

## MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

399559

|  |  |  |                    |
|--|--|--|--------------------|
| Licensee   |  | 3. License Number  | 48-00268-03        |
| 1. Beloit College<br>Department of Physics<br>and Astronomy  |  | 4. Expiration Date   | September 30, 2001 |
| 2. 700 College Avenue<br>Beloit, WI 53511  |  | 5. Docket or<br>Reference No.  | 030-34019          |
| 6. Byproduct, Source, and/or<br>Special Nuclear Material   | 7. Chemical and/or Physical<br>Form                            | 8. Maximum Amount that Licensee<br>May Possess at Any One Time<br>Under This License |                    |
| A. Cobalt-60   | A. Sealed sources  | A. 1 millicurie  |                    |
| B. Americium-241   | B. Sealed source   | B. 0.1 millicurie  |                    |
| C. Cesium-137  | C. Sealed source (New<br>England Nuclear<br>Model No. NER-570) | C. 120 millicuries   |                    |
| D. Plutonium   | D. Sealed source<br>(Source No. N480E2)                        | D. 48 grams  |                    |
| E. Any byproduct<br>material   | E. Activation products   | E. See Item 9.E. below   |                    |
| 9. Authorized Use:   |  |  |                    |
| A. and B. Laboratory instruction of students.  |  |  |                    |
| C. To be used in NEN Model NER-400 N or custom designed source holder for laboratory instruction of students.                        |  |  |                    |
| D. To be used in U.S. Nuclear Corp. Model NR-2-M3 Howitzer for education and training.   |  |  |                    |
| E. Possession incident to the performance of irradiation experiments utilizing the Pu-Be source. To be used for student instruction. |  |  |                    |

## CONDITIONS

10. Licensed material shall be used only at the licensee's facilities located at 700 College Street, Department of Physics and Astronomy, Beloit, Wisconsin.

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**MATERIALS LICENSE  
SUPPLEMENTARY SHEET**

License Number

48-00268-03

Docket or Reference Number

030-34019

11. The Radiation Safety Officer for this license is David A. Dobson, Ph.D.
12. Licensed material shall be used by, or under the supervision of, David A. Dobson, Ph.D., or J. Patrick Polley, Ph.D.
13.
  - A. Sealed sources and detector cells shall be tested for leakage and/or contamination at intervals not to exceed 6 months or at such other intervals as specified by the certificate of registration referred to in 10 CFR 32.210.
  - B. Notwithstanding Paragraph A of this Condition, sealed sources designed to emit alpha particles shall be tested for leakage and/or contamination at intervals not to exceed 3 months.
  - C. In the absence of a certificate from a transferor indicating that a leak test has been made within 6 months prior to the transfer, a sealed source or detector cell received from another person shall not be put into use until tested.
  - D. Sealed sources need not be leak tested if:
    - (i) they contain only hydrogen-3; or
    - (ii) they contain only a radioactive gas; or
    - (iii) the half-life of the isotope is 30 days or less; or
    - (iv) they contain not more than 100 microcuries of beta and/or gamma emitting material or not more than 10 microcuries of alpha emitting material; or
    - (v) they are not designed to emit alpha particles, are in storage, and are not being used. However, when they are removed from storage for use or transferred to another person, and have not been tested within the required leak test interval, they shall be tested before use or transfer. No sealed source or detector cell shall be stored for a period of more than 10 years without being tested for leakage and/or contamination.
  - E. The leak test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. If the test reveals the presence of 0.005 microcurie or more of removable contamination, a report shall be filed with the U.S. Nuclear Regulatory Commission in accordance with 10 CFR 30.50(b)(2), and the source shall be removed immediately from service and decontaminated, repaired, or disposed of in accordance with Commission regulations. The report shall be filed within 5 days of the date the leak test result is known with the U.S. Nuclear Regulatory Commission, Region III, ATTN: Chief, Nuclear Materials Safety Branch, 801 Warrenville Road, Lisle, Illinois 60532-4351. The report shall specify the source involved, the test results, and corrective action taken.

COPY

**MATERIALS LICENSE  
SUPPLEMENTARY SHEET**

License Number

48-00268-03

Docket or Reference Number

030-34019

- F. Tests for leakage and/or contamination shall be performed by the licensee or by other persons specifically licensed by the Commission or an Agreement State to perform such services.
14. Sealed sources or detector cells containing licensed material shall not be opened or sources removed from source holders by the licensee.
  15. The licensee shall not use licensed material in or on human beings except as provided otherwise by specific condition of this license.
  16. The licensee shall not use licensed material in field applications where activity is released except as provided otherwise by specific condition of this license.
  17. In addition to the possession limits in Item 8, the licensee shall further restrict the possession of licensed material to quantities below the limits specified in 10 CFR 30.72 which require consideration of the need for an emergency plan for responding to a release of licensed material.
  18. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents including any enclosures, listed below. The Nuclear Regulatory Commission's regulations shall govern unless the statements, representations and procedures in the licensee's application and correspondence are more restrictive than the regulations.
    - A. Application dated November 27, 1995 (excluding leak testing procedures); and
    - B. Letters dated November 27, 1995, July 10, 1995 (excluding sections A.3., D.1. and D.2.) and August 14, 1996.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Date

*September 17, 1996*

By

*Colleen C. Casey*  
Nuclear Materials Licensing Branch, Region III

**COPY**

(FOR LFMS USE)  
INFORMATION FROM LTS

RECEIVED

DEC 07 1995

REGION 1

BETWEEN:

LICENSE FEE MANAGEMENT BRANCH, ARM  
AND  
REGIONAL LICENSING SECTIONS

PROGRAM CODE: \_\_\_\_\_  
STATUS CODE: 3  
FEE CATEGORY: \_\_\_\_\_  
EXP. DATE: 0  
FEE COMMENTS: \_\_\_\_\_  
DECOM FIN ASSUR READ: \_\_\_\_\_  
.....

LICENSE FEE TRANSMITTAL

A. REGION

1. APPLICATION ATTACHED  
APPLICANT/LICENSEE: BELOIT COLLEGE  
RECEIVED DATE: 951129  
DOCKET NO: 3034019  
CONTROL NO.: 399559  
LICENSE NO.: \_\_\_\_\_  
ACTION TYPE: NEW LICENSE

2. FEE ATTACHED  
AMOUNT: 0  
CHECK NO.: 0

3. COMMENTS

SIGNED  
DATE

S. Hersey  
11-30-95

B. LICENSE FEE MANAGEMENT BRANCH (CHECK WHEN MILESTONE 03 IS ENTERED ☒)

1. FEE CATEGORY AND AMOUNT: EX 3P 1D

2. CORRECT FEE PAID. APPLICATION MAY BE PROCESSED FOR:  
AMENDMENT \_\_\_\_\_  
RENEWAL \_\_\_\_\_  
LICENSE ☒

3. OTHER

SIGNED  
DATE

SC  
12/5/95

|                   |                    |
|-------------------|--------------------|
| RECEIVED BY LFDCB |                    |
| Date              | <u>Dec 4, 1995</u> |
| Log               | <u>Dec 4 TH</u>    |
| By                | <u>SC</u>          |
| Date Completed    | <u>12/5/95</u>     |

170.11(A)(4)  
**FEE EXEMPT**



(10-94)  
10 CFR 30, 32, 33  
34, 35, 36, 39 and 40

EXPIRES 6-30-96

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 8 HOURS. SUBMITTAL OF THE APPLICATION IS NECESSARY TO DETERMINE THAT THE APPLICANT IS QUALIFIED AND THAT ADEQUATE PROCEDURES EXIST TO PROTECT THE PUBLIC HEALTH AND SAFETY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0120), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

## APPLICATION FOR MATERIAL LICENSE

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

## APPLICATION FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

DIVISION OF INDUSTRIAL AND MEDICAL NUCLEAR SAFETY  
OFFICE OF NUCLEAR MATERIALS SAFETY AND SAFEGUARDS  
U.S. NUCLEAR REGULATORY COMMISSION  
WASHINGTON, DC 20555-0001

## ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS:

## IF YOU ARE LOCATED IN:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND,  
MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, PENNSYLVANIA,  
RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

LICENSING ASSISTANT SECTION  
NUCLEAR MATERIALS SAFETY BRANCH  
U.S. NUCLEAR REGULATORY COMMISSION, REGION I  
475 ALLENDALE ROAD  
KING OF PRUSSIA, PA 19406-1415

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, PUERTO  
RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA,  
SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING SECTION  
U.S. NUCLEAR REGULATORY COMMISSION, REGION II  
101 MARIETTA STREET, NW, SUITE 2900  
ATLANTA, GA 30323-0199

## IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN,  
SEND APPLICATIONS TO:

MATERIALS LICENSING SECTION  
U.S. NUCLEAR REGULATORY COMMISSION, REGION III  
801 WARRENVILLE RD.  
LISLE, IL 60532-4351

ALASKA, ARIZONA, ARKANSAS, CALIFORNIA, COLORADO, HAWAII, IDAHO, KANSAS,  
LOUISIANA, MONTANA, NEBRASKA, NEVADA, NEW MEXICO, NORTH DAKOTA,  
OKLAHOMA, OREGON, PACIFIC TRUST TERRITORIES, SOUTH DAKOTA, TEXAS, UTAH,  
WASHINGTON, OR WYOMING, SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING SECTION  
U.S. NUCLEAR REGULATORY COMMISSION, REGION IV  
611 RYAN PLAZA DRIVE, SUITE 400  
ARLINGTON, TX 76011-8064

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S. NUCLEAR REGULATORY COMMISSION JURISDICTIONS.

