RADIATION SAFETY OFFICE
UNIVERSITY STATION, BOX 3944
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MS-12
T1

THE UNIVERSITY OF WYOMING

RADIOLOGICAL SAFETY CONTROL PROGRAM
BIOCHEMISTRY BUILDING

LARAMIE, WYOMING 82071

February 15, 1984

Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 1000
Arlington, Texas 76011

Re: Control No. 60030

Gentlemen:

Enclosed are respones to the information you requested in your letter of October 20, 1983. The responses for item 8 are being sent in a separate package.

With respect to item 19: Since I have been at UW I have signed license renewals and other correspondence with the NRC. Dr. Jenkins has a copy of the license renewal and is in the process of reviewing it. A decision will be made during the next two weeks on our internal operations concerning legal commitments with NRC. I expect to have that authorization formally as well as implicitly as is now the case.

With respect to item 13: The revisions of the UWRSM as listed are under final review by the Radiation Safety Committee. There may be a few minor changes in language but not in intent. On final approval, the revisions will be incorporated in the manual and sent to all users. NRC will also receive a copy.

Sincerely,

John E. Doerges

John E. Doerges
Health Physicist

JD/mhm
enclosures

60030

MS-12

RESPONSE TO NRC LETTER
Dated October 20, 1983

Response to Item #1

1. Management commitment to ALARA

a. Plan to make occupational personnel aware of the ALARA commitment.

Commitment to ALARA will be made known to occupational personnel as follows:

i. All new applications to use radionuclides will include a section requiring the applicant to address the ALARA commitment.

ii. All new personnel in radioactive laboratories will receive a form letter advising that ALARA principles apply at the University of Wyoming.

iii. Each film badge user receives a notice for each occasion when film badge readings are above background. Users receiving more than 10 mrem whole body exposure during a monthly wear period are asked to review their procedures and/or account for the elevated exposures.

iv. Letters are written to the principal researcher in laboratories advising him/her of a summary of the exposures of personnel in the laboratory when the majority of the workers in the laboratory receive exposure above background on film badge reports.

v. Consistent exposure of personnel exceeding 10 mrem/month is reviewed by the Radiation Safety Committee. If the exposure is not explained and/or justified, the user will be limited to using smaller amounts of activity or restricted from using radionuclides, based on the judgement of the committee.

vi. Nexus, a pamphlet published by Landauer, is distributed to all film badge users. Extra copies are maintained in the Radiation Safety Office.

b. Formal audits of the UW radiation safety program

Audits of the Radiation Safety Program are performed on an annual basis. Specific items in the audit related to ALARA are:

i. Review of film badge records and a summary of film badge exposures compared to the previous years exposure.

ii. Review of laboratory surveys performed by the Radiation Safety Office.

c. Availability of a trained radiation protection staff to ensure the ALARA concept.

The Radiation Safety Officer (RSO) requirements include educational training and experience equivalent to or exceeding a master degree in Health Physics from an accredited college or university. A second half-time technical assistant is also on the Radiaiton Safety Office staff. This part-time person receives training in radiation safety and measurement techniques at the 700 course level (graduate or qualified senior). The Radiation Safety Committee includes personnel who have experience and training in radiation safety.

d. Radiation safety training for all occupationally exposed personnel.

Each user of radioactivity is required to fill out a form (RS-2) stipulating training and experience in handling radionuclides including the radionuclide(s) used and the maximum amounts used. Depending on the training and experience, the user is classified as a supervised, independent, or principle user. Supervised users require supervision by an independent or principle user whenever handling radionuclides are involved.

The Radiation Safety Officer conducts short courses for individuals or groups on an "as needed" basis.

Item 12 outlines the training established by the Radiation Safety Committee for radionuclide users and UW personnel who are required to work in the vicinity of radioactive materials.

e. RSO authority on responsibilities in promulgating the ALARA concept.

The RSO is responsible for promulgating the ALARA concept in all University of Wyoming jurisdictions involving ionizing radiation. The RSO has the authority to immediately shut down any activity involving ionizing radiation which is judged unsafe in his estimation. The decision stands until the Radiation Safety Committee reviews the situation. The Radiation Safety Committee may sustain the shut down or stipulate conditions for renewing the activity.

f. Each application to use radioactive material is reviewed in terms of satisfactory monitoring equipment for the radionuclide, quantity of activity, the physical state(s) of the elements or compounds involved, and whether it is a sealed or unsealed source. Each laboratory is classified as a low, medium, or high hazard laboratory according to TABLE 1 (page 16:00:00) of the UW Radiation Safety Manual.

All procedures handling volatile radionuclides which may cause air contamination exceeding 0.1 MPC must be carried out in an approved hood or glove box.

As far as practical experiments in existing laboratories are designed to minimize personnel exposure by limiting and controlling access to laboratires using radionuclides. "Hot" activites are carried out in specific areas away from the major amount of personnel occupation. Plans for new buildings anticipating use of radioactive materials are reviewed by the RSO in conjunction with the specific department and the architect.

NRC
Response to Item #2

2. List of departments using radioactive materials, quantities and types.

Typical Inventory of Unsealed Radioactivity by Department and Radionuclide

COLLEGE AND DEPARTMENT	RADIONUCLIDE (mCi)							
	H-3	C-14	P-32	I-125	S-35	Cr-51	Ca-57	Other
Agriculture								
Animal Science	8.00	1	0.5	16			1	0.501
Microbiology	25.00	4	10.0		10	10		0.25
Biochemistry	192.25	45	630.0	31	21			13.00
Health Science								
Pharmacy	5.00	10						
Arts & Science								
Botany	10.00	3						
Chemistry	500.00	11			5			0.25
Zoology	126.50	7.5	18.3	11.5				
Engineering								
Petroleum Eng.	500.00	10						
Other								
Rad Safety	11.70	13.2						5.00
TOTALS	1378.45	104.7	658.8	58.5	36	10	1	19.001

SEALED SOURCE INVENTORY

DEPARTMENT	RADIONUCLIDE
Ag Engineering	Am-241 - 250 mCi
Botany	Am-241 - 50 mCi
Physics	Co-60 - 3 mCi
Rad Safety Office	Am-241 - 60 mCi; Sr-90 - 100 mCi; Ni-63 - 10 mCi; H-3 - 500 mCi; Ra-226 - 15 mCi; Co-60 - 490 mCi; Pb-210 - 250 mCi; Pu-239 - 2000 mCi; Cf-252 - 1.55 mCi; Cs-137 - 9.1 mCi
Water Resources	Am-241 - 110 mCi

Total sealed source activity:

ISOTOPE	ACTIVITY (mCi)
Am-241	470
Sr-90	100
Ni-63	10
H-3	500
Ra-226	15
Co-60	493.5
Pu-239	2000
Cf-252	1.55
Cs-137	9.1

Sealed beta and gamma reference sources are possessed by Physics, Zoology, Physiology and Geology departments and the Radiation Safety Office. Liquid scintillatio. standards for ^{3}H and ^{14}C and/or quench sets are possessed by the Biochemistry, Zoology, Physiology, Pharmacy, Microbiology, Animal Science, and Botany departments and the Radiation Safety Office.

NRC
Response to Item #3

3. Submit a detailed description of your planned calibration procedures.

Arrangements are being made to purchase a beam calibrator from J.L. Shepherd and Associates of Glendale, California. The model number is 28-6A which contains a 1.2 Ci Cs-137 source. Traceability to a primary standard will be provided at a later date. Until the new calibrator is received, we will contin e to use the 1.2 mCi Cs source to calibrate instruments (which have little potential of being used in high exposure situations) up to 6 mR/hour. Instruments which are to be used for higher exposure rates will be calibrated at Colorado State University using their .75 Ci Cs-137 source.

Procedure for calibration

Calibration procedures will be carried out in room located or shielded such that radiation will be less than 2 mrem/hour at any occupied area external to the room when the beam port of the calibrator is open. (Radiation is less than 2 ml/hour at 1 foot from any surface of the calibrator when the beam port is closed.) Presently, the room is 108 in the Biochemistry building.

For calibration, the following procedures are followed.

1. The calibrator stand places the beam height at 36 inches above the floor of the room. All obstructions that may cause scattering of the beam are removed from the beam path for a minimum distance of six meters.

