030-20385

NRC FORM 313
(1-84)
10 CFR 30, 32, 33, 34, 35 and 40

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED BY OMB
3150-0120
Expires: 5-31-87

APPLICATION FOR MATERIAL LICENSE

L+L 23224

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.

FEDERAL AGENCIES FILE APPLICATIONS WITH:

U.S. NUCLEAR REGULATORY COMMISSION
DIVISION OF FUEL CYCLE AND MATERIAL SAFETY, NMSS
WASHINGTON, DC 20555

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS, IF YOU ARE LOCATED IN:

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

U.S. NUCLEAR REGULATORY COMMISSION, REGION I
NUCLEAR MATERIAL SECTION B
631 PARK AVENUE
KING OF PRUSSIA, PA 19406

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

U.S. NUCLEAR REGULATORY COMMISSION, REGION II
MATERIAL RADIATION PROTECTION SECTION
101 MARIETTA STREET, SUITE 2900
ATLANTA, GA 30323

IF YOU ARE LOCATED IN:

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

U.S. NUCLEAR REGULATORY COMMISSION, REGION III
MATERIALS LICENSING SECTION
799 ROOSEVELT ROAD
GLEN ELLYN, IL 60137

ARKANSAS, COLORADO, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, SOUTH DAKOTA, TEXAS, UTAH, OR WYOMING, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
MATERIAL RADIATION PROTECTION SECTION
611 RYAN PLAZA DRIVE, SUITE 1000
ARLINGTON, TX 76011

ALASKA, ARIZONA, CALIFORNIA, HAWAII, NEVADA, OREGON, WASHINGTON, AND U.S. TERRITORIES AND POSSESSIONS IN THE PACIFIC, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION V
MATERIAL RADIATION PROTECTION SECTION
1450 MARIA LANE, SUITE 210
WALNUT CREEK, CA 94596

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 JURISDICTION.

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

- [X] A. NEW LICENSE
- [ ] B. AMENDMENT TO LICENSE NUMBER _____
- [ ] C. RENEWAL OF LICENSE NUMBER _____

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include Zip Code)*

Arctic Investigation Laboratory
Center for Infectious Diseases
Centers for Disease Control
225 Eagle Street, Anchorage, Alaska 99501

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

Arctic Investigation Laboratory, Center for Infectious Diseases, Centers for Disease Control
225 Eagle Street
Anchorage, Alaska 99501

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Alan J. Parkinson, Ph.D.

TELEPHONE NUMBER

(907)271-4011

SUBMIT ITEMS 5 THROUGH 11 ON 8½ 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 AND 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

AMOUNT ENCLOSED $

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, 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.

SIGNATURE–CERTIFYING OFFICER	TYPED/PRINTED NAME	TITLE	DATE
	Joseph M. Posid	Assistant to the Director for Program and Operations	03/22/85

14. VOLUNTARY ECONOMIC DATA

a. ANNUAL RECEIPTS

- [ ] <$250K
- [ ] $250K–500K
- [ ] $500K–750K
- [ ] $750K–1M
- [ ] $1M–3.5M
- [ ] $3.5M–7M
- [ ] $7M–10M
- [ ] >$10M

b. NUMBER OF EMPLOYEES *(Total for entire facility excluding outside contractors)*

c. NUMBER OF BEDS

d. WOULD YOU BE WILLING TO FURNISH COST INFORMATION *(dollar and/or staff hours)* ON THE ECONOMIC IMPACT OF CURRENT NRC REGULATIONS OR ANY FUTURE PROPOSED NRC REGULATIONS THAT MAY AFFECT YOU? *(NRC regulations permit it to protect confidential commercial or financial–proprietary–information furnished to the agency in confidence)*

- [ ] YES
- [ ] NO

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	COMMENTS	APPROVED BY
170.11A5			FEE EXEMPT 70172	

AMOUNT RECEIVED | CHECK NUMBER | DATE

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REG5 LIC30
50-23224-01 PDR

See Continuation on the Reverse

PRIVACY ACT STATEMENT

Pursuant to 5 U.S.C. 552a(e)(3), enacted into law by section 3 of the Privacy Act of 1974 (Public Law 93-579), the following statement is furnished to individuals who supply information to the Nuclear Regulatory Commission on NRC Form 313. This information is maintained in a system of records designated as NRC-3 and described at 40 Federal Register 45334 (October 1, 1975).