## 1. THIS IS AN APPLICATION FOR (Check appropriate item)

- ☒ A. NEW LICENSE  
☐ B. AMENDMENT TO LICENSE NUMBER \_\_\_\_\_  
☐ C. RENEWAL OF LICENSE NUMBER \_\_\_\_\_

## 2. NAME AND MAILING ADDRESS OF APPLICANT (Include Zip code)

Beloit College  
700 College Street  
Beloit, WI 53511

## 3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

Beloit College  
700 College Street  
Beloit, WI 53511

## 4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

David A. Dobson  
Radiation Protection Officer  
TELEPHONE NUMBER  
(608)-363-2649

SUBMIT ITEMS 5 THROUGH 11 ON 8-1/2 X 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

## 5. RADIOACTIVE MATERIAL

- a. Element and mass number; b. chemical and/or physical form; and c. maximum amount which will be possessed at any one time.

## 6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.

## 7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING EXPERIENCE

## 8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS

## 9. FACILITIES AND EQUIPMENT

## 10. RADIATION SAFETY PROGRAM

## 11. WASTE MANAGEMENT

## 12. LICENSEE FEES (See 10 CFR 170 and Section 170.31)

FEE CATEGORY exempt AMOUNT ENCLOSED \$ 0.00

## 13. CERTIFICATION (Must be completed by applicant) THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, 36, 39 AND 40, AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

CERTIFYING OFFICER - TYPED/PRINTED NAME AND TITLE

Nancy A. McDowell  
V.P. for Academic Affairs & Dean

SIGNATURE



DATE

11-27-95

## FOR NRC USE ONLY

| TYPE OF FEE | FEE LOG | FEE CATEGORY | AMOUNT RECEIVED | CHECK NUMBER | COMMENTS |
|-------------|---------|--------------|-----------------|--------------|----------|
|             |         |              | \$              |              |          |
| APPROVED BY |         |              |                 | DATE         |          |

170.11(A)(4)

FREE EXEMPT

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NOV 29 1995

REGION II

PRINTED ON RECYCLED PAPER

399559



Beloit, Wisconsin 53511

Department of Physics and Astronomy

(608) ~~365-3384~~  
363-2649

November 27, 1995

Materials Licensing Section  
U.S. Nuclear Regulatory Commission, Region III  
801 Warrenville Road  
Lisle, IL 60532-4351  
ATTN: J. R. Madera

SUBJECT: LICENSE APPLICATION

Dear Mr. Madera,

On October 25, 1995 I received a telephone call from Ms. Patricia Vacherlon, informing me that Beloit College's NRC License had expired on September 30, 1995.

This regrettable situation resulted from a misunderstanding on my part, rather than a lack of awareness of the license expiration date.

Notice of a proposed rule to extend certain material licenses by five years was sent to us in August, and Beloit College seemed to fit nicely into the category of licensees to be so extended. The proposed rule mentioned July 1, 1995 as an expiration date before which licensees could not qualify for the extension. I should have realized that our license would expire near the end of the 30 day comment period, and therefore would not likely be covered anyway.

Attached is our new license application. The sealed sources that we possess have been locked in secure storage since October 25th and will not be used or handled again until we receive NRC permission, in the form of a new license.

Please accept my sincere apology.

Very Truly Yours,

David A. Dobson  
Radiation Protection Officer

(Expired License No. 48-00268-02)

RECEIVED  
NOV 29 1995  
REGION III

Application for Material License - Beloit College - Nov 22, 1995

5. Radioactive Material.

| a. Element and<br>Mass Number | b. Chemical and/or<br>Physical Form                          | c. Max. Amount which will be<br>possessed at any one time                                 |
|-------------------------------|--|---|
| A. Cobalt-60                  | A. Sealed Sources  | A. 1 millicurie   |
| B. Americium-241              | B. Sealed Source   | B. 0.1 millicurie   |
| C. Cesium-137                 | C. Sealed Source<br>(New England Nuclear<br>Model # NER-570) | C. 120 millicuries  |
| D. Plutonium-239              | D. Sealed Source<br>(Source # N480E2)                        | D. 48 grams   |
| E. Any byproduct<br>Material  | E. Activation<br>products                                    | E. Possession as a<br>result of using the<br>Pu-Be source (in D.)<br>to activate samples. |

6. Purpose for which the Licensed Material will be used.

All of the items specified in A through E above will be used only for Laboratory instruction of students under faculty supervision.

The Radiation Protection Officer will assure that all sources are used in a manner that keeps radiation exposure to all individuals as low as reasonably achievable, and in any case below the levels specified in 10 CFR Part 20.

## Details concerning the use of Item C

Item C is used for Compton scattering experiments. During use, as well as storage, the CS-137 source will remain enclosed in its custom designed lead-shielded source holder, constructed in accordance with an NRC-approved design. This holder provides at least 3 inches of lead shielding in every direction, when its collimated beam hole is plugged. Survey measurements have shown that the radiation level is below 1.5 mR/hr at all points on the exterior surface of the source holder while the collimator hole is plugged. The sealed source is secured in this holder by a padlocked lead plug, which is not unlocked or removed while the source is in use.

A second lead plug on the opposite end of the shielding holder, with a separate padlock and different key, is removed during use to permit a collimated gamma-ray beam to emerge from the source. The radiation field at the collimator opening is approximately 1 R/hr. The collimator plug is easily unlocked and then removed or inserted without exposing the user's hand to the direct beam.

The experiment is set up so that the collimated beam from the source holder points toward an outside wall of the building. No individuals are able to pass in front of the open collimator. Each time the experiment is set up, the radiation field at all points where experimenters or observers are allowed to stand during the experiments will be checked with a survey instrument, to assure that it is less than 5 mR/hr. Check-out of the scattered photon detector and its associated electronics is performed with the collimator plugged, using a small, exempt Cs-137 source. The collimator plug will be re-inserted during repositioning of the scattering target or scattered photon detector, to assure that the hands and arms of experimenters are not exposed to the gamma-ray beam.

#### Details concerning the use of Item D

Item D is used for production of short-lived isotopes by neutron activation. The encapsulated Pu-Be neutron source is stored and used in a U.S. Nuclear Corp. Model NR-2-M3 Howitzer. The samples activated will typically be solid pieces of metallic silver (Ag-108,  $T_{1/2} = 144$  s. and Ag-110,  $T_{1/2} = 24$  s.). These samples are activated for about ten minutes and then counted with Geiger-Mueller counters to supply data showing the concurrent exponential decay of two isotopes. The activity level achieved is less than one nanocurie, so this experiment is relatively safe. Any other use of Item D will be carefully reviewed and tested in advance by the radiation safety officer to assure compliance with exposure limits.

#### 7. Radiation Protection Officer.

David A. Dobson, PhD 1964 University of California, Berkeley is the designated Radiation Protection Officer.

His graduate research, in Nuclear Physics, (1961-1963) involved the development of continuous-flow gas targets for the 60-inch and 88-inch cyclotrons to produce Neon-19, in 100 mC quantities, and the design of shielding systems for both detectors and personnel. He was trained by LBL health physics personnel to perform radiation surveys around his experimental apparatus and to perform repairs safely on activated targets.