2. When in use, appropriate signs including "Authorized Personnel Only", "Radiation Area" and "Personnel Monitoring Required" shall be posted. (Personnel monitoring is required for all persons in the room.)

3. When using the 1.2 Ci Cs-137 calibrator, a second person should be available for assistance and to record data.

4. A movable instrument support stand designed to minimize scattering of the beam shall hold instruments in the calibration beam when the calibrator is on.

5. A mirror or mirrors shall be positioned in a manner to read instrument scales from a position remote from the beam path when the beam port is open.

6. Instruments will be calibrated at two points on each scale reading, one point in the lower 30% of the scale reading and one point in the upper 40% of the scale reading. Points shall be separated by at least 50% of the scale reading.

7. The beam port shall be closed when instruments are repositioned, adjustment calibrations are performed, or anytime personnel have reason to encounter space in the beam path.

8. Calibrations of scales less than 10 mR/hr shall be accomplished by using a x10 attenuator on the calibration.

The RSO for the University of Wyoming shall be the person responsble for supervising instrument calibrations. Minimum qualifications for the RSO are stated elsewhere in the application. John Doerges has been the RSO at UW since November 1974. His PH.D. level training is in Radiology and Radiation Biology specializing in Health Physics. He is a past president of the Central Rocky Mountain Chapter of the Health Physics Society and is presently editor of the chapters newsletter with an indefinate term.

NRC
Response to Item #4

4. Specify the procedures you will use to leak test sealed sources in your possession. Provide descriptions of the following:

a) The materials and procedures used for collecting leak test samples.

Sealed sources are stored at various locations on campus. The Radiation Safety Office (RSO) maintains an inventory of these sealed sources and where thy are stored. Every six months, the RSO performs leak tests on those sealed sources that are used by university and other approved personnel. Six inch long cotton tipped applicators are used to test the sealed sources for removable contamination. The cotton tip is applied to the sealed source and then placed into a plastic bag to transport back to the RSO where it is counted.

b) The name of the manufacturer and model number of the measuring instruments used to analyze leak test samples.

The weak (^{3}H and ^{14}C) beta emitters and the alpha emitters are counted on a Beckman LS-3150P liquid scintillation counter. The remaining samples are counted using a Nuclear Associates, Inc. Model 30 200 halogen quenched geiger tube. The geiger tube is mounted on a 3 inch thick cast iron shield. The signal from the geiger tube is fed into a homemade signal pick-off unit. The signal pick-off unit goes into an Ortec Model 775 counter. The high voltage power supply is provided by an Ortec Model 456H power supply. Gamma emitters are counted using a 2" x 2" NaI well type crystal manufactured by Bicron Model 2MW2P. The signal is routed to an Ortec Model 485 amplifier, then to an Ortec Model 406A single channel analyser and then to an Ortec Model 775 counter. An Ortec Model 773 timer is interfaced with the geiger and NaI detector systems.

c) Your procedures for calibration of the measuring instrument(s) including a sample calculation showing how leak test results are converted to microcuries.

Geiger counter calibration and conversion to microcuries. (Example illustration)

1) Cotton tipped swab is applied to approximately 100 cm^2 of the sample to be tested.
2) Swab is counted in geiger counter for 1 minute. Assume count equals 100 cpm = R_1.

3) Count a comparison source of similar energy and geometry.
Activity = 0.1 μCi = A
Assume nuclide = P-32

4) Geiger counter registers 40,000 cpm for comparison source = R_2. (R_2 source(s) is/are similar in energy to wipe test radionuclide.)

5) Removable contamination equals

$$A \left(\frac{R_1}{R_2}\right) = 0.1\ \mu Ci \left(\frac{100\ cpm}{40{,}000\ cpm}\right) = 0.003\ \frac{\mu Ci}{100\ cm^2}$$

6) Test is negative if removable contamination is less than 0.005 μCi/100 cm^2

Liquid Scintillation Calibration

From a known Beckman Tritium Standard, we have calculated the efficiency of the counter at 35%, from the equation eff. = cpm/dpm x 100. For the radionuclides that we count, tritium has the lowest efficiency, we therefore use this efficiency to calculate removable contamination for all radionuclides that we count on the liquid scintillation counter (primarly ^{3}H and ^{14}C).

The formula we use to calculate removable contamination is

$$\frac{\text{counts per minute in ch. A}}{(\text{efficiency})\ (2.22 \times 10^6\ \frac{dpm}{mCi})} = \mu Ci/100\ cm^2$$

$$\text{efficiency} = .35$$

The wipe test is considered positive if it is greater than 0.005 μCi/100 cm^2.

$$\text{eff.} = \frac{cpm}{dpm} \times 100$$

1) Beckman C-14 standard, dpm = 30900, cpm = 28378 in channel B. C-14 eff. = $\frac{28378}{30900} \times 100 = 91.8\%$

2) Beckman H-3 standard, dpm = 102000, cpm = 36061 in channel A. H-3 eff. = $\frac{36061}{102000} \times 100 = 35.3\%$

Gamma calibration follows a similar procedure.

NRC
Response to Item #5

5. Compliance with sections 20.1(c), 20.103 and 20.106 of 10 CFR Part 20 in procedures that may release volatile or gaseous radioactive material into restricted or unrestricted areas.

20.1(c) All procedures that may release volatile or gaseous radioactive materials in amounts where air concentrations in the laboratory may exceed those listed in Appendix B, Table II, Column 1 of 10 CFR Part 20 must be carried out in an approved hood. Where hood exhausts exceed maximum permissible concentrations on an intermitent basis, the atmosphere in the vicinity of the hood exhaust will be monitored to ensure that MPC's are maintained. If MPC's are not maintained the amount of radioactivity permitted to be used will be reduced until an appropriate filter system is installed in the fume hood.

20.103 Thyroid counts are taken of all individuals working with I-125 in laboratories using I-125 in procedures where I-125 may be in a volatile form. A copy of the form used for reporting the thyroid survey is attached (Exhibit A). Thyroid counts are taken routinely of individuals performing iodination experiments within 72 hours of completion of the experiment. Presently I-125 and occassionally H-3 are the only radionuclides which present a significant airborn hazard at UW.

20.106 No radioactivity in excess of the amounts permitted in Appendix B Table II of 10 CFR Part 20 will be released in effluents under this license unless specified in an amendment to the license.

Exhausts of all hoods using I-125 will be monitored initially during experiments involving I-125 by collecting an air sample with activated charcoal filters contained in a thin walled glass or plastic cylinder. The filter will be counted using a 2" x 2" NaI (Tl) crystal with a 5/8" x 1 7/16" well produced by the Bicron Corporation. The detector output is routed to a single charcoal analyzer with a window set for the .03549 Mev I-125 photopeak. The single channel analyzer is calibrated by aliquoting a known activity of I-125 into the charcoal filter and determining the efficiency of the system for I-125. A check is made by counting a standard .30 µCi I-129 solution.

The following procedures are and calculations are provided to show evidence of detection levels of 8×10^{-11} µCi/ml as specified in appendix A Table II of 10 CFR Part 20.

Natural background of NaI detector system with 0.25 volt window set on I-125 photopeak is nominally 300 $\pm$ 8cpm. For a 40 minute count and where $\pm$ 8 cpm is a three standard deviation interval from the mean.

This background count rate indicates a count rate of at least 309 cpm would be required to be statistically different from background (9 cpm > background).

A concentration level of 8×10^{-11} µCi/ml of I-125 is equivalent to 8×10^{-8} µCi/liter which implies 0.178 cpm of Iodine at 30% counting efficiency this would translate into .053 cpm/l

$$\frac{9 \text{ cpm}}{.053 \text{ cpm/l}} = 168.9/1.$$ or approximately 170 l. of atmosphere required to be sampled

A sampling rate of 2.5 l/m would require a minimum sampling time of 68 minutes.

The counting system is modular, consisting of ORTEC NIM bin with single channel analyzers, timers counters and linear amplifiers.

The surveys shall be taken in the hood environment or at the hood exhaust on a quarterly basis by the radiation safety officer or a trained technician from the Radiation Safety Office.

