biochemically important radioisotopes are metabolites that are easily assimilated either by ingestion or absorption through the skin. If the skin becomes contaminated, wash with soap and water immediately.

3. Do not contaminate laboratory, clothes, books, etc. with radioisotopes. Therefore, work on an absorbent disposable surface (e.g., blotting paper) and only at a location specifically designated for radioisotope work. All spills should be wiped up immediately and the instructor informed of the accident.

4. Label all radioactive containers, glassware, etc. with the special yellow labels.

5. Radioactive liquids must <u>NEVER</u> be poured down the sink, dispose into the appropriate vessel marked for that purpose.

6. Contaminated equipment (glassware, pipettes, tubing, etc.) should be specially washed, separately from uncontaminated equipment.

7. All disposable contaminated materials (kimwipes, paper towels, syringes, filters, etc.) should be placed into an appropriately marked container.