1. **AUTHORITY:** Sections 81 and 161(b) of the Atomic Energy Act of 1954, as amended (42 U.S.C. 2111 and 2201(b)).

2. **PRINCIPAL PURPOSE(S):** The information is evaluated by the NRC staff pursuant to the criteria set forth in 10 CFR Parts 30, 32, 33, 34, 35 and 40 to determine whether the application meets the requirements of the Atomic Energy Act of 1954, as amended, and the Commission's regulations, for the issuance of a radioactive material license or amendment thereof.

3. **ROUTINE USES:** The information may be (a) provided to State health departments for their information and use; and (b) provided to Federal, State, and local health officials and other persons in the event of incident or exposure, for their information, investigation, and protection of the public health and safety. The information may also be disclosed to appropriate Federal, State, and local agencies in the event that the information indicates a violation or potential violation of law and in the course of an administrative or judicial proceeding. In addition, this information may be transferred to an appropriate Federal, State, or local agency to the extent relevant and necessary for an NRC decision or to an appropriate Federal agency to the extent relevant and necessary for that agency's decision about you.

4. **WHETHER DISCLOSURE IS MANDATORY OR VOLUNTARY AND EFFECT ON INDIVIDUAL OF NOT PROVIDING INFORMATION:** Disclosure of the requested information is voluntary. If the requested information is not furnished, however, the application for radioactive material license, or amendment thereof, will not be processed. A request that information be held from public inspection must be in accordance with the provisions of 10 CFR 2.790. Withholding from public inspection shall not affect the right, if any, of persons properly and directly concerned need to inspect the document.

5. **SYSTEM MANAGER(S) AND ADDRESS:** U.S. Nuclear Regulatory Commission
Director, Division of Fuel Cycle and Material Safety
Office of Nuclear Material Safety and Safeguards
Washington, D.C. 20555

5. Radioactive Material

Element/Mass Number	Chemical/Physical form	Maximum Amount
1. I-125	inorganic	1mCi
2. I-125	Iodinated Antibody	5mCi
3. H-3	organic	5mCi
4. Cr-51	inorganic	1mCi
5. P-32	inorganic	1mCi

70172

6. Purposes for which licensed material will be used.

1. I-125: Invitro labeling of antibody/proteins for immunoassay.

2. I-125: Invitro use of commercial (Abbott) immunoassay.

3. H-3: Invitro assay of lymphocyte function.

4. Cr-51: Invitro assay of cytotoxic lymphocyte activity.

5. P-32: Invitro assay of DNA:DNA or DNA:RNA hybridization.

7. Individuals responsible for radiation safety, training and experience.

Alan J. Parkinson, Ph.D.

Training:

Formal: 1972 University of Otago Dunedin in New Zealand Lecture and two practical laboratory periods covering the theory and use of radioisotopes.

Informal: 1972-74 Honors thesis. "Labeling immunoglobulin with iodoacetic acid-2-H3.

1974-76 Ph.D. Thesis "Radioimmunoassay of antiviral antibody".

1977-79 Postdoctoral Fellow, Departments of Microbiology & Immunology and Medicine University of Oklahoma Health Sciences Center. Use of H-3 and I-125 for lymphocyte stimulation and antiviral antibody and antigen radioimmunoassay.

1979-84 Staff Scientist Oklahoma Medical Research Foundation.

1981-1984 Oklahoma Health Sciences Center Radioactive material license holder 81VU03. (Copy attached)

Publications using Radioisotopes:

PUBLICATIONS:

A. Journal Articles:

1. Parkinson, A.J., and Kalmakoff, J.: 1973. Labeling of immunoglobulins using (2-^{3}H)-iodoacetic acid. University of Otago Med. School. 51:60-61.

2. Kalmakoff, J., and Parkinson, A.J.: 1974. Labeling antibodies with H^{3}-acetate. Appl. Microbiol. 28:624-626.

3. Bilimoria, S., Parkinson, A.J., and Kalmakoff, J.: 1975. Comparative study ^{125}I and ^{3}H-acetate labeled antibodies in detecting irridescent viruses. Appl. Microbiol. 28:133-137.