For experiments involving tritium in the volatile state where over 20 mCi per week may potentially be released into the environment, a tritium sampling program will be instituted. The sampling system will be reviewed for each individual circumstance but will rest principally on the collection of a condensed tritium compound, in most cases water. Products which do not condense at dry ice - acetone temperature will be oxidized by a catalyst or flame. An excess of H_2 will be introduced in the oxidation stream to provide a sufficient amount of water to rinse out any tritiated water which might otherwise adhere to the oxidation compartment of the system.

NRC
Response to Item #6

6. Your license currently allows you to possess up to 1 curie of phosphorus-32, you should develop and submit special safety instructions to be provided to individuals using millicurie quantities of phosphorus-32.

The five NRC procedures outlined will be followed by all user's of millicurie amounts of phosphorus-32.

a) The use of low density shielding (e.g., plexiglass) in order to keep Bremsstrahlund radiation at a minimum.
b) A mandatory radiation survey and wipe test procedures after each use.
c) The use of finger type extremity monitors for procedures that involve millicurie quantities of phosphorus-32.
d) The use of a dry run prior to the performance of unfamiliar procedures in order to preclude unexpected complications. In addition, it is recommended that the radiation protection officer be present during the first experimental run of new procedures.
e) The use of eye protection for procedures that involve 10 millicuries or more of phosphorus-32.

In addition, the following procedure will be required of personnel working with greater than 1 mCi amounts of phosphorus-32.

f) Urine samples will be collected not more than 12 hours after use with greater than 1 mCi amounts of phosphorus-32 per experiment. Urine sample frequency may be reduced for routine operations where urine samples have a history of minimum contamination (less than 3 times background).

NRC
Response to Item #7

7. Provide a general description of UW's facilities and equipment, e.g., general or stack monitors filtering systems, remote handling equipment, and the security control measures associated with handling and storage of byproduct material. Indicate the availability and location of glove boxes and their special filters, dedicated waste receptacles, special sinks, and effluent filter systems.

At present the UW facilities do not have any continuous stack monitors for radioactive hoods. Several of the hoods on campus are filtered with HEPA filters and with provisions for other absorbers such as a charcoal filter.

A number of hand held remote handling tools are available in a few laboratories and in the Radiation Safety Office. These tools range in size from approximately 1' to 4' in length.

Security control measures associated with handling and storage of byproduct material include:

1. Any transfer of radioactive material, on or off campus or between laboratories is processed through the Radiation Safety Office. Sample copies of the transaction forms are attached. (Exhibit C)
2. All radioactive material is stored in laboratories which are locked when unoccupied.
3. All areas where radioactive materials are stored are identified on the placard of each laboratory. The sketch is posted near the entrance of each lab.
4. The university has a number of radioactive storage areas including concrete vaults, safes, underground vaults, and rooms with walls constructed of high density concrete. Each of these areas are separately keyed and access to the keys is restricted.

Three "glove" boxes are presently in use where radioactivity is involved. Two use P-32 and have a recirculating charcoal filter. The other is a chamber for testing the behavior of some labeled straight chain hydrocarbons and uses small quantities of C-14.

The hood drains in Physical Science laboratory rooms 3, 5 and 7 can be diverted into a holding tank located in the utility shaft adjacent to the laboratory (see basement floor plan of the Physical Science building). The holding tank can be emptied into the sanitary sewer system or into separate containers. Before the tank is emptied, the solution is analyzed for the radioactive contents and a decision is made to divert the solution to the sanitary sewer or to the radioactive waste stream designated for burial. The system has not been used since at least November 1974.

The location of radioactive waste recepticals and/or special sinks for washing radioactive contaminated laboratory ware are identified on each laboratory placard which is posted in an obvious location near the entrance of each approved laboratory.

NRC
Response to Item #8

8. Include an explanatory sketch of each area (i.e., site, building, laboratory room) where hazardous materials are used and stored or where hazardous operations are performed.

Exhibit B includes a map of the physical facilities of the UW Campus with all buildings identified which use and/or store radioactive materials. Floor plans of each building (and appropriate level) where radioactive materials are present are identified. (Floor plans are mailed under separate cover - mailing tube.)

NRC
Response to Item #9

9. Confirm that all releases of byproduct materials into the sanitary sewer systems conform to the requirements of 10 CFR 20.303.

10 CFR 20.303 states that the quantity of licensed and other radioactive material released into the sanitary sewage system shall not exceed 1 curie per year. The hydrogen-3 release may not exceed 5 curies per year, and 1 curie of carbon-14 may be released.

This statement is to confirm that by-product material releases from the University of Wyoming conform to the requirements of 10 CFR 20.303.

NRC
Response to Item #10

10. Confirm that all releases of byproduct materials into air and water are in agreement with the requirements of 10 CFR 20.106.

10 CFR 20.106 restricts releases of licensed material to unrestricted areas not to exceed the limits specified in Appendix "B", Table II of Part 20 of the Code of Federal Regulations.

If any release of licensed material is expected to reach unrestricted areas a calculation is performed prior to the release to make sure that the specified limits are not exceeded.

NRC
Response to Item #11

11. Information submitted in your application referencing disposal operations will be evaluated separately by NRC's Division of Waste Management. A member of the Division of Waste Management will be contacting you in the near future to discuss your proposed mode of land burial waste disposal.

No response required.

NRC
Response to Item #12

12. Outline of training established by the Radiation Safety Committee.

The responsibility for training resides on the principle investigator whose project is approved by the Radiation Safety Committee. The basic guideline for UW is NCRP Report No. 71 entitled Operational Radiation Safety Training. This outline draws substantially from material presented in NCRP Report No. 71.

I. The training requirements of individuals may vary depending on several factors listed below.
   A) The potential for radiation exposure
   B) The complexity of the task
   C) Other factors may modify the training including:
      1) Personnel who are directly and continuously supervised will normally need less training than those who work independently or who have infrequent supervision.
      2) Individuals who are responsible for the supervision of others will require more training.
      3) Individuals who have received previous training may not require additional training. However, care must be taken to assure that the previous training is current and applicable to the needs of the employees present position.
      4) Individuals who have extraordinary personal concerns about ionizing radiation may need special attention.

II. Topics to be specifically considered in the Radiation Safety program are numbered and listed below.
   1. Radioactivity and radioactive decay;
   2. Characteristics of ionizing radiation;
   3. Man-made sources;
   4. Acute effects of exposure to radiation;
   5. Risks associated with occupational exposures;
   6. Special considerations in the exposure of women of reproductive age;
   7. Dose-equivalent limits;
   8. Mode of exposure - internal, external;
   9. Dose-equivalent determinations;
   10. Basic protective measures - time, distance, shielding;
   11. Basic radiation survey instrumentation - calibration and limitations;
   12. Radiation monitoring programs and procedures;
   13. Contamination control, protective clothing and equipment (including respirators), workplace design;
   14. Personnel decontamination;
   15. Emergency procedures;
   16. Warning signs, alarms;
   17. Responsibilities of employees and of the organization;
   18. Interaction with radiation safety staff;
   19. Specific procedures for maintaining exposure as low as is reasonably achievable.

III. Personnel to be trained includes:
- A) Occupationally exposed workers
  - 1) Persons subjected to routine personnel monitoring.
- B) Occasionally exposed workers
  - 1) Duties may occasionally bring them into areas where radiation exposure may occur.
- C) Management and supervisory personnel
- D) Contractor personnel
- E) Visitors
- F) Emergency personnel
- G) Special cases
  - 1) To be addressed on a case by case basis.

IV. Records will be maintained in the Radiation Safety Office of individuals who receive training. Records will contain:
- A) Instructors name
- B) Topics covered and time allocation
- C) Duration of training
- D) List of attendees and their departments
- E) Date and location of class

NRC
Response to Item #13

The UW Radiation Safety manual is being revised as follows with respect to the twelve items listed (a through p) in your letter.

a) Care, selection and use of protective apparel.

Section II E will be added to the UWRSM entitled "Protective Clothing" as follows:

E. Protective Clothing

Protective clothing is provided for the purpose of preventing contamination to the skin or clothing of the radiation worker. Personnel using unsealed radioactive material must wear protective clothing appropriate for the specific job. In general, when using activity greater than ten control units (refer to Table II) a minimum of rubber gloves, laboratory coats of tightly woven fabrics, and eye protection are required. Contact lenses are not allowed. Shoe covers and/or coveralls may be required - depending on the activity levels and potential for floor contamination to reduce the probability of spreading contamination.