From 1964-1968 he performed similar experiments at the Lawrence Livermore Laboratory using the 90-inch cyclotron (to produce Neon-23 and Argon-35) and the LPTR, a 1-Megawatt research reactor, (to produce Neon-23 and Argon-41). The work at the reactor included the design of a special in-core irradiation facility.

Since coming to Beloit College in 1968, he has taught courses on nuclear physics and atomic energy, including radiation safety, biological effects of radiation, and radiation in the environment. From 1972-1978, 1984-1991 and 1993-the present time, Dobson has served as the Radiation Protection Officer at Beloit College.



#### 8. Other Personnel to work with Licensed Sources.

Professor J. Patrick Polley, PhD 1985 University of Florida, Gainesville will frequently teach the course in which Silver samples are irradiated in the Neutron Howitzer. He has taken courses in nuclear physics and is familiar with monitoring techniques and the nature of radiation hazards. Professor Polley has been instructed on the proper way to perform required leak tests on our sealed sources, in the event that this must be done when the Radiation Protection Officer is temporarily unavailable.

#### 9. Facilities and Equipment.

All radioactive sources are stored in a special storeroom, which is kept locked at all times and is not accessible to students. Source items C and D are always locked inside their shielded holders, described in item 6 above, and the keys are kept by the Radiation Protection Officer in another secure location.

##### Radiation Survey Instruments:

1. R&C, Model H-572 Geiger-Mueller portable survey meter for beta/gamma low level surveys (50 mR/hr max.)
2. Eberline, Model PIC-6A Ion Chamber portable survey meter for gamma higher-level survey (1 mR/hr to 1000 R/hr in three ranges)

##### Other Equipment:

1. Bendix, Model 884 Dosimeter, with charger/reader unit and Cs-137 (exempt source) calibrator.
2. Alpha-sensitive Counter. Shielded thin-window (1.4 mg/cm<sup>2</sup>) G-M counter, set up in the radioactive materials storeroom, which is used exclusively for the counting of sealed source wipe test specimens. Dedicated Electronics. Exempt alpha and beta calibration sources from Eberline.
3. Energy dispersive gamma counting equipment:
  - 3x3" NaI(Tl) Scintillation Counter
  - Proportional counter with Be window
  - Ortec NIM Electronics
  - Tracor-Northern TN-1705 PHA/MCA
4. Beta/gamma Counters (8 setups):
  - G-M tubes with HV power supplies and electronics
  - Computer interface, for use as MCA.

## 10. Radiation Safety Program

### Duties and Responsibilities of the Radiation Protection Officer:

- a. To ensure that all use of radioactive material at Beloit College is done safely and in accordance with the conditions set forth in this license application, 10 CFR Chapter 1 part 20, the license itself and any subsequent ammendments.
- b. To ensure that all radioactive materials are adequately secured against unauthorized use or removal at all times.
- c. To ensure that all authorized users of radioactive sources are properly trained to perform their activities safely, understand the nature and extent of the hazards present, and are aware of their responsibilities under the license.
- d. To perform routine inspections of the laboratory setups where radioactive sources are used and the storeroom where they are kept.
- e. To perform required periodic leak tests of sealed sources.
- f. To maintain all records and post all notices required by the NRC.
- g. To immediately halt any activity judged to be a potential threat to health, safety or the environment involving radiation or radio-active materials, or a violation of 10 CFR Chapter 1 part 20 or our NRC license.

### Sealed Source Leak Testing Procedures:

Wipe tests, and calibrations of the shielded thin-window detector used to count any activity picked up on the wipes, shall be performed at prescribed intervals by the Radiation Safety Officer or by an individual named in item 8 above and trained in these prcedures by the Radiation Safety Officer.

Calibration of the thin-window detector shall be done each time leak tests are performed to assure that the equipment is working correctly and has the expected sensitivity.

- a. The background counting rate shall be established, with sufficient statistical precision. All subsequent counts shall be corrected for background, after recording the uncorrected count.
- b. The calibration sources (Th-230; 0.0012 microcuries, for alpha) and (Tc-99; 0.0016 microcuries, for beta) shall be used to recalibrate the sensitivity of the shielded detector system.
- c. The source capsules, or surfaces within the shielded source holder near the source capsule, shall be carefully wiped with a moistened tissue. The tissue wipe should be held with a tongs to minimize the dose to the fingers. Sources shculd not be removed completely from their shielding holders for wiping, since this would needlessly expose the individual to gamma rays or fast neutrons.

d. The surface of the wipe which contacted the capsule or shield surface directly must face the detector during counting. The count for each wipe shall be of sufficient duration to establish conclusively that no leak of radioactive material has occurred, with a statistical error of less than plus or minus 0.005 microcuries, allowing for the errors in wipe count, background and recalibration.

e. If leakage is detected in the wipe test, the source shall immediately be removed from service and the NRC notified. Subsequently, the leaking source shall be decontaminated and repaired or packaged and disposed of in accordance with NRC regulations and directions.

#### Security and Safety Issues

The Campus Security Department is responsible for dealing with a wide variety of incidents, accidents and hazards on campus, including fire, tornado, etc. Campus Security calls in the Beloit city fire department, police, etc. as deemed necessary. Campus Security is kept aware of the special hazards associated with radioactive materials, by the Radiation Protection Officer. Security Officers are not trained to deal with such hazards, but rather to recognize situations in which they might be present and promptly contact the Radiation Protection Officer.

#### Ordering and Receipt of Radioisotopes

The purchasing office of Beloit College has been notified that any requisition for the purchase of non-exempt radioactive materials must be formally approved by the Radiation Protection Officer, to assure that licensed possession limits are not exceeded and that shipments will be properly received. All shipments to Beloit College, whether by mail, package express or common carrier, are received at the mail room, which is a secure facility. The Radiation Protection Officer will notify the Mail Room Manager in advance of any radioisotope shipment to the College. In no case shall anyone other than the Radiation Protection Officer open a package in which radioactive material has been shipped.

#### 11. Waste Management

Working with sealed sources, disposal of radioactive material becomes a problem only in the event of disposal of a source which develops a leak, or one which is no longer needed.

In the event that this is necessary, the Radiation Safety Officer will contact the NRC to determine what options are currently available before taking any action.

#### 12. License Fees

As provided under 10 CFR part 170, section 170.11(a)(4), Beloit College, a non-profit educational institution is exempt from license fees for possession and use of byproduct material and special nuclear material under the conditions specified in this license application.

SEP 27 1996

David A. Dobson, Ph.D.  
Radiation Safety Officer  
Beloit College  
Department of Physics  
and Astronomy  
700 College Avenue  
Beloit, WI 53511

Dear Dr. Dobson:

Enclosed is your NRC Material License Number 48-00268-03 in accordance with your request.

Please review the enclosed document carefully and be sure that you understand all conditions. If there are any errors or questions, please notify the U.S. Nuclear Regulatory Commission, Region III office at (630) 829-9887 so that we can provide appropriate corrections and answers.

Please be advised that your license expires at the end of the day, in the month, and year stated in the license. Unless your license has been terminated, you must conduct your program involving byproduct materials in accordance with the conditions of your NRC license, representations made in your license application, and NRC regulations. In particular, note that you must:

1. Operate in accordance with NRC regulations 10 CFR Part 19, "Notices, Instructions and Reports to Workers; Inspections," 10 CFR Part 20, "Standards for Protection Against Radiation," and other applicable regulations.
2. Not possess and use materials authorized in Items 6, 7, and 8, on the license until:
  - a. You have constructed the facilities and obtained the equipment described in the license application and supporting documentation; and
  - b. You have notified the U. S. Nuclear Regulatory Commission, Region III, ATTN: Chief, Nuclear Materials Licensing Branch, in writing, that activities authorized by the license will be initiated.
3. Notify NRC, in writing, within 30 days:
  - a. When the Radiation Safety Officer permanently discontinues performance of duties under the license or has a name change; or

399559



- b. When the licensee's mailing address changes (no fee is required if the location of byproduct material remains the same).
- 4. In accordance with 10 CFR 30.36(b) and/or license condition, notify NRC, promptly, in writing, and request termination of the license:
  - a. When you decide to terminate all activities involving materials authorized under the license; or
  - b. If you decide not to complete the facility, acquire equipment, or possess and use authorized material.
- 5. Request and obtain a license amendment before you:
  - a. Change Radiation Safety Officers;
  - b. Order byproduct material in excess of the amount, or radionuclide, or form different than authorized on the license;
  - c. Add or change the areas of use or address or addresses of use identified in the license application or on the license; or
  - d. Change ownership of your organization.
- 6. Submit a complete renewal application with proper fee or termination request at least 30 days before the expiration date of your license. You will receive a reminder notice approximately 90 days before the expiration date. Possession of byproduct material after your license expires is a violation of NRC regulations. A license will not normally be renewed, except on a case-by-case basis, in instances where licensed material has never been possessed or used.