4. Parkinson, A.J., and Kalmakoff, J.: 1976. Tritium labeling of immunoglobulins with iodoacetic-acid. Int. J. Appl. Rad. Isotopes. 26:367-371.

5. Parkinson, A.J., and Kalmakoff, J.: 1976. Detection of virus specific immunoglobulins using doubly labeled fluorescein ^{125}I antibody. J. Clin. Microbiol. 3:637-639.

6. Kalmakoff, J., Parkinson, A.J., Crawford, A. and Williams, B.R.G.: 1977. Solid-phase radioimmunoassay using labeled antibody: A conceptual framework for designing assay. J. Immunol. Methods 14:73-84.

7. Parkinson, A.J., Muchmore, H.G., and Scott, E.N.: 1981. Identification of parainfluenzavirus isolates recovered from subjects at South Pole during the winter of 1978 by radioimmunoassay and enzyme immunoassay. Antarctic J. U.S. 16:183-184.

8. Parkinson, A.J., Scott, E.N., and Muchmore, H.G.: 1981. Purification of labeled antibody by minicolumn gel centrifugation. Anal. Biochem. 118(2):401-404.

9. Parkinson, A.J., Scott, E.N., and Muchmore H.G.: 1982. Comparison of a solid-phase enzyme immunoassay and radioimmunoassy using a double labeled enzyme ^{125}I antibody. J. Clin. Lab. Automation. 2(3):177-182.

10. Parkinson, A.J., Scott, E.N., and Muchmore, H.G.: 1983. Rapid preparation and purification of alkaline phosphatase and ^{125}I labeled antibody by minicolumn gel centrifugation chromatography. J. Chromatog. 254:219-228.

0347D

OKLAHOMA HEALTH CENTER

RADIOACTIVE MATERIAL LICENSE

License No. 81VU03

Expiration Date: January 15, 1982

This license is issued by the Radiation Safety Committee under the authority delegated by the US Nuclear Regulatory Commission. this authority is contained in and relates to US NRC Licenses:

35-00526-04	V	Oklahoma City Veterans Administration Hospital
35-03176-01	U	University of Oklahoma Health Sciences Center
35-15970-01	C	Oklahoma Children's Memorial Hospital
35-16329-01	T	University Hospital & Clinics
35-16329-02	H	University Hospital & Clinics

Person Licensed Alan J. Parkinson, Ph.D.

Office Location Dept. of Medicine Telephone Ext. 2133 or VA 491

RADIOACTIVE MATERIAL	CHEMICAL/PHYSICAL FORM	POSSESSION LIMIT
^{3}H	Organic	10 mCi
14C	Organic	5 mCi
^{125}I	Inorganic	1 mCi

Authorization:

Hazard Class II

In Vitro X Animals ____ Human, Routine ____ Human NR ____

Locations:							
	Room 1060	Bldg. BMSB	Room 301	Bldg. VAMC
	Room 1040	Bldg. BMSB	Room 306	Bldg. VAMC
	Room 1036	Bldg. BMSB	Room 317	Bldg. VAMC
	Room ____	Bldg. ____	Room B808	Bldg. VAMC

Chairman, Radiation Safety Committee 10/17/79

OKLAHOMA HEALTH CENTER

RADIOACTIVE MATERIAL MINI-LICENSE

AMENDMENT

MINI-LICENSE # 81VU03

PERSON LICENSED: Alan J. Parkinson

DATE OF AMENDMENT: May 18, 1981

RADIOACTIVE MATERIAL	CHEMICAL/PHYSICAL	POSSESSION LIMIT
INCREASE		
I-125		5 mCi

OTHER CONDITIONS:

This amendment is part of your original mini-license and must be attached to it. The entire license including any amendments must be renewed prior to the original expiration date in order to remain in force.