Rubber gloves and shoe covers should be considered as potentially contaminated and disposed of as radioactive waste. Gloves and shoe covers should be removed in a manner that does not contaminate uncovered portions of the skin.

Users should not touch uncovered portions of the skin, reach into pockets or handle any personal items not required in the experiment while wearing rubber gloves.

Lead impregnated aprons, gloves or other garments may be required for protection from low energy gamma or x-rays and beta emitters.

When the potential for serious contamination exists, more elaborate protective clothing programs are required on a case by case basis with review and approval by the RSO.

Protective clothing worn by radiation workers must be kept separate from protective clothing of other workers. The clothing must be marked permanently with a distinctive mark. Clothing contaminated with radioactive material that may be decontaminated shall be bagged and processed through the Radiation Safety Office.

b) Limitations, conditions, and special equipment used relative to handling liquid, gaseous, finely divided or uncontained radioactive materials.

Section III C page 12:00:00 of the Radiation Manual will be revised as follows:

C. Handling, Labelling, Transportation and Storage of Radioactive Material

1. Handling of radioactive material requires confining the material to designated restricted areas, minimizing the time of exposure, maintaining the maximum distance from the radioactive material feasible with proper handling, and provision for shielding above and beyond the normal safety precautions taken in a laboratory handling hazardous materials.

For convenience, the term "Control Unit" is used in this manual to refer to the activity, in microcuries, that determines the labeling and waste disposal requirements for any radionuclide. The values of the Control Unit for various radionuclides are listed in Table II.

Guidelines for work with various levels of Control Units are set forth in Table III. Projects which involve the handling of uncontained liquid, gaseous, and/or finely divided radioactive materials must have specific approval of the Radiation Safety Committee in terms of limitations of activity levels, conditions of use, and special equipment and/or instrumentation which may be required.

General guidelines for work with radioactive materials are shown in Table III.

2. The following signs or labels, carrying the approved radiation symbol, are to be placed on rooms, containers, etc. as indicated:

CAUTION - RADIOACTIVE MATERIAL - for each room or container in which is used, transported or stored a combined quantity of radioactive material greater than one control unit (see Table II).

CAUTION - RADIATION AREA - for areas in which the exposure rate is, or could be, from 2 to 100 mR/hour.

CAUTION - HIGH RADIATION AREA - for areas having actual or potential exposure rates greater than 100 mR/hour.

All labels or individual containers of radioisotopes shall also include the type and quantity of nuclide, date of assay and should include the name of the responsible user. (Containers used transiently while the user is present are exempt from these labeling requirements.)

3. Storage areas for radioactive material must be identified on the room placard for radioactive laboratories and identified with a "radioactive materials" label. The storage area must be secure from unauthorized personnel. Shielding or restricted access may be required to limit exposure to ionizing radiation.
(The balance of C is included under the response to item h.)

c) Special equipment procedures, and precautions to be used in working with neutron and alpha emitters and radionuclides that decay by spontaneous fission.

Section II F entitled "Use of Neutron and Alpha Emitters and Radionuclides Which Decay by Spontaneous Fission" will be added to the UWRSM as follows:

Users of neutron or alpha emitters and radionuclides which decay by spontaneous fission must have appropriate counting or detection equipment approved by the RSO. When such sources have a potential of becoming airborne, air monitoring must be provided for and specifically approved by the Radiation Safety Committee. In the case of neutrons, neutron dosimeters must be worn by all personnel who may receive significant exposure. Laboratories and storage areas may be required to be monitered as determined by the Radiation Safety Committee.

Users must also be specifically trained concerning the biological hazards and handling techniques of these sources on a case by case basis.

Signs and barriers graded according to the hazard involved shall be posted or constructed to alert workers or the public of the possible radiation hazard. Barriers should be constructed in a manner to cause minimum interference with the work being done.

Areas where exposures may be over 10 mR per week shall constitute a controlled area. When not occupied by authorized personnel, the area must be locked or otherwise made inaccessible.

d) Surveying and monitoring procedures to be followed during day-to-day operations; minimum number of operable instruments to be available at all times to the individual users in each user category.

Section II B of the UWRSM will be changed as follows:

B. Methods and Frequencies for Conducting Laboratory Surveys

1. Laboratory Survey Methods

Each laboratory is required to have a schematic drawing of the laboratory indicating well defined sampling and/or monitoring locations. The sampling and monitoring stations should be chosen to assure adequate coverage of the laboratory and such that they are sensitive to potential changes in radioactive levels.

Monitoring instruments shall be appropriate to the radiation being measured. For low energy beta or alpha radiation or where background radiation levels hinder detection of contamination wipe tests shall be conducted using 1" or greater diameter filter papers or cotton tipped "wipes" (commonly referred to as cue tips). The filter papers are then to be counted using thin window geiger tube detector, proportional counters, or liquid scintillation counters.

2. Frequency of Survey

Laboratories are classified as low, moderate, or high hazard according to the type and amount of isotope used. The minimum frequency of laboratory surveys is determined by this classification modified by the use patterned after the "Recommendation of the International Commission on Radiological Protection - Report of Committee V": Pergamon Press, New York, N.Y. (1965)

a) Classification of Laboratory Areas for Survey Frequency Determination

RADIONUCLIDE GROUP**	LOW	MEDIUM	HIGH
1	<10 µCi	10 µCi - 1 mCi	>1 mCi
2	<1 mCi	1 mCi - 100 mCi	>100 mCi
3	<100 mCi	100 mCi - 10 Ci	>10 Ci
4	<10 Ci	10 Ci - 1000 Ci	>1000 Ci

**From Table I

b) Frequency of Surveys
1) Low level areas - Not less than once per month
2) Medium level areas - Not less than once per week
3) High level areas - Not less than once per day

c) Modification of Survey Frequency
The amounts of activity in each classification category shall be multiplied by the following factors, based on the type of laboratory activity, to determine the survey of frequency requirements.

MODIFYING FACTOR	MULTIPLICATION FACTOR
1. Simple storage.	100
2. Very simple wet operations (e.g. preparation of aliquots of stock solutions).	10
3. Normal chemical operation (e.g. analysis, simple chemical preparation).	1
4. Complex wet operations (e.g. multiple operations, or operations with complex glass apparatus).	.1
5. Simple dry operations (e.g. manipulation of powders) and work with volatile radioactive compounds.	.1
6. Exposure to non-occupational persons.	.1
7. Dry and dusty operations.	0.01

Example: A laboratory in which 10 mCi of a Group 2 radionuclide is used in normal chemical operation should be surveyed on a MEDIUM frequency. If simple storage is done, then a LOW frequency is adequate. (The NEW LOW Range = <1 mCi x 100 = <100 mci.) If a dry grinding operation is done a HIGH frequency is required. (The NEW HIGH Range = >100 mCi x 0.01 = >1.0 mCi.)

3. Instrumentation

Except for low energy radiations, such as tritium, each laboratory using unsealed sources or where personnel may receive greater than 2 mR/hour of X or gamma radiation, appropriate operational survey instruments must be available according to the following schedule:

LABORATORY'S RATING	MINIMUM NUMBER OF OPERATIONAL INSTRUMENTS REQUIRED
Low Hazard	1 with a backup source identified
Moderate Hazard	2 with a backup source identified
High Hazard	2 with a backup source identified

e) Emergency procedures and instructions for fires, and release or loss of material.

Section III H will be added to the UWRSM as follows:

H. Emergency Procedures for Fire, Release of, or Loss of Radioactive Material.

1. Fire

Minor fires should be put out or controlled by approved fire extinguishers/water using your best judgement. Water safety showers and/or fire blankets are appropriate when a person's clothing is on fire.

For fires that are not readily controlled, evacuate occupants at once and call the campus police at 5179. Respond to their questions and stay on the line until dismissed.

2. Unscheduled release of radioactive material
   a. Check for contamination of personnel
   b. Prevent spread of contamination by:
      i) Shutting off ventilation if contamination is airborn
      ii) Isolating the area
      iii) Preventing entry by unauthorized personnel
   c. Notify the Radiation Safety Office as quickly as possible.