In addition, please note that NRC Form 313 requires the applicant, by his/her signature, to verify that the applicant understands that all statements contained in the application are true and correct to the best of the applicant's knowledge. The signatory for the application should be the licensee or certifying official rather than a consultant.

You will be periodically inspected by NRC. Failure to conduct your program in accordance with NRC regulations, license conditions, and representations made in your license application and supplemental correspondence with NRC will result in enforcement action against you. This could include issuance of a notice of violation, or imposition of a civil penalty, or an order suspending, modifying or revoking your license as specified in the General Policy and Procedures for NRC Enforcement Actions. Since serious consequences to employees and the public can result from failure to comply with NRC requirements,

D. Dobson

-3-

prompt and vigorous enforcement action will be taken when dealing with licensees who do not achieve the necessary meticulous attention to detail and the high standard of compliance which NRC expects of its licensees.

Sincerely,

Original Signed By  
Colleen C. Casey  
Nuclear Materials Licensing Branch

License No.: 48-00268-03

Docket No.: 030-34019

Enclosures: 1. License No. 48-00268-03  
2. NRC Form 313

DOCUMENT NAME: M:\03034019.CL6

To receive a copy of this document, indicate in the box: "C" = Copy without attachment/enclosure "E" = Copy with attachment/enclosure "N" = No copy

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| OFFICE | DNMS/RIII C4C K |  |  |  |  |  |  |  |  |
| NAME   | CCCASEY:jaw     |  |  |  |  |  |  |  |  |
| DATE   | 09/17/96        |  |  |  |  |  |  |  |  |

OFFICIAL RECORD COPY

# Beloit College

700 College Street, Beloit, WI 53511-5595

Department of Physics and Astronomy

608-363-2276

Fax 608-363-2718

Internet: polleyp@beloit.edu

Colleen C. Casey  
Nuclear Materials Licensing Branch  
U.S. Nuclear Regulatory Commission, Region III  
801 Warrenville Road  
Lisle, IL 60532-4351

August 14, 1996


Dear Ms. Casey:

This letter is in response to your FAX of August 2, 1996 and our telephone conversation of August 12, 1996. It relates to Beloit College's license application dated November 27, 1995 and my response with additional information dated July 10, 1996. Refer to control number 399559.

1. We will comply with regulatory requirement 10CFR20.1301. Specifically, each experimental setup will be checked by radiation survey to assure that individual students and other members of the public are never exposed to radiation fields in excess of 2 mR/hr.
2. Either Dr. David A. Dobson or Dr. J. Patrick Polley will be physically present at all times during experiments. Our understanding of "physically present" in this context would allow for brief absences from the room, not to exceed five minutes, while students are collecting data. Any more extended absence will require students to leave the lab and the door to be locked.
3. Typical duration of the Compton Scattering experiment is about two (2) hours. The maximum duration would be limited to four (4) hours.
4. We will use an NRC or Agreement State licensed person to carry out annual calibration of our survey instrument, and as necessary will use a loaner instrument to replace it while it is off-site. Our sealed Cs-137 source was originally about 100 mCi. The vendor who supplied it recommended that we apply for a license to cover 120 mCi, to assure that we were in compliance, in the event that the source was actually slightly larger than 100 mCi; and we did so. Allowing for decay, that source is presently about 70 mCi.
5. We will use a commercial vendor's leak test kit and send the wipes to the licensed vendor for analysis every six months.

I trust that these written clarifications will complete our license application, to the satisfaction of the NRC.

Yours Truly,

  
David A. Dobson  
Radiation Protection Officer

RECEIVED  
AUG 19 1996  
REGION III



AUG 19 1996

## CONVERSATION RECORD

TIME

11:44am-12:05pm

DATE

8/12/96

TYPE

☐ VISIT☐ CONFERENCE☒ TELEPHONE☐ INCOMING☒ OUTGOING

ROUTING

NAME/SYMBOL

INT

Location of Visit/Conference:

NAME OF PERSON(S) CONTACTED OR IN CONTACT WITH YOU

David Dobson, Ph.D.

ORGANIZATION (Office, dept., bureau, etc.)

Beloit College

TELEPHONE NO.

608-363-2649

SUBJECT

C/N 399539 New lic. no. Y8-00268-03

2<sup>nd</sup> Deficiency Contact

SUMMARY

We need additional information as follows:

- ① Item A.2: 10 CFR 20.130 limits exposures to public, etc. to "2 mR/hr," not "3 mR/hr." Please confirm that the regulatory requirement will be complied with during experiments.
- ② Item A.2, etc.: Confirm that Dr. Dobson or Dr. Colley will be physically present at all times during experiments.
- ③ What are typical + maximum durations of experiments?
- ④ Until you can resolve the issue of NBS/NIST traceability for your Cs-137 source, it cannot be used to calibrate survey instruments. Confirm that you will use an NRC or Agreement State licensed person for these calibrations and that loaner instruments will be obtained as necessary (or available). ALSO: ACTIVITY DISCREPANCY: "120mCi" OR "100mCi, DECAYED TO 70mCi" ??
- ⑤ D.1 - Pu-Be leak testing procedure - R 2: Pg. 4 of original application states window is "1.4mg/cm<sup>2</sup>" but this letter says it is "3.5mg/cm<sup>2</sup>" - which is it? Please provide us with manufacturer's specs. that prove this detector, a G.M. tube, can detect "alpha radiation with high efficiency." We are not familiar with such a piece of equipment. Also, leak test procedure and calculations do not appear to prove sensitivity to .005 uCi. Please confirm that you will use a commercial leak test kit for analysis by a vendor who has a specific license for this service.
- ⑥ Please note we must issue this license ASAP to end period in violation. If necessary, we will condition the license to resolve the above issues.

SIGNATURE

Colleen C. Casey

TITLE

Materials  
Licensing Reviews

DATE

8/12/96

CONVERSATION RECORD



RECEIVED

JUL 12 1996

REGION III

page 1 of 11

Colleen C. Casey  
Nuclear Materials Licensing Branch  
U.S. Nuclear Regulatory Commission, Region III  
801 Warrenville Road  
Lisle, IL 60532-4351

July 10, 1996

Dear Ms. Casey:

This letter contains the additional information requested in your letter dated June 12, 1996 to supplement our application dated November 27, 1996 for a new byproduct and special nuclear materials license. Please refer to Control Number 399559.