Chairman and/or Vice Chairman, Radiation Safety Committee

70172

OKLAHOMA HEALTH CENTER

RADIOACTIVE MATERIAL MINILICENSE

AMENDMENT

MINILICENSE NO: 81VU03

MINILICENSE HOLDER: Dr. Alan J. Parkinson

DATE OF AMENDMENT: April 5, 1982 EXPIRATION DATE: April 15, 1983

RADIOACTIVE MATERIAL	CHEMICAL/PHYSICAL	POSSESSION LIMIT
ADD		
P-32	Inorganic	10 mCi

OTHER CONDITIONS:

NEW PERSONNEL: Harold G. Muchmore, M.D.; Charles Stewart, Richard Ditmars, Nan Scott, Ph.D., H. G. Jensen

This amendment is part of your original minilicense and must be attached to it. The entire license including any amendments must be renewed prior to the original expiration date in order to remain in force.

Chairman and/or Vice Chairman
Radiation Safety Committee

70172

Approved: 11/81

OKLAHOMA HEALTH CENTER

RADIOACTIVE MATERIAL MINILICENSE

AMENDMENT

MINILICENSE NO: 81VU03

MINILICENSE HOLDER: Alan J. Parkinson, Ph.D.

DATE OF AMENDMENT: November 9, 1983 EXPIRATION DATE: _____

RADIOACTIVE MATERIAL	CHEMICAL/PHYSICAL	POSSESSION LIMIT

OTHER CONDITIONS:

NEW ROOM: 1G114, VAMC
ROOM DELETED: B808, VAMC
NEW PERSONNEL: E. Nan Scott, Ph.D.; Douglas P. Fine, M.D.; Kyle Hoskins

This amendment is part of your original minilicense and must be attached to it. The entire license including any amendments must be renewed prior to the original expiration date in order to remain in force.

_____

Chairman and/or Vice Chairman
Radiation Safety Committee

70172

Approved: 11/81

OKLAHOMA HEALTH CENTER

RADIOACTIVE MATERIAL MINILICENSE

AMENDMENT

MINILICENSE NO: 81VU03

MINILICENSE HOLDER: Alan J. Parkinson

DATE OF AMENDMENT: March 6, 1984 EXPIRATION DATE: March 15, 1985

RADIOACTIVE MATERIAL	CHEMICAL/PHYSICAL	POSSESSION LIMIT

OTHER CONDITIONS:

PERSONNEL DELETED: Douglas P. Fine, M.D. and H. G. Jensen
ROOMS ADDED: 311, 310, and 1G114 - VAMC
ROOMS DELETED: 317 and B808 - VAMC

This amendment is part of your original minilicense and must be attached to it. The entire license including any amendments must be renewed prior to the original expiration date in order to remain in force.

Chairman and/or Vice Chairman
Radiation Safety Committee

70172

Approved: 11/81

8. Training of individuals working in restricted areas:

1. Training programs are made available annually within CDC to all personnel using radioisotopes (Radiation Safety in the Laboratory 9007-C). In addition to formal training, hands on training in radiation safety and proper handling of radioisotopes as per the attached protocol will be provided.

2. The following protocol will be used in my laboratory for instruction of new personnel and day to day use of radioisotopes.

WORKING RULES FOR RADIOACTIVE COMPOUNDS

General

1. Film Badges. These contain photographic film which is blackened depending on the amount of energy absorbed and this is correlated with the dose of radiation. Film badges will be worn at all times when working with radioisotopes or in areas for radioisotope use. Wearing a film badge also provides a psychological reminder to use extra care in handling radioisotopes; the film badge will be changed once a month for monitoring.

2. Containment. There must be a restricted area in the laboratory which is clearly marked and where the radioisotopes are handled. Use trays (metal or plastic) lined with paper towels, or if available, perspex front cabinets of fume hoods. Keep radioisotope solutions in minimum volumes and preferably in double containers. It should be remembered that ordinary glassware or polyethlene will absorb most ß particles. As a result, an open vessel such as a beaker may be safe when held in the hand, but the area above the open top may be dangerous. All containers or apparatus being used should carry the radioactive -warning- yellow- sticky tape. If a spill on a lab bench occurs, wipe with cotton wool and place in a plastic bag for disposal (see monitoring).

3. Good Housekeeping. Keep work areas clear of nonessential equipment and glassware; have a plastic bag ready for disposal of wet paper towels, tissue or disposable solid wastes; change lab coats at least once a week.