3. Loss of Radioactive Material
   Any loss of radioactive material must be reported to the Radiation Safety Office as soon as possible after loss is noted.

f) Requirement for material storage and safeguarding; labeling containers; processing and storing contaminated articles, including glassware.

The response to this item is included in response to item c.

g) Care and proper use of personnel monitoring devices, where to obtain them, and where to record exposure results.

Section II A. of the UWRSM will be revised by inserting the following paragraphs immediatly after the table on page 3:00:00 of the present manual.

Personnel monitoring devices including pocket dosimeters (Landsverk type), film badges for beta, x and gamma, and neutron exposure, and TLD's are available from the Radiation Safety Office. Alarm type exposure rate dosimeters may also be checked out from the Radiation Safety Office.

Dosimeters should be stored away from excessive heat and in a "background" radiation area when not being used. Direct reading dosimeters should be calibrated periodically when in regular use and before use when used on an irregular basis. Dosimeters should not be subject to abuse.

Radiation exposures recorded on dosimeters should be kept in duplicate. The original copy is to be returned to the Radiation Safety Office on a monthly basis where exposures will be incorporated into the permanent exposure records as appropriate.

h) Transporting other forms of radioactive material between buildings and rooms and/or transporting sealed sources and loose radioactive materials to field sites outside the confines of the University Campus.

Section C. Handling, Labelling, Transportation and Storage of Radiation Sources will have the following appended to the section presented under item b.

4. Transporting of radioactive material between rooms, buildings and/or field sites outside the confines of the University Campus.
    a) Between buildings or rooms which are not immediately connected.
    Unsealed sources in amounts exceeding 1 control unit (refer to Table II) must be labeled specifying the radionuclide and user. The sources should be double contained with enough absorbent to absorb any liquid which might be released.
    Sealed sources must be properly labeled including the radionuclide, and activity as of a stated date. Containers for sealed sources should identify the responsible user and return address.
    b) Radioactive material transported outside of the confines of the UW campus must be packaged according to the Department of Transportation (DOT) regulations as prescribed in 49 CFR: Proper shipping papers and a shippers "Declaration of Dangerous Goods", properly filled out and signed, must accompany the shipment. No radioactive material is to be taken as personal baggage in a passenger carrying aircraft.

i) Acceptable and unacceptable levels of contamination (fixed and removable) for equipment, facilities, clothing, skin, etc., in both restricted and unrestricted areas and protective action (i.e., decontamination disposal, etc.) to be taken with respect to unacceptable levels.

Section II B3 will be added to the UWRSM as follows:

3. Acceptable levels of contamination, contamination of skin, clothing, laboratory work surfaces, equipment and facilities should be kept as low as reasonably achievable. General limits of contamination in non-restricted areas are set forth in the following table.

CONTAMINATION LIMITS FOR UW LABORATORIES

CONTAMINATED ITEM OR AREA	HAZARD GROUP [1]	PERMISSABLE EXPOSURE (mrem/hr) [2]	COUNT RATE (cpm) [3]
Skin Local	I or II	1.0	1000
Skin Local	III or IV	0.1	<100
Skin General	All	0.1	<100
Clothing Local	I or II	1.0	1000
Clothing Local	III or IV	0.1	<100
Clothing General	All	0.1	<100
Equipment, floors walls and work surfaces	I or II	1.0	1000
Equipment, floors walls and work surfaces	III or IV	0.1	<100

1. Radionuclide hazard groups from Table I page 15:00:00.
2. Measured in a small volume of air above any 2 in^2 area of the body.
3. Net count rate above background.

Equipment or areas in the laboratory which are contaminated at higher levels because of the nature of the equipment design, levels of activity handled or other special factors must be located in restricted areas and be designated as radiation areas if the exposure rate exceeds 2 ml/hour.

4. Decontamination

For skin contamination, wash the contaminated area for 2 minutes using a mild, pure soap and tepid water. Pay particular attention to areas between fingers or around fingernails. If the contamination is localized, consider masking off the area with tape and cleaning with swabs. Rinse the contaminated area thoroughly, dry and count.

If soap and water alone do not remove the contamination, repeat the 2 minute wash using a soft brush to help remove the contamination. Use light pressure and change wash water frequently. Rinse, dry and count. Repeat up to three times unless the skin starts to turn red. If the contamination cannot be brought within acceptable limits, contact the RSO or hospital as soon as possible.

Contaminated clothing should be bagged for storage to allow for radioactive decay or turned over to the RSO for decontamination or disposal.

Glassware and other contaminated equipment should be cleaned using laboratory detergents, acids, or cleaning solutions as appropriate. All equipment contaminated with long lived radionuclides which cannot be cleaned to acceptable levels must be discarded as radioactive waste. Such glassware and equipment should be destroyed to prevent accidental return to stock or other use. Equipment contaminated with short lived radionuclides and stored to allow for radioactive decay must be clearly identified and stored in a secure location.

Laboratory work surfaces and floors which cannot be decontaminated to acceptable levels must be: treated to fix the radioactivity in place and shielded to bring exposure limits to acceptable levels, identified as a radiation area, isolated to allow for radioactive decay or removed and disposed of as radioactive waste.

j) Requirements and procedures for leak-testing sealed sources.

Section II G entitled "Leak Testing of Sealed Sources" will be added to the UWRSM as follows:

G. Leak Testing of Sealed Sources

All sealed sources requiring leak testing according to section 31.5 (c) of 10 CFR will be leak tested at least every six months unless the source is in storage.

Leak tests shall be performed by wiping the source container with a cotton swab and then counting the swab using a detector and instrumentation suitable for the type and quality of radiation and capable of detecting 0.002 µCi of activity on the swab.

Any source showing 0.005 µCi of removable contamination shall be immediately removed from service. The RSO shall be notified immediately and will be responsible for subsequent action as required under section 31.5 (c) 5 of 10 CFR.

k) Instructions to be provided to animal caretakers should radionuclides be administered to animals; specify instructions for cleaning animal quarters and handling animal excretion and carcasses.

Section III I will be added to the UWRSM as follows:

I. Special Requirements for Administering Radionuclides to Animals

Unsealed radioactive sources shall not be used on animals until the RSO and the Radiation Safety Committee review the facilities, personnel and equipment to be used. Items which must be considered in applying to use radionuclides in animals are:

a) Rooms where radionuclides are involved should be close together and regarded as a controlled area.
b) Animals treated with radionuclides are to be regarded as a source of radiation and contamination.
c) Animal attendents shall have written instructions as to their duties and radiation protection procedures.
d) Loitering near radioactive animals is to be avoided.
e) The quantity of radioactive material on hand should be limited so far as reasonable to the amount required for the treatment.
f) Cages and/or rooms must be designed to prevent unwarrented spread of contamination by animals or animal excreta.
g) Excreta, body constituents from biopsies and autopsies and animal cadavers shall be treated as radioactive waste.
h) Possible hazards of spread of contamination through the decomposition process should be prevented by deep freezing, disinfectants, sealed plastic containers, and other approved methods.
i) Provision for collection of excreta and decontamination of cages is required.
j) Animals or cages are to be marked with labels indicating the radionuclide, the amount of activity administered and the time of administration of the radionuclide.
k) No uncontrolled exchange of animals, instruments, cages, etc. between radioactive and non-radioactive laboratories is permitted.
l) Precautions should be taken to prevent the possibility of contaminating wounds in the course of handling animals. Contamination from radioactive aerosols or splashings produced by the animals movements, coughing, etc. should also be considered.
m) The presence of vermin as potential vectors of contamination should be considered.

1) Procedures and requirements for picking up, receiving, and opening packages containing radioactive material.

Section III B of UWRSM will be revised as follows:

The first two sentences which read "All orders for radioactive materials or radiation sources must be approved in advance by the RSO. This requirement also applies to no-charge and generally licensed acquisitions." will be changed to read;

"All orders or shipments of radioactive material must be processed through the Radiation Safety Office. This requirement also applies to no-charge and generally licensed acquisitions."

All radioactive shipments are ordered, received, opened, leak tested, checked against the order, and delivered to the user, therefore procedures and requirements regarding receiving, opening etc. are not included in the UWRSM. This topic is also covered under item 15.