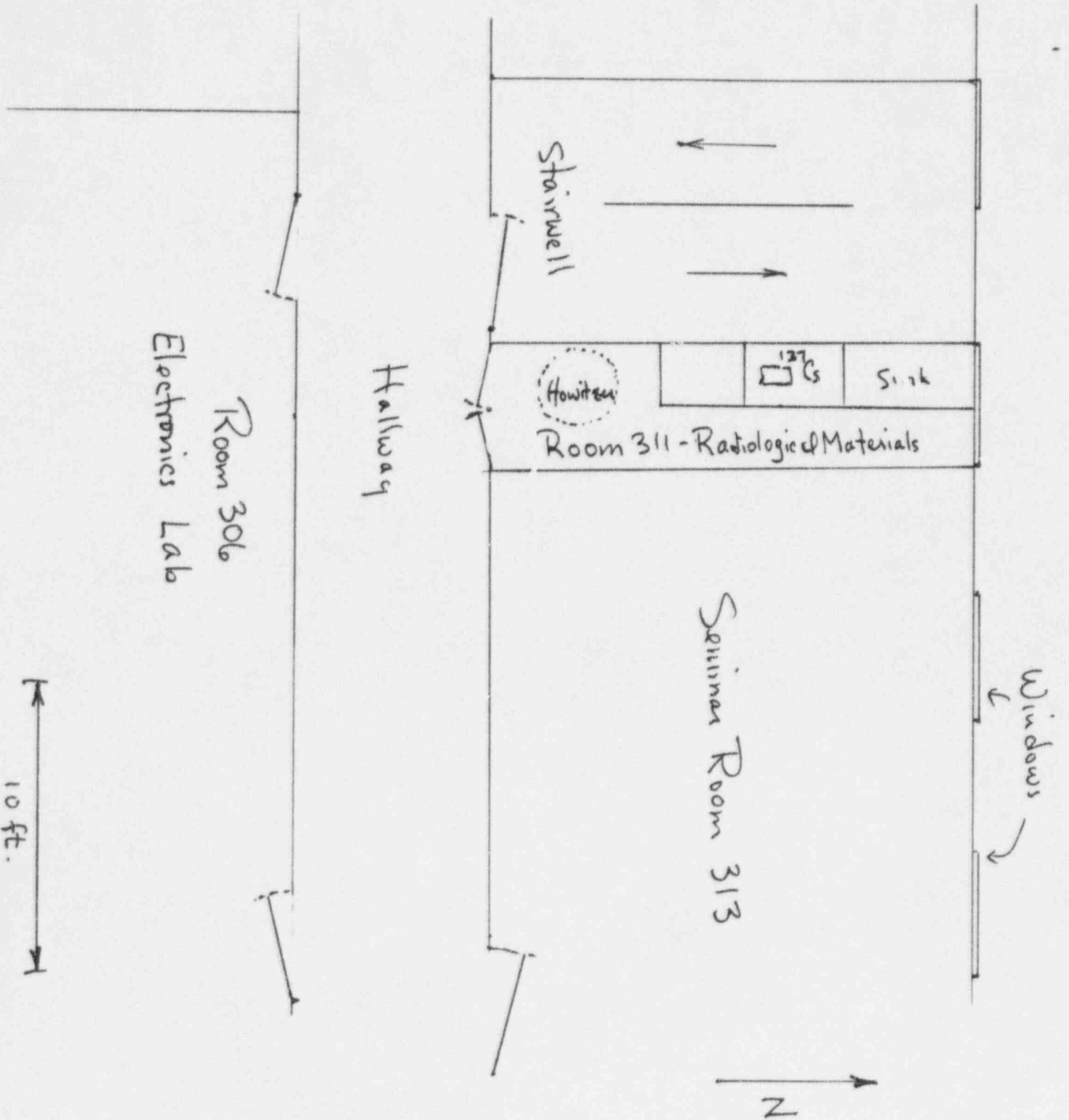
This letter refers to items A-F (and numbered sub-items), as outlined in your letter:

- A.1 All use and the storage of licensed materials is restricted to the following three rooms on the third floor of Chamberlain Hall:

Attached you will find Figure 1, which shows our Radioactive Materials storage area (Room 311) this Room is used exclusively to store all of our radioactive materials, as well as associated items such as survey meters, leak testing apparatus, radiation detectors and records concerning our NRC license. The door is equipped with a dead-bolt lock and is kept locked at all times. Sources A, C & D are each enclosed in separate shielding enclosures, which provide adequate shielding during storage.

Figure 2 shows our Advanced Laboratory area. We have partitioned Room 302 with a permanent wall and lockable door, as shown in the Figure 2, to provide a study area for Physics majors (who can obtain keys to access Room 302 from the hallway) and a separate, secure area (designated Room 302A) where expensive or hazardous equipment can be used under supervision. This room is separately keyed and accessible only to the Physics Faculty. Radioactive sources are moved temporarily from Room 311 to 302A at times when radiation experiments will be performed, under the supervision of an authorized user. Ordinarily, these experiments are concluded within one week and the sources returned to storage (Room 311). Room 302A is kept locked at all times if radiation sources are present unless supervised experiments are underway.

Figure 3 shows our General Physics Laboratory. The only licensed radioactive source used in Room 310 is Source D, for the irradiation of Silver samples to demonstrate neutron activation and radioactive decay. Sample irradiation is always conducted by an authorized user (a Faculty member). The howitzer is kept in Room 310 for only two or three days each semester, then returned to storage in Room 311. Room 310 is ordinarily kept locked at all times, except during supervised laboratory sessions. Particular attention is paid to this policy when the Howitzer is present.



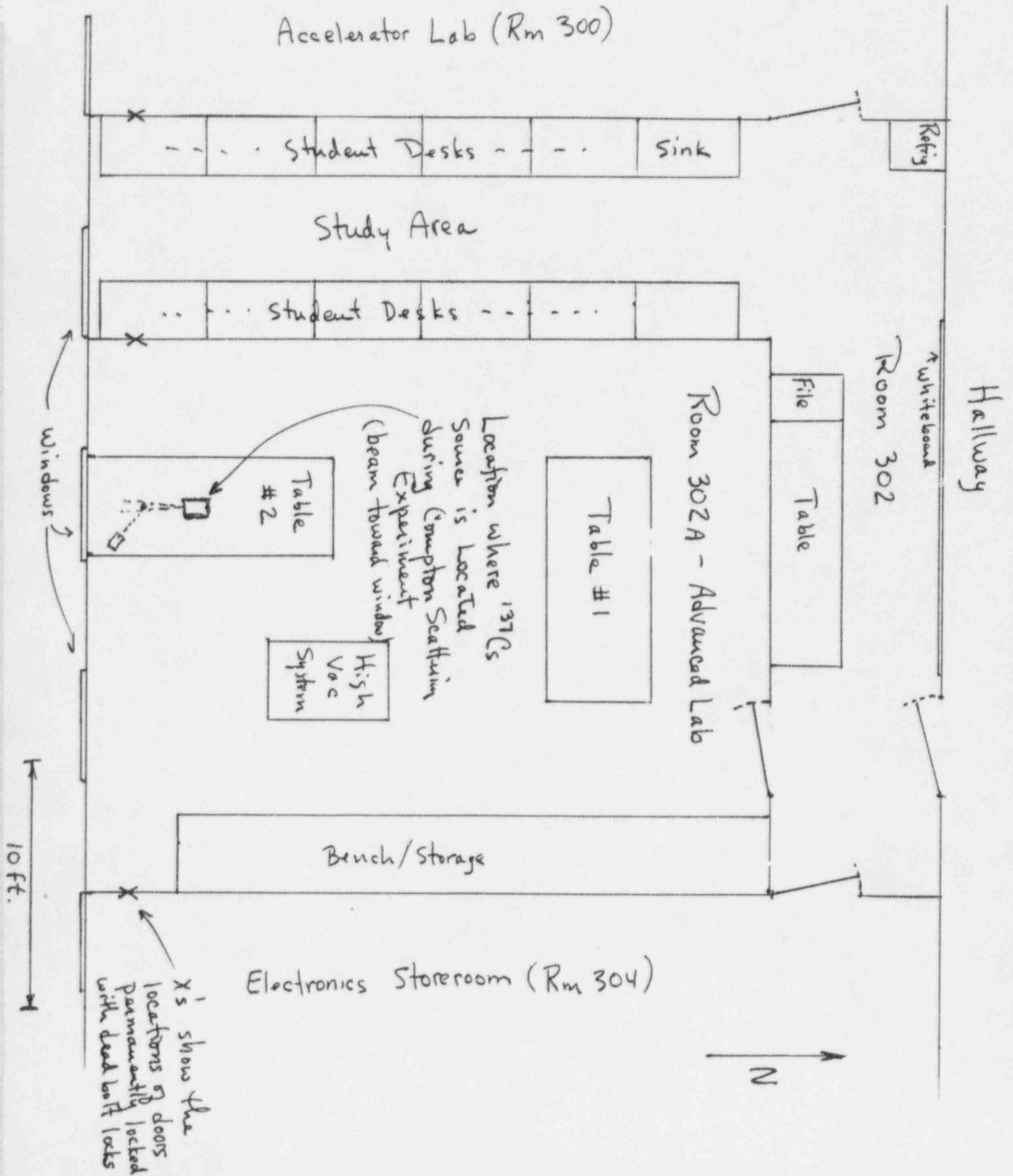


Fig 3.

Optics Lab (Rm 308)

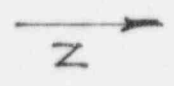
Room 310 - General Physics Lab

Storeroom (Rm 312)

Hallway

Chalkboard

Location of Hovitz  
during experiment



Bench

Bench

Bench

Bench

Bench

Windows

10 ft.



A.2 The setup of our Compton Scattering experiment is illustrated in Figure 4. The source holder weighs over 250 pounds and is not easily (or accidentally) moved. The table on which the experiment is set up is placed directly against the wall in front of a fixed window (set into the brick wall of the building). When the collimator plug is out, the radiation field at the scatterer position is about 50 mr/hr. The Aluminum scatterer is repositioned with tongs so that the experimenter's hands will not enter this radiation field. Survey measurements show that the radiation field is below 3 mr/hr, with the collimator plug out, at all places where experimenters or observers might be standing or sitting. There is no concern of exposure to persons outside the building, because the lab is up on the third floor and there are no balconys or catwalks on the building. Even window washing is done from the ground, with a very long handled tool and a hose.