4. Personnel Protection. In all work with radioisotopes rubber or disposable plastic gloves must be worn; leave them inside out on removal. Minimize radiation exposure by using forceps or tongs where practicable. Pipetting by mouth is dangerous, use rubber bulbs, or disposable syringe.

5. Ingestion of radioisotopes emitting low energy beta or gamma rays presents the greatest hazard. Inhalation is minimized by adequate ventilation and the use of fume cupboards or portable cabinets with transparent fronts. The skin is an important barrier against ingestion. It is generally recommended that anyone with cut or damanged skin should avoid use of radioisotopes, but this must be treated reasonably. If skin contamination occurs, wash with toilet soap and plenty of water. Do not scrub or abrade the skin. If ingestion is suspected, this can be monitored by testing urine or breath moisture samples using scintillation counting.

6. There must be no smoking, eating or drinking in a radioisotope lab.

7. Personal responsibility is the major factor in keeping radiation exposure to minimum levels.

Disposal of Wastes

As far as practicable, keep volumes reasonably small. This simplifies shielding, reduces work area, and makes waste disposal and cleaning easier.

8. Solid Waste. Place in covered container provided in room. These will be monitored before disposal.

9. Glass Ware. Disposal is more difficult and contaminated glassware should be kept to a minimum. Sometimes repeated rinsing may remove sufficient activity to permit reuse. However, one should always check for cross-contamination (in the radioactive sense) when re-using glassware. Store such waste as glassware, needles, metal fittings in a metal container with close-fitting lid. Arrangements will be made for disposal of such material.

10. Liquids. Water soluble liquids can be disposed of by flushing down the sink provided the activities are low e.g. isotopes can be flushed down the sink if diluted with running water, but must not exceed 100μCi/L of tap water.

11. Radioactive Decay. For significantly high activities, and depending on the radioisotope concerned, wastes may be stored until physical decay reduces activities to background levels permitting disposal as above or re-use. Storage should be in containers which are well shielded.

Monitoring

12. Laboratory benches, hoods and other working surfaces should be regularly monitored with a portable Geiger counter equipped with a ß probe. Activity levels below 50 cpm are permissible. Occasional activity levels up to 1000 cpm are permissible provided the level cannot be reduced by washing and can be shown safe by wipe monitoring method. However, as a rough guide, anything giving 10X background cannot be ignored since it is possible to contaminate low-activity samples.

The wipe method is useful for low-energy radiations such as ^{3}H, ^{14}C, ^{131}I, etc. A piece of clean, lightly oiled filter paper (Whatman No. 1) 1 in. diameter is rubbed over the bench top or equipment for a path length of about 36 in.

This is subsequently counted in a scintillation counter. The counts are recorded.

In checking hands or clothes, a counting rate of 100 cpm is not tolerated and the hands should be washed and lab coat changed. Contaminated lab coats should be disposed of as per solid waste. Great care must be taken to avoid contaminating the portable counter itself.

13. Units of radioactivity. The basic unit of radioactivity, the curie was originally defined as the number of disintegrations per second emitted from 1 gram of radium (approximately 3.7 x 10^{10}/Sec). This unit, now is defined as that quantity of radioactive substance which emits 3.7 x 10^{10} disintegrations per second. The millicurie, mc (3.7 x 10^{7} disintegrations per second) and the microcurie, μc (3.7 x 10^{4}) disintegrations per second or 2.2 x 10^{6} counts per minute, cpm are useful subdivisions of the curie. The units of radioactivity define the rate of disintegration, and not the amount of material. For any particular isotope, however, the rate of disintegration is determined by the total number of radioactive atoms present and by the disintegration constant of the isotope; therefore, the rate can be directly related to the amount of labeled material. This relationship is termed specific radio-activity. The particular units of specific radioactivity depend on the units of measurement available; the most commonly used expressions are:

millicuries/millimole (mc/mmole), millicuries/gram (mc/g), counts per minute/milligram (cpm/mg).