NRC
Response to Item #14

14. Describe your procedures for receipt of radioactive materials during off-duty hours, and for notification of responsible persons upon receipt of radioactive materials. These procedures of responsible persons ensure that possession limits are not exceeded, that radioactive materials are secured against unauthorized removal at all times, and that radiation levels in unrestricted areas do not exceed the limits specified in section 20.105 of 10 CFR Part 20.

During off-duty hours, any radioactive package that arrives at the university is taken to the campus police station instead of the receiving department. Upon receipt of a package, campus police call the university health physicist, RSO or his assistant. One of these employees will get the package from campus police and take it to the Radiation Safety Office, where it will be stored until working hours resume. The Radiation Safety Office is located within the Biochemistry Building. If a package is received during the weekend hours, it is locked in the radiation office. The Biochemistry Building is also locked during weekends.

Possession limits are assured during the time of ordering. Ordering is processed by the Radiation Safety Office.

NRC
Response to Item #15

15. Confirm that your procedures for safely opening packages are in accordance with section 20.105 or 10 CFR Part 20. As a minimum, you should wipe the external surface of the final source container, assay the wipe in a low background area with a thin-end-window GM survey meter or equivalent instrument.

Initially, all radioactive packages are delivered to the shipping and receiving department of the University of Wyoming. Upon arrival of a package, receiving calls the Radiation Safety Office. A Radiation Safety Office employee picks up the package as soon as possible and takes it to the Radiation Safety Office where the package is leak tested. In the instance when a package comes in on the weekend, the package is delivered to the university police. The university police have two phone numbers to call, the health physicist and his assistant.

The cardboard box that contains the "final source container" is visually checked for any apparent damage. The package is opened and the "final source container" is checked for removable contamination by means of a cotton swab. The swab is then counted by a lead shielded GM tube. For carbon-14 and tritium and other low energy beta emitters, the swab is counted in a liquid scintillation counter. All counting systems are capable of detecting <0.002 μCi of activity on the swab.

NRC
Response to Item #16

16. Pertaining to the use of radioactive materials in animals.

At the present time, no radioactivity is being administered to animals. Any application for such use will require:

a) A description of the animals' housing facilities and a simple annotated sketch.
b) A copy of the instructions provided to animal caretakers for handling of animals, animal waste, including carcasses, and the cleaning and decontamination of animal cages.
c) Procedures for maintaining security of animals containing radioactive material.

The items above will be reviewed by the RSO and the Radiation Safety Committee when such applications are received.

NRC
Response to Item #17

17. Specify the frequency that the radioactive waste storage areas are to be surveyed.

The UW Radioactive Waste Storage area will be surveyed after each campus pickup (normally once per week) and after each disposal.

NRC
Response to Item #18

18. Provide a description of each UW Radiation Safety Committee members training and experience with radiation and radioactive materials.

See attached Statement Of Training and Agreement sheets.

University of Wyoming
Form RS-2
April, 1974

STATEMENT OF TRAINING AND AGREEMENT

Principle User ✓

1. Name Bruce W Cutler, Ph D Independent User _____ (Check one)

Supervised User _____

2. Type of Training:

Type	Where Trained	When	Formal Course	On Job
a. Principles and Practices of radiation Protection	Univ Ks. Med Ctr Univ Colorado Med Ctr	1970-1975 1975-1977	Yes (No)	(Yes) No
b. Radioactivity measurement, monitoring techniques, and instruments.	" "	" "	(Yes) No	(Yes) No
c. Mathematical principles applicable to radiation measurements and dose	" "	" "	(Yes) No	(Yes) No
d. Biological effects of radiation.	" "	" "	(Yes) No	(Yes) No

3. Formal Courses: List all courses pertaining to isotopes, atomic and nuclear structure, radiochemistry, radiobiology, etc. (Use extra sheet if necessary)

Title of Course	Where Trained	When	Course Content
a. Pharmacokinetics	Univ Kansas Med Ctr	1970-1975	radiation physics + dose
b. Radiation Instrumentation			liquid scintillation counting
c. Toxicology			Biological effects of radiation
d.			

4. Experience: Actual use of isotopes

Isotope	Maximum Amount (mc)	Where Experience Gained	When	Type of Use
^{3}H	1 mc/kg	UCMC + UCMC	1970-1977	Thesis research
^{14}C	1 mc/kg	" "	" "	

5. Remarks:

6. Statement of Agreement: The below named individual signifies that he has read and is willing to abide by the Radiation Safety Manual governing the use of radioisotopes and other sources of ionizing radiation. The undersigned agrees to comply strictly with all such rules and regulations and hereby waives any right or recourse against the University of Wyoming for any damage whatsoever resulting from any failure to fully conform with said regulations.

Date 10/4/77 Signed Bruce W Cutler

7. Approved: H.P. _____/___/___ Committee _____/_____/_____

Form RS-2, Dec. 1971

STATEMENT OF TRAINING AND AGREEMENT

1. Name Daniel R. Caldwell A.U.? Yes or Assoc. of ____________

2. Type of Training:

Type	Where Trained	When	Formal Course	On Job
a. Principles and Practices of Radiation Protection	University of Maryland, College Park and Agricultural Research Service, Beltsville, Md.		(Yes) No	(Yes) No
b. Radiaoactivity measurement, monitoring techniques, and instruments.	University of Maryland, College Park, and Agricultural Research Service, Beltsville, Md.		(Yes) No	(Yes) No
c. Mathematics and calculations basic to the use and measurement of RAM	University of Maryland, College Park, and Agricultural Research Service, Beltsville, Md.		(Yes) No	(Yes) No
d. Biological effects of radiation.	University of Maryland, College Park, and Agricultural Research Service, Beltsville, Md.		(Yes) No	(Yes) No

3. Formal Courses: List all courses pertaining to isotopes, atomic and nuclear structure, radiochemistry, radiobiology, etc.

Title of Course	Where Trained	When	Course Content
a. Radiochemistry (Lect.)	University of Maryland		Interaction of Radiation, Measurement, Statistics, structure etc.
b. Radiochemistry (Lab.)	University of Maryland		Instrumentation, Measurement, Statistics, Radiation Chemistry
c. Advanced Radiochem (Lect.)	University of Maryland		Use of RAM in Biological Chem Research
d. Advanced Radiochem (Lab.)	University of Maryland		Use of RAM in Biochemical Research

4. Experience: Actual use of isotopes

Isotope	Maximum Amount (mc)	Where Experience Gained	When	Type of Use
C^{14}	0.100	Beltsville, Md.	1967–1969	Metabolic pathway studies, uptake, fermentation balances, action label data, metabolite tracing

5. Remarks:

6. Statement of Agreement: The below named individual signifies that he has read and is willing to abide by the Radiation Safety Manual governing the use of radioisotopes and other sources of ionizing radiation. The undersigned agrees to comply strictly with all such rules and regulations and hereby waives any right or recourse against the University of Wyoming for any damage whatsoever resulting from any failure to fully conform with said regulations.

Date 1-20-72 Signed Daniel R. Caldwell

Approved: H.P. John Doege 6/30/76 Committee 7/13/76 GJM

Univeristy of Wyoming
Form RS-2
September, 1980

STATEMENT OF TRAINING AND AGREEMENT

Principle User ~~X~~ N.A.

1. Name Dr. C.N. Rhodine Independent User ~~X~~ (Check One)

Supervised User ~~X~~

2. Type of Training: Member Rad. Saf. Comm.

TYPE	WHERE TRAINED	WHEN	FORMAL COURSE	ON JOB
A. Principles and Practices of radiation Protection	Univ. of Wyo. Atomics International	1957 1960	(Yes) YES (NO)	(Yes) YES (NO)
B. Radioactivity measurement, monitoring techniques, and instruments.	Univ. of Wyo Atomics International	1957 1960	(O) YES (NO)	(O) YES (NO)
C: Mathematical principles applicable to radiation measurements and does	Univ. of Wyo. Atom. Intern.	1957 1960	(O) YES (NO)	(O) YES (NO)
D. Biological effects of radiation	Univ. of Wyo Atom. Intern.	1957 1960	(O) YES (NO)	(O) YES (NO)

Received Reactor Operators License from AEC #OP1800 8/7/61

3. Formal Courses: List all courses pertaining to isotopes, atomic and nuclear structure radiochemistry, radiobiology, etc. (Use extra sheet if necessary)

TITLE OF COURSE	WHERE TRAINED	WHEN	COURSE CONTENT
A. Radiology	Univ. of Wyo	1957	Nuclear Instrumentation,
B. Phys. 672F			sources and
C.			Biological Effects
D.			