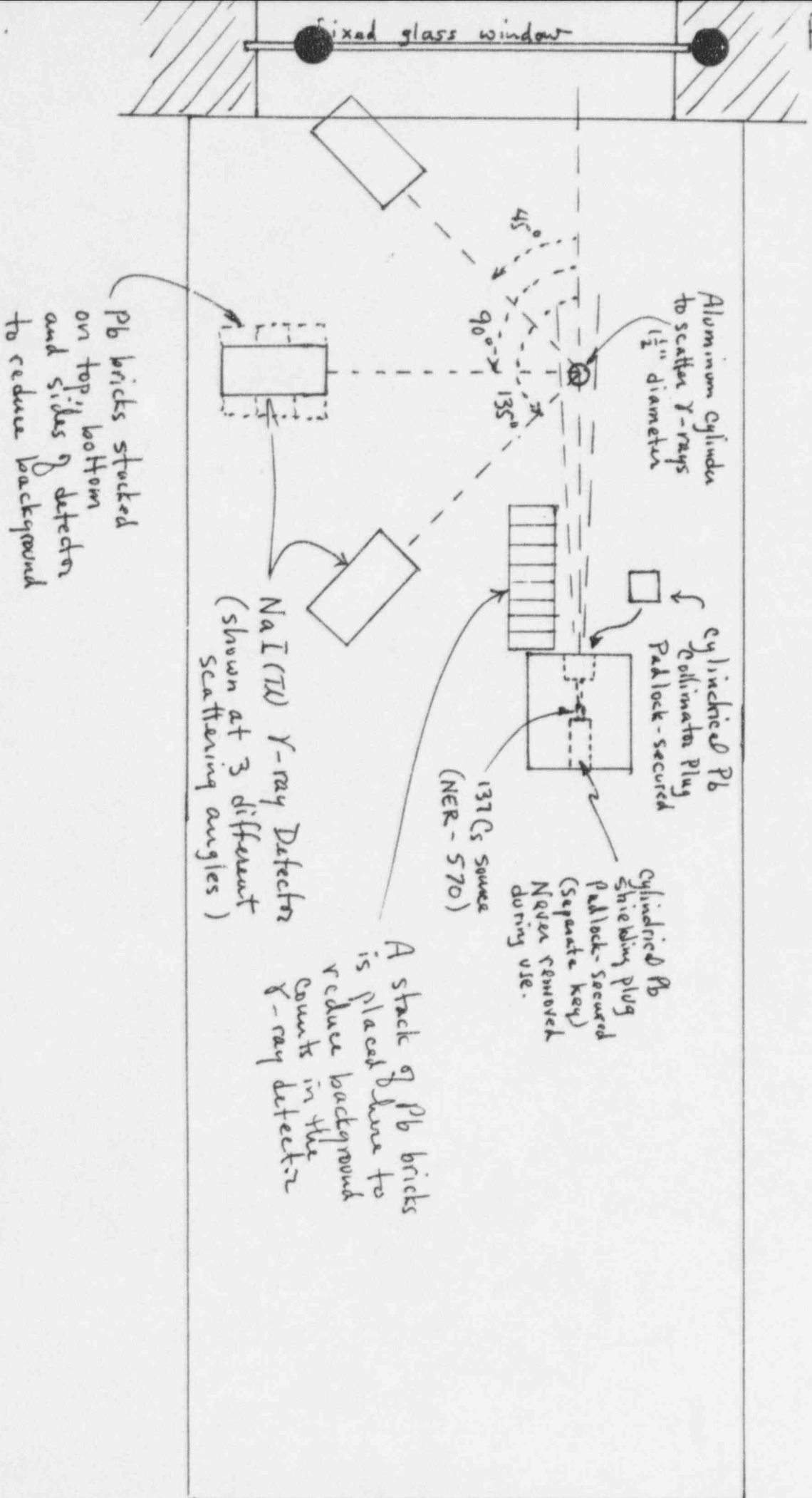
The students who perform this experiment are third or fourth year Physics majors, and they have been properly educated about the hazards of ionizing radiation. I am the person who teaches the course in which this experiment is done, and I have confidence in the maturity and carefulness of these students. I personally set up the experiment each time and conduct a brief radiation survey to be sure that nothing is changed. I am always present when a group (of two or three students) begin the experiment, and I'm usually around for most of the experiment, in case they have any questions or problems.

A.3 I propose to use our existing 100 mC Cs-137 source (New England Nuclear, NER-570) for annual survey instrument calibration. This source was nominally 100 mC in October 1980. (Corrected for decay, this becomes 70 mC in July 1996.) Since we cannot trace this activity level to an NBS standard, if required I propose that we hire a licensed contractor with a properly calibrated instrument to come to Beloit and measure the radiation intensity to establish a traceable exposure rate at a given distance from the source on a given date. Thereafter, I will be able to perform the required annual calibrations and maintain the records of them. All provisions of the model procedure described in Appendix B to Regulatory Guide 10.8, Rev. 2 can be followed, once the exposure rate has been established. Calibration procedures will be performed by David A. Dobson, Radiation Safety Officer. No backup instruments will be required, since calibration will be performed on-site.

Please advise me on the acceptability of this proposal. Is there a list of commercial calibration services licensed to operate in Wisconsin? May I get a copy, or directions on how to find it?

A.3.g The most sensitive range on our G-M survey meter is 0.5 mr/hr full scale (linear), which is adequate for detection of small increases above normal background. The most sensitive range on the Ion Chamber survey meter is 1 mr/hr to 1 r/hr (3 decade logarithmic scale), which is not able to see background levels, but it is immune to the saturation effects which will invalidate G-M readings in high radiation fields. These two instruments complement one another.

Fig 4 Enlarged View of Table #2, Room 302A  
Showing setup of Compton Scattering Experiment



A.4 Not required, if self-calibration as described in A.3 above can be done to the satisfaction of the NRC.

B.1 Four categories of personnel have been identified for which different training programs are appropriate.

1. Campus Security Officers: These people maintain 24 hour surveillance of the Campus, including a walk-through of all floors of Chamberlain Hall during hours when the building is closed. They would be the most likely people to discover a fire, leaking water, vandalism or theft in the building, should it occur. Their training lecture and tour will begin with the elementary basics of radiation and radioactivity. It will focus on the sealed sources at Beloit College, where they are used and stored, what they look like, the hazards they might present, especially in the event of fire or explosion, and the proper procedures for prompt notification of the authorities in cases of suspicious circumstances or disaster.

2. Authorized Users (as defined in item 8 of the license application): This will be done most effectively with a combination of xeroxed handouts and interpersonal discussion. Handouts will include copies of Beloit College's license application, supplements (such as this letter), the license itself, and appropriate sections from NRC publications, if these have been updated, and any recent documents such as inspection reports. The discussion will review items under #1 above, and add instruction in the proper use of survey instruments and sources and a broader discussion of radiation safety and policies. The training for General Physics students will also be discussed.

3. Students in P235 - Nuclear and Particle Physics: These are generally mature, responsible Physics majors, and their entire course focuses on energetic particles and their behavior. The specific radiation safety training they receive will include the use of survey instruments and the interpretation of the results, shielding principles, the ALARA philosophy, and the specific hazards and proper procedures for the experiments they will be carrying out. A discussion of the Commission, its regulations, and the College's license will also be included.

4. Students in General Physics: These are typically people encountering radioactivity for the very first time, at a conscious level. They will receive a handout and lecture/-discussion covering the basics of radioactivity and ionizing radiation, sources of the natural background, geiger counters, neutron activation, and radiation safety, appropriate to the sources they will be using.

Housekeeping, maintenance and other support personnel are not allowed to enter areas where radioactive sources are being kept. All cleaning and maintenance in the storage area (Room 311) is done by the Radiation Safety Officer in person, or under his direct supervision.