14. Beta Shielding. B^- particles have a finite range and can be shielded by using moderate thickness of material of low atomic number (e.g. "perspex"). If heavy metals are used "bremsstrahlung" are produced in the shielding material. These secondary radiations are γ rays, X-rays, and other electro magnetic radiations. The thickness of shielding depends on the beta energy. The following table gives the thickness in millimeters (mm) appropriate to various energies and materials.

E_{max} MeV

	0.5	1	2	3
"Perspex"	2	4	7	12
Glass	1	2	4	7
Wood	4	7	14	24

Since there are no pure beta emitters with energies greater than 2MeV, a 0.5 inch thick "Perspex" or its equivalent is ample for shielding. Ordinary glassware is sufficient shielding for energies below 1 MeV. ^{32}P will produce a significant amount of ß particles to penetrate ordinary

glassware, however, ^{3}H and ^{14}C can be considered to be shielded by orginary glassware.

15. How safe is "safe". Provided that proper precautions are observed, radioactive materials present less hazard in use than do many substances commonly used in the lab. Nevertheless, the fixing of safe limits of exposure is still very difficult and has been done very cautiously. There are three units of radiation dose in common usage.

    (i) Roentgen (R). The unit of exposure dose of x- or γ radiation. It expresses the capacity of a given beam of radiation to ionize air, the corpusular emission per .001293 grams of air that produces one electrostatic unit of electricity of either sign is one R.

    (ii) rad. The rad is a measure of absorbed dose in a specified material and is equal to 100 ergs per gram. 1 roentgen in air is almost equal to 1 rad in normal body tissue.

    (iii) rem. The biological effects of equal absorbed doses, in rads, of different kinds of radiation are not the same. Rem is defined as the absorbed dose multiplied by a quality factor (QF) which for x-rays, γ-rays, β-particles and positrons which biologists are likely to encounter the QF is 1. Rads and rems for our purposes are equivalent terms.

Some guide lines have been provided for external radiation.

Maximum Permissible Doses for Various Parts of the Body

Part of the body irradiated	Maximum Permissible Dose (rems)	
	Per 3 month period	Per Year
Gonads and blood-forming organs	1.25	5
Skin - other than hands and forearms, feet and ankles	7.5	30
Hands, forearms, feet and ankles	18.75	75

A commonly used nuclide which presents an external radiation hazard is P-32. The lead pot in which P-32 normally is stored provides good shielding, however, over an open solution of P-32 with a concentration of 1mCi/ml, the dose rate at the surface is about 13 rems per minute. It is necessary to work quickly in a fume hold and with adequate shielding when using this nuclide. A dilution to a working stock of 10 or 100μ Ci/ml greatly reduces the hazard. At 10 cm the dose is 3.1 rad/hr.

Estimation of dose rates at 10 cm from source can be made using the following expressing: (for only those ß emitters of energy comparable to P-32) dose rate = 3100 Ci rads/hour.

The hazards from γ-emitting radioisotopes is comparably higher since it is more difficult to adequately shield. Shielding is most economically done with concrete. Small containers can be shielded with lead pots or by the construction of lead castles from lead bricks. The dose rate from a γ-emitting radioisotope depends on the strength of the source, the distance from the source and the energy of the γ-radiation, the following expression can be used to calculate the dose rate.

$$\text{dose rate} = \frac{0.5 \text{ Ci} \times \text{energy}}{\text{distance}} \text{ rads/hour}$$

Where Ci is the strength of the source in curies, the energy is the total energy of γ-radiation in MeV per transformation and the distance is in meters from the source, e.g. ^{131}I 1 meter from a Ci source, the dose rate is 0.21 rad/hr.

16. Minimum requirements.

If you are working with radioactive compounds the following is required for radiological safety.

(1) A large plastic garbage can (dustbin) with a tight fitting lid for combustible wastes.

(2) A portable wooden or perspex cabinet for beta shielding while working with P-32.

(3) A supply of disposable plastic gloves and bags for handling and disposal respectively.

(4) A plastic "drip" tray(s) for lab bench working areas.

(5) Access to a portable radiation monitor with ß probe when working with P-32.

(6) For dispensing of material from concentrated stock solutions, you require disposable plastic syringes and needles, or rubber bulbs, or rubber tubing lead to a pipette.