4. Experience: Actual use of isotopes N.A.

ISOTOPE	MAXIMUM AMOUNT (MC)	WHERE EXPERIENCE GAINED	WHEN	TYPE OF USE
Responsible for instrumentation on the L-77 reactor and training of operators while on UW Campus				

5. Remarks:

6. Statement of Agreement: The below named individual signifies that he has read and is willing to abide by the Radiation Safety Manual governing the use of radioisotopes and other sources of ionizing radiation. The undersigned agrees to comply strictly with all such rules and regulations and hereby waives any right or recourse against the University of Wyoming for any damage whatsoever resulting from any failure to fully conform with said regulations.

N.A.

Date 10/11/83 Signed [signature]

Univeristy of Wyoming
Form RS-2
September, 1980

STATEMENT OF TRAINING AND AGREEMENT

Principle User _____

1. Name Stanley Anderson Independent User _____ (Check One)

Supervised User X

2. Type of Training:

TYPE	WHERE TRAINED	WHEN	FORMAL COURSE	ON JOB
A. Principles and Practices of radiation Protection	Oregon State University	1970	(YES) NO	(YES) NO
B. Radioactivity measurement, monitoring techniques, and instruments.	Oak Ridge National Lab	1974/75	(YES) NO	(YES) NO
C: Mathematical principles applicable to radiation measurements and does	Oak Ridge National Lab + ORAU	75	(YES) NO	(YES) NO
D. Biological effects of radiation	Oak Ridge Nat. Lab + ORAU	75	(YES) NO	(YES) NO

3. Formal Courses: List all courses pertaining to isotopes, atomic and nuclear structure radiochemistry, radiobiology, etc. (Use extra sheet if necessary)

TITLE OF COURSE	WHERE TRAINED	WHEN	COURSE CONTENT
A. Intro To Rad. Bio	Oregon State U	1970	General Overview
B. Radio isotopes	ORAU	1975	Isotope Use
C. Instrumentation	ORAU	1975	Use of Equipment
D. Medical Radiobiol	ORAU	1975	Medical effect of Rad.

4. Experience: Actual use of isotopes

ISOTOPE	MAXIMUM AMOUNT (MC)	WHERE EXPERIENCE GAINED	WHEN	TYPE OF USE
C^{14}	Low level	ORAU	1975	Teaching/Plant
H^3 Co^{60} Cs^{137} Ca^{101}				
Fothes Fem	Hers low level	ORNL	1970-75	Animal Res.

5. Remarks:

6. Statement of Agreement: The below named individual signifies that he has read and is willing to abide by the Radiation Safety Manual governing the use of radioisotopes and other sources of ionizing radiation. The undersigned agrees to comply strictly with all such rules and regulations and hereby waives any right or recourse against the University of Wyoming for any damage whatsoever resulting from any failure to fully conform with said regulations.

Date 10/6/83 Signed Stanley H Anderson

Form RS-2, Dec. 1971

STATEMENT OF TRAINING AND AGREEMENT

1. Name Robert G Jenkins A.U.? yes or Assoc. of _____

2. Type of Training:

Type	Where Trained	When	Formal Course	On Job
a. Principles and Practices of Radiation Protection	Iowa State University	1964	Yes (No)	(Yes) No
b. Radiaoactivity measurement, monitoring techniques, and instruments.	Iowa State University	1964 very little done	Yes (No)	(Yes) No
c. Mathematics and calculations basic to the use and measurement of RAM			Yes No	Yes No
d. Biological effects of radiation.	Iowa State University	1964	Yes (No)	(Yes) No

3. Formal Courses: List all courses pertaining to isotopes, atomic and nuclear structure, radiochemistry, radiobiology, etc.

Title of Course	Where Trained	When	Course Content
a.			
b.			
c.			
d.			

4. Experience: Actual use of isotopes

Isotope	Maximum Amount (mc)	Where Experience Gained	When	Type of Use
Tritium	10 - 15 mc	Iowa State University	1964-65	Autoradiography
"	5 mc	University of Wyoming	1970-71	"

5. Remarks:

6. Statement of Agreement: The below named individual signifies that he has read and is willing to abide by the Radiation Safety Manual governing the use of radioisotopes and other sources of ionizing radiation. The undersigned agrees to comply strictly with all such rules and regulations and hereby waives any right or recourse against the University of Wyoming for any damage whatsoever resulting from any failure to fully conform with said regulations.

Date 1/23/1972 Signed Robert G. Jenkins

7. Approved: H.P. ____/__/__ Committee ____/__/__

I will be glad to abide by Manual if one is available. please provide or advise of source.

Form RS-2, Dec. 1971

STATEMENT OF TRAINING AND AGREEMENT

1. Name Raymond Kunselman A.U.? _____ or Assoc. of _____

2. Type of Training:

Type	Where Trained	When	Formal Course	On Job
a. Principles and Practices of Radiation Protection	L.B.L. Physics 110C	~1966 ~1964	Yes No (Yes)	(Yes) No
b. Radiaoactivity measurement, monitoring techniques, and instruments.	Physics 110C	~1967	(Yes) No	Yes No
c. Mathematics and calculations basic to the use and measurement of (RAM).			Yes No	Yes No
d. Biological effects of radiation.	LBL outside reading	~1968	Yes (No)	Yes No

3. Formal Courses: List all courses pertaining to isotopes, atomic and nuclear structure, radiochemistry, radiobiology, etc.

Title of Course	Where Trained	When	Course Content
a. Physics 14, 129A, 129B	Berkeley, Univ. Calif.	~1962	Atomic structure, nuclear
b. 221A, 248	" " "	1966	nuclear structure &
c. Physics 110C fall	" " "		atomic structure
d.			

4. Experience: Actual use of isotopes

Isotope	Maximum Amount (mc)	Where Experience Gained	When	Type of Use
Am, Li, Be, C	.01	LBL Berkeley	~1967	Sources
Li, F, 131I			present	
Ti	.01	Univ. Wyoming	present	Foams

5. Remarks:

6. Statement of Agreement: The below named individual signifies that he ~~has read and~~ is willing to abide by the Radiation Safety Manual governing the use of radioisotopes and other sources of ionizing radiation. The undersigned agrees to comply strictly with all such rules and regulations and hereby waives any right or recourse against the University of Wyoming for any damage whatsoever resulting from any failure to fully conform with said regulations.

Date 4-22-74 Signed Raymond Kunselman

7. Approved: H.P. _____/___/___ Committee _____/_____/_____

University of Wyoming
Form RS-2
April, 1974

STATEMENT OF TRAINING AND AGREEMENT

Principle User X

Name John E. Boegs

Independent User _____ (Check one)

Supervised User _____

2. Type of Training:

Type	Where Trained	When	Formal Course	On Job
a. Principles and Practices of radiation Protection	Colorado State Univ.	Aug-Nov 72	(Yes) No	(Yes) No
b. Radioactivity measurement, monitoring techniques, and instruments.	"	"	(Yes) No	(Yes) No
c. Mathematical principles applicable to radiation measurements and dose	"	"	(Yes) No	(Yes) No
d. Biological effects of radiation.	"	"	(Yes) No	(Yes) No

3. Formal Courses: List all courses pertaining to isotopes, atomic and nuclear structure, radiochemistry, radiobiology, etc. (Use extra sheet if necessary)

Title of Course	Where Trained	When	Course Content
a.			
b. See Transcript			
c.			
d.			