- B.2 Changes in the license, changes in regulatory requirements, NRC information notices and NRC inspection findings are appropriate, and will be used with group 2, and to some extent with group 3.
- B.3 Different methods are appropriate, and will be used with the various groups of personnel identified on the previous page:
1. 30 minute lecture plus walking tour of facilities.
  2. Handouts, as described above, plus one-on-one discussion.
  3. Lecture/discussion in class, and in the lab as well.
  4. Handout to be read in advance, plus pre-lab discussion.
- B.4 Orientation training and annual refresher training of personnel will ordinarily be carried out by the Radiation Safety Officer in all cases except category 4, where another authorized user (the course instructor) may provide the training.
- B.5 Records of initial and refresher training will be kept, and will include syllabi, time spent, dates given, and names of students and instructor.
- B.6 Thank you for the suggestions.
- C.1 All persons (normally only the Radiation Safety Officer) handling sealed sources will use tongs or a threaded rod to reduce whole body and hand exposure. The activation level of the Silver Howitzer targets is quite low (less than 1 nanocurie) and presents little hazard to the handler. Any new activation procedure will be carefully evaluated in advance to assure its safety.
- C.2 Procedures for any handling of sealed sources will be planned in advance to keep total exposure at As Low as Reasonably Achievable levels.
- C.3 The discussion of Ordering and Receipt of Radioisotopes on page 6 of our license application was a statement of a general College policy. No new acquisitions of radioactive materials are anticipated under the license being applied for. Any future plans for new source acquisition would be preceded by a request for license amendment.
- Only authorized users (Faculty) have access to Room 311. Students will only use radiation sources in the context of a specific lab experiment in a specific course under supervision of an authorized user.
- C.4 In the case of the General Physics course, activation of samples will be done by the authorized user. Insertion of activated samples into geiger counters for counting will be done by the students, but after safety instruction, and with the authorized user present. Samples are then collected by the user after decaying to background levels.
- In the case of Physics 235, I will be present initially to be sure the equipment is working and that safety requirements are clearly understood, but may not remain physically present in Room 302A throughout the entire data collection period. (See response A.2)



- C.5 I do not believe that any use of personnel monitoring devices by the students in our program is justified. The experiments they will perform are well planned and controlled to assure that personnel exposure is negligible in comparison with the levels specified in section 4.6.2 of Regulatory Guide 10.3, Rev 1. A dose rate area survey will be conducted each time experiments with the Co-60 or Cs-137 sources are set up for student use, to assure that any exposure to students will indeed be negligible. Records of these surveys will be kept, along with a record of participants in each experiment, its date and duration.

On those infrequent occasions when the Radiation Safety Officer or another authorized user is engaged in activities with a higher risk of exposure, such as during survey instrument calibration or brief removal of sources from their holders for leak testing, that person will wear a pocket dosimeter. This is an appropriate device for personnel monitoring in these situations, because they occur very infrequently (only a few times per year) and for a short duration (less than one hour, in almost all cases). A film badge program is needed where personnel may be exposed to chronic radiation fields above background and/or unanticipated exposure due to radiation sources in the workplace. These situations are not at all likely to occur at Beloit College.

- C.6 All radioactive materials will be stored in Room 311, Chamberlain Hall. All use of the materials will occur in Room 302A or in Room 310. These rooms are all on the third floor of Chamberlain Hall, and no source will be taken from this floor. Each of the rooms where sources will be used is within 60 ft. of the storage room, and the movement of sources between these locations will be by authorized users only.
- C.7 A physical inventory of all licensed sources will be performed every six months, and records of these inspections will be kept.
- D.1 Leak Testing Procedure for Sealed Sources:

The Pu-Be neutron source (item D on the license application) will be leak tested every 6 months. All licensed sources will be leak tested prior to use, if they have not been leak tested within the preceeding 6 month period.

Leak testing is done with a special thin ( $3.5 \text{ mg/cm}^2$ ) end window Geiger-Mueller detector, capable of detecting alpha radiation with high efficiency. This detector is kept in Room 311 and used only for the purpose of leak testing sources.

To reduce natural background to a low level, the detector is surrounded by lead bricks while counting is performed. It is essential that the configuration of the lead bricks be exactly the same while establishing the background level, counting the calibration source and counting wipes from the sources being tested.



Calibration sources and wipes must always be placed on a shelf directly under the G-M tube and within 5 mm of its end window.

Turn on the HV power supply and adjust the output voltage to 1100 Volts. Turn on the counter electronics, confirm the presence of background counts and wait at least 10 minutes. Check that the HV reading has not drifted.

Reset the counter and accumulate background counts for 5 minutes. Repeat for another 5 minutes. The results should agree within statistical counting error ( $N^{1/2}$ ). If not repeat the process. Compute the average background in 5 minutes,  $N_b$ .

Place the Th-230 alpha calibration source on the shelf under the thin window of the G-M tube and accumulate counts for 5 minutes. Call this result  $N_c$ .  $N_c$  must turn out to be several times larger than  $N_b$  in order for the sensitivity of the forthcoming leak test to be adequate. If it is not, the problem must be identified and remedied before proceeding.

Subtract the average background from  $N_c$  to obtain the net count from the calibration source, and divide this by the calibration activity in nanocuries to obtain the alpha sensitivity factor,  $S_a$ .

$$S_a = (N_c - N_b) / 1.20 \text{ nC}$$

Raise the Pu-Be source within the howitzer so that its top surface can be wiped with a moistened tissue, held with forceps. Lay the wipe flat on the shelf of the detector, making sure the surface that contacted the source capsule is facing up. Accumulate counts for 5 minutes. Call this result  $N_v$ .

Subtract the average background from  $N_v$  and divide the result by the alpha sensitivity factor,  $S_a$  to obtain the wiped "leak" activity,  $L_a$ .

$$L_a = (N_v - N_b) / S_a$$

If  $L_a$  is greater than 5 nC, the source has failed the leak test and must be removed from service immediately, and the Nuclear Regulatory Commission must be notified.

Statistical counting errors in  $N_v$  and  $N_b$  make it very unlikely that  $L_a$  will turn out to be exactly zero. So long as  $L_a$  is small compared to one and comparable to  $N_b^{1/2}/S_a$  in magnitude, there is no detectable leak of the source.

The same leak testing procedure is used with the other sources, except that for beta-gamma emitters, the sensitivity of the detector must be established with a beta source. For this purpose, use the Tc-99 calibration source (1.60 nC activity level).

Test results and calculations are recorded in a notebook for later reference, and for examination by NRC inspectors.

D.2 The following calculations are taken from our notebook of recorded leak tests:

Background (5 min): 343, 317 ( $N_b = 330$  counts/5 min)

Th-230 Cal (5 min): 1148 counts/5 min

$S_A = (1148 - 330)/1.20 = 682$  counts/nC

Tc-99 Cal (5 min): 1293 counts/5 min

$S_T = (1293 - 330)/1.60 = 602$  counts/nC

PuBe Capsule wipe (5 min): 327, 335 (ave = 331 counts/5 min)

$L_A = (331 - 330)/682 = .001$  nC (0, within statistical error)

E.1 Sealed sources will only be disposed of to an appropriately licensed entity or vendor, in accordance with 10 CFR Part 20, subpart K and 10 CFR 30.41 and 30.51.

E.2 All activated targets from the neutron howitzer are kept in the radiological materials storeroom until they have decayed to background levels. No such target will be disposed of without testing it for residual activity first.

F The neutron howitzer is a commercially manufactured item by U.S. Nuclear Corporation, Burbank, CA. It is model NR-2-M3. I do not have a drawing of its internal construction, but will provide a description of its operation. It is a 30" diameter welded steel tank 31" high mounted on wheels for portability. It weighs several hundred pounds. It is my understanding that the sealed tank is filled with a mixture of hydrogenous material and a Boron mineral, to provide neutron moderation and thermal neutron absorption.

The source hangs from an acrylic shielding plug inserted through a 2" diameter hole in the top of the howitzer. Three radial sample irradiation ports are located half way down on the sides of the howitzer. With the source in its "stored" position, it hangs below the plane of the irradiation ports by about 5 inches. To activate samples the source is raised to the plane of the ports and locked in place. The source holder and all three sample ports are equipped with padlocks to prevent unauthorized entry.

If you require any further information to process our license application, contact me by mail, by e-mail (dobson@beloit.edu) or leave a telephone message at 608-363-2649.