4. Experience: Actual use of isotopes

Isotope	Maximum Amount (mc)	Where Experience Gained	When	Type of Use
C-14	Curies	CSU	1965	Research and
Cs-137	Curie Comp	CSU	1	Training
Ra-226	-	CSU	"	
Uran.	1000	CSU	1972	Uranium mine research
Tracer Lab	500	CSU Oak Ridge	1963-64 1968-72	

5. Remarks:

6. Statement of Agreement: The below named individual signifies that he has read and is willing to abide by the Radiation Safety Manual governing the use of radioisotopes and other sources of ionizing radiation. The undersigned agrees to comply strictly with all such rules and regulations and hereby waives any right or recourse against the University of Wyoming for any damage whatsoever resulting from any failure to fully conform with said regulations.

Date 9/1/75 Signed John E Boegs

7. Approved: H.P. John E Boegs 9/1/75 Committee 7/13/76

ersity

John Doerges

3. Formal Courses taken at Colorado State University pertaining to Health Physics

Course No.	Title	Credit
R550	Radiobiology	4
R741	Radiological Physics	3
R751	Radiation Dosimetry	4
R762	Radiation Surveillance	2
R795cx	Spec. Studies in Rad. Bio.	2
R862	Radiation Biology II	4
R863	Radiation Biology	4
R897	Sem. in Radiation Biol.	9
R899bx	Doc. Reas. in Rad. Bio.	16
AY705	Biol. Prep Elec Micro	2
AY707	Elec Micro Operation	3
BC501	Gen Biochem I	3
BC503	Gen Biochem II	4
BC505	Gen Biochem III	3
C665	Radiation Chemsitry	2
CS380	Mach. Comp. Data Pro.	3
C664	Radiochemistry	3
CS381	Programming Lang.	3
ME881	Thermo Aerosols	4
PH525	Intro. To Radioisot.	3
ST284	Intro. Comp. Methods	3
ST301	Stat. Meth I	4
ST302	Stat Meth II	3
St303	Stat Meth III	3
		94

Summer Institute Oak Ridge, Tennessee

Numerous weekend institutes at Argone Laboratories

Univeristy of Wyoming
Form RS-2
September, 1980

STATEMENT OF TRAINING AND AGREEMENT

Principle User_____

1. Name Carl E. Long Independent User_____ (Check One)

Supervised User_____

NONE

2. Type of Training:

TYPE	WHERE TRAINED	WHEN	FORMAL COURSE	ON JOB
A. Principles and Practices of radiation Protection	—	—	YES NO	YES NO
B. Radioactivity measurement, monitoring techniques, and instruments.	—	—	YES NO	YES NO
C: Mathematical principles applicable to radiation measurements and does	—	—	YES NO	YES NO
D. Biological effects of radiation	—	—	YES NO	YES NO

3. Formal Courses: List all courses pertaining to isotopes, atomic and nuclear structure radiochemistry, radiobiology, etc. (Use extra sheet if necessary) None

TITLE OF COURSE	WHERE TRAINED	WHEN	COURSE CONTENT
A. —			
B. —			
C. —			
D. —			

None

4. Experience: Actual use of isotopes

ISOTOPE	MAXIMUM AMOUNT (MC)	WHERE EXPERIENCE GAINED	WHEN	TYPE OF USE
—				
—				
—				

5. Remarks: No training, courses or experience in this area.

6. Statement of Agreement: The below named individual signifies that he has read and is willing to abide by the Radiation Safety Manual governing the use of radioisotopes and other sources of ionizing radiation. The undersigned agrees to comply strictly with all such rules and regulations and hereby waives any right or recourse against the University of Wyoming for any damage whatsoever resulting from any failure to fully conform with said regulations.

Date_____ Signed_____

File: _____

INVIVO RADIOACTIVE IODINE MEASUREMENT INFORMATION

1. **Name** _____ **Report No.** _____
2. **Date** _____ **Time** _____ **Next bioassay date range** _____
3. Type of Count _____ Time after Potential exposure _____ (hr., days)
   (Baseline, Routine, Special)
4. Gross Count Rate _____ (cpm)
5. Background Count Rate _____ (cpm)
6. Net Count Rate _____ (cpm)
7. *Baseline Count Rate _____ (cpm)
8. Net Count Rate above Baseline _____ (cpm)
9. Conversion Factor _____ (μCi/cpm)
10. Thyroid Burden (TB) _____ (μCi)
11. Last TB _____ _____ (μCi)
12. ΔTB _____ (μCi)
13. **Elasped Time _____ (days)
14. **T_{eff} _____ (days)

*Use average nonexposed baseline if baseline > nonexposed baseline + 2s.
**Only if ΔTB is negative.

15. Enter appropriate information in **Iodine Report Log Book** and **Appointment Book**.
16. Iodine Isotope _____
    (I-125 or I-131)
17. Thyroid burden greater than 0.12 μCi I-125 or 0.04 μCi I-131? (yes or no) _____.
18. If answer to 12 is 'yes' then continue, if 'no' go to 20.
19. A. Carry out investigation of operations and conduct in-plant survey of area.
    B. Should worker be restricted from further exposure? (yes or no) _____.
    C. List corrective actions on back of this sheet.
    D. Set date (within 2 weeks) for repeat bioassay.
    E. NRC report required? (yes or no) _____, if 'yes' date filed _____ (attach copy).
    F. Thyroid burden exceeds 0.5 μCi of I-125 or 0.14 μCi of I-131? (yes or no) _____, (if 'yes' continue, if 'no' go to 20).
    G. Refer the case to appropriate medical/health physics consultation for recommendations regarding therapeutic procedures that may be carried out to accelerate the removal of radioactive iodine from the body.
    H. Carry out repeated measurements at approximately 1-week intervals at least until the thyroid burden is less than 0.12μCi of I-25 or 0.04 μCi of I-131. If there is a possibility of longer-term compartments containing I-125 or I-131 that require evaluation continue measurements as long as necessary to ensure that appreciable exposures to these other compartments do not go undetected.
20. Is report completed? (yes or no) _____.
21. Comments:

No.[2] _____

EXHIBIT C

CHANGE OF RADIOACTIVE INVENTORY, DELETION[1]

(One form for each radionuclide)

To: Radiation Safety Office from _____ _____
(user)

Mode of Deletion (circle no.)

1. Radioactive waste
2. Shipment outside UW[3]
3. Decay (show calculations on back)
4. Other (specify) _____

Method of Disposal (circle no.)

1. RSO pickup
2. Sanitary sewer
3. Disposal site
4. Release to atmosphere
5. Other (specify) _____

Nuclide _____ Received by _____ Date ___/___/___

Activity _____ Recorded into RSO inventory by _____ ___/___/___

Inorganic/organic _____ Burial Data Activity as of Date

pH (acid/base) _____ ___ _____ ___/___/___

_____ ___/___/___

Present activity charged to user _____ (mCi) _____ ___/___/___

New activity charged to user _____ (mCi) _____ ___/___/___

Burial Date ___/___/___

[1] Form to be completed by user
[2] Number assigned by RSO
[3] Must be processed through RSO

Original (white) to RSO, Duplicate (pink) to user.

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Number[2] _____

CHANGE OF RADIOACTIVE INVENTORY, INTRA UW TRANSFER[1]

EXHIBIT C

From: _____ (user) To: _____ (user)

Nuclide _____

Activity _____ (mCi)

Chemical formula _____

Physical form _____

	Originator	Receiver
Present activity charged to user	_____ (mCi)	_____ (mCi)
New activity charged to user	_____ (mCi)	_____ (mCi)

Date

Transfer approved by RSO by _____ ___/___/___

Radionuclide received by _____ ___/___/___

Recorded in RSO inventory by _____ ___/___/___

[1] Transfer must be approved by RSO before physical transfer.
[2] Number assigned by RSO.

Original (white) to RSO, first copy (yellow) to orginator, second copy (pink) to receiver.

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No._____

EXHIBIT C

CHANGE OF RADIOACTIVE INVENTORY, ADDITION

To: _____ from Radiation Safety Office

Requisition No._____ Date_____ Vendor_____

Leak Test: Pos ☐ Neg ☐ by_____

Nuclide _____

Activity _____ (mCi)

Chemical formula_____

Physical form _____

Dates

Received by RSO _____/ /_____

Recorded in RSO inventory _____/ /_____

by_____. (initials)

Present activity charged to user_____mCi

New activity balance_____mCi

Received by _____ _____/ /_____

Original (white) to RSO, Duplicate (pink) to user.

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