Very Truly Yours,



David A. Dobson, Ph.D.  
Professor of Physics  
Radiation Safety Officer

JUN 12 1996

David A. Dobson, Ph.D.  
Department of Physics  
and Astronomy  
Beloit College  
700 College Street  
Beloit, WI 53511

Dear Dr. Dobson:

We have reviewed your application dated November 27, 1995, requesting a new byproduct and special nuclear material license and find that we will need additional information as follows:

A. Facilities and Equipment

1. Please submit custom, hand-drawn diagrams for all laboratories and radioactive material storage areas showing the locations of shielding, the proximity of radiation sources' use and storage areas to unrestricted areas, the locations of lockable doors, and any other appropriate items related to radiation safety. Diagrams should be drawn to a specified scale, or dimensions should be indicated. Please identify room numbers and building names and show the direction of north. Please do not submit blueprints.

Item 9.1 and Exhibit 6 of the enclosed copy of Regulatory Guide 10.8, Revision 2, may assist you. Although this guide is intended primarily for our human use/medical licensees, it contains a number of model procedures that NRC finds acceptable in meeting regulatory requirements for a variety of different licensed programs.

2. Page 3 of your application, Item 6, states that, for the use of your cesium-137 source, "The experiment is set up so that the collimated beam from the source holder points toward an outside wall of the building. No individuals are able to pass in front of the open collimator."

Please explain this experiment in greater detail and illustrate its set-up with a diagram. What administrative controls will be in place to ensure that no individuals can pass in front of the open collimator, in both the restricted area of use as well as the unrestricted area outside the building?

3. Please submit survey instrument calibration procedures and specify the frequency at which they will be performed, normally at least once each calendar year. If you propose to calibrate your own radiation survey and monitoring instruments, you should submit a detailed description of your planned calibration procedures. The description of calibration procedures should include, as a minimum:
  - a. The manufacturer and model number of the source(s) to be used.
  - b. The nuclide and activity of the licensed material contained in the source.
  - c. The accuracy of the source(s). Traceability of the source to a primary standard should be provided.
  - d. The step-by-step procedures, including associated radiation safety procedures. These procedures should include a two-point calibration of each scale of each instrument with the points separated by at least 50% of the scale.
  - e. The name(s) and pertinent experience of person(s) who will perform the calibrations.
  - f. Please confirm that backup instruments will be available to replace instruments off-site for calibration.
  - g. Please also specify the lowest ranges (most sensitive settings) for each survey instrument.

Appendix B in Regulatory Guide 10.8 and section 4.5.5 of Regulatory Guide 10.3 may be helpful in preparing your response. Appendix B, Regulatory Guide 10.8, provides model procedures that are acceptable to the NRC.

4. Another option to consider is that you may return the instruments to the manufacturer for calibration or employ the services of a licensed consultant in your area. If you intend to have a consultant calibrate your survey instruments, you should contact the consultant to determine if they are licensed to operate a commercial calibration service with the NRC or an Agreement State. Please submit the name, address, and NRC or Agreement State license number of the consultant or other calibration service you will use.

B. Training

1. Describe your program for orientation training and refresher training for all appropriate persons who handle licensed material or who frequent areas where licensed material is used, in accordance with 10 CFR Part 19.12, enclosed. This training program should include a review of emergency procedures (such as for a leaking or lost source or a fire) and response criteria and include sections that are tailored to various types of radiation and ancillary workers such as authorized users, students, housekeeping, security, and other ancillary personnel.
2. The annual refresher training should include components that will serve to maintain an awareness of radiation safety with respect to the changes in the license, changes in regulatory requirements, and "lessons learned" experiences derived from NRC Information Notices, NRC's NMSS Newsletters and NRC inspection findings at your own institution.
3. Please describe the methods you will use to accomplish this training, i.e., will you utilize your own "in-house" lectures, "hand-outs," videocassette presentations, etc.
4. Please identify the instructors who will conduct this training and, if instructors other than the licensed authorized users will conduct this training, briefly describe their qualifications to conduct the training.
5. Confirm that you will maintain records of initial and refresher training that will include a list of topics covered, the amount of time spent and the date, and the instructors' and students' names.
6. Sections 4.6.9. and 4.6.10. in Regulatory Guide 10.3 and Appendix A in Regulatory Guide 10.8 may assist you.

C. Laboratory Safety Instructions/Area Surveys/Personnel Monitoring

Concerning your general laboratory safety instructions, including area surveys and personnel monitoring, please respond to the following:

1. Please confirm that all persons handling the sealed sources and activated targets will use remote handling tools, as appropriate.
2. Please confirm that all persons handling the sealed sources and activated targets will employ the principles of time, distance and shielding to maintain their exposures at "As Low As Reasonably Achievable (ALARA)" levels.



3.
  - a. Your application briefly describes your radioactive materials package ordering and receipt procedures. It is our understanding that no additional radioactive materials will be obtained under this license-please confirm.
  - b. Please describe the procedures that the students will use for obtaining and using the radioactive materials. If only a licensed authorized user will obtain and use the radioactive materials, please so state.
4. Please describe in greater detail how the authorized users will exercise supervision of the students while radioactive materials are in use, i.e., will the authorized users be physically present in the classroom or laboratory during use of the sources?
5. Please confirm that personnel monitoring devices will be used and that direct dose rate area surveys will be performed. Refer to the enclosed Regulatory Guide 10.3, "Guide For the Preparation of Applications For Special Nuclear Material Licenses of Less Than Critical Mass Quantities," sections 4.6.2., and 4.6.3. and address the information contained therein. Specify the types of personnel monitoring badges used and the frequency of which they will be exchanged for processing.
6. Will there be any movement of radioactive materials between buildings or laboratories? Or will all work with the sources be conducted in the immediate vicinity of their storage locations?  
  
It is our understanding that the sources will only be used in the immediate vicinity of their storage locations. If our understanding is incorrect, please contact Colleen C. Casey of this office immediately.
7. Please confirm that you will conduct an inventory every six months of all sealed sources possessed under the license. Confirm that you will maintain records of inventories for five years from the date of each inventory.
8. You may refer to sections 4.6.6., 4.6.8. and 4.6.9. of Regulatory Guide 10.3 for additional assistance in responding to the above.

D. Leak Tests of Sealed Sources

Your application did not completely address leak testing of your sealed sources. Please provide the following information:

1. A description of the procedure for leak testing the source.

2. a. The instrumentation used to measure activity on the wipe and the lower limit of detectability for this instrumentation. Please note that "a statistical error of less than plus or minus 0.005 microcuries," as stated on page 6 of your application is ambiguous and not acceptable. Please clarify.
- b. Please also demonstrate, with actual calculations, that your thin-window detector is capable of detecting 0.005 microcuries of each licensed material on a sample.
3. Appendix H of the enclosed Regulatory Guide 10.8 and section 4.6.7 of Regulatory Guide 10.3 may be helpful to you in preparing your response and provides a program that is acceptable to the NRC.
4. If you elect to have another person perform the leak test, please submit the name of the person and the applicable NRC or Agreement State license number. If this person does not hold a current, appropriate license, please submit a description of their procedure, leak test kit and instrumentation and show equivalence to the procedures in the above-mentioned regulatory guides above.

E. Waste Management

1. Confirm that the sealed sources will only be disposed of to an appropriately licensed entity or vendor, in accordance with 10 CFR Part 20, Subpart K and 10 CFR 30.41 and 30.51. Copies of Parts 20 and 30 are enclosed. You may also refer to section 4.6.4. of Regulatory Guide 10.3 for assistance.
2. Please also confirm that the activated targets used in your experiments will be held until they have decayed to background levels prior to disposal.

F. Licensed Material

Please submit illustrations and a description of the howitzer's construction, especially with respect to its shielding.

We will continue our review of your application upon receipt of this information. Please reply in duplicate, within 30 days, and refer to Control Number 399559.

Upon failure to file an answer within the specified time, we may consider that you have abandoned your request and may void this action. This is without prejudice to resubmission of the application.

D. Dobson

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However, as you are presently in possession of licensed materia<sup>n</sup> without an NRC license, you will have to immediately divest yourself of all licensed materials in accordance with 10 CFR Part 20, Subpart K, 10 CFR 30.41, 70.50, and 30.51, 10 CFR 70.42 and 70.50 should this application be abandoned.

If you have any questions or require clarification on any of the information stated above, you may contact us at (708) 829-9887.

Sincerely,

Original Signed By  
Colleen C. Casey  
Nuclear Materials Licensing  
Branch

Enclosures:

1. Reg. Guide 10.3
2. Reg. Guide 10.8, Rev. 2
3. 10 CFR Part 19
4. 10 CFR Part 20
5. 10 CFR Part 30
6. 10 CFR Part 70
7. Form NRC-3
8. 10 CFR Part 21

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