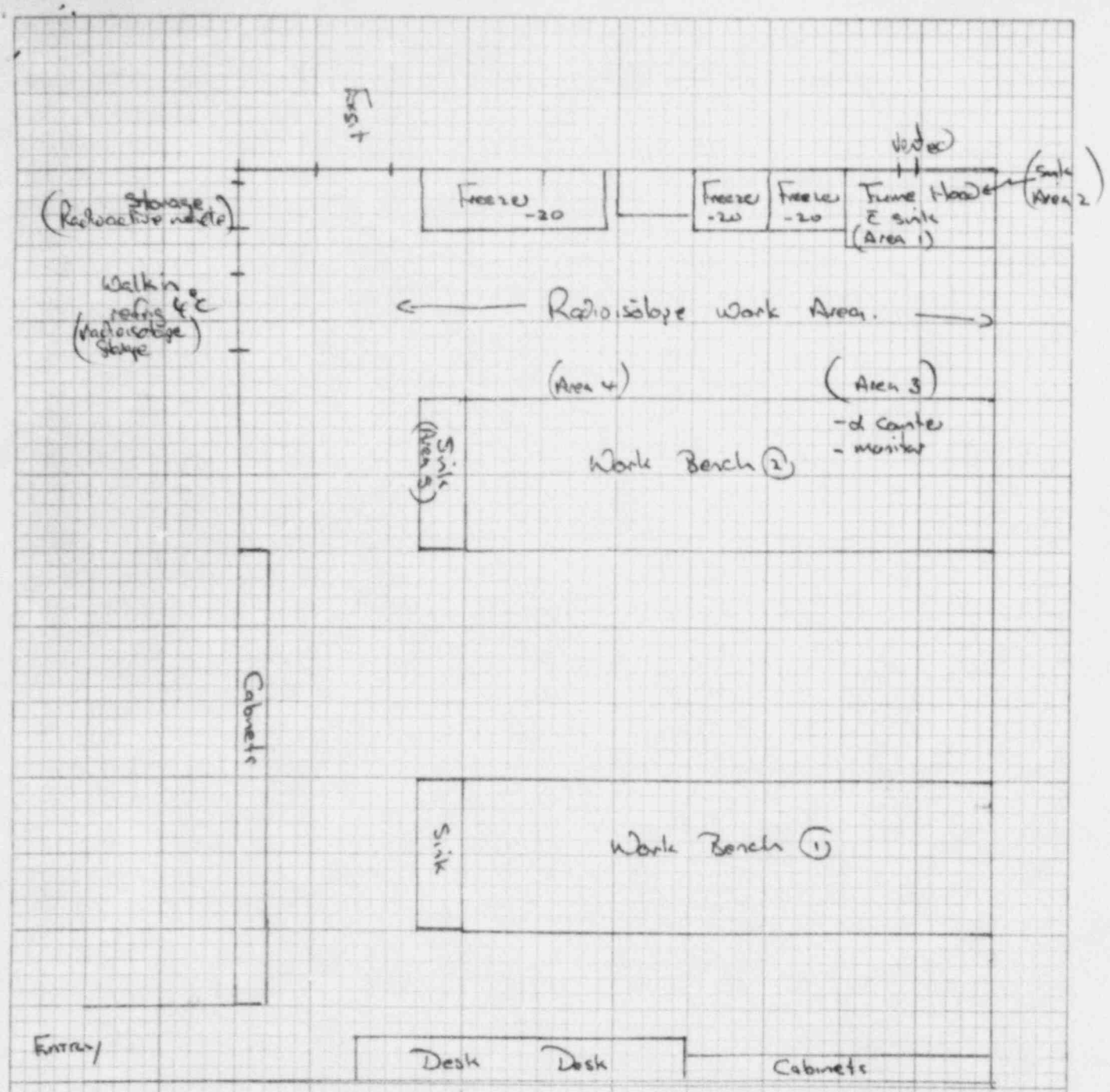
(7) Radioactive -warning-yellow-sticky-tape.

(8) Provisions for decontaminating of glassware of pipettes used.

(9) Common sense.

9. Facilities and Equipment

The laboratory contains 730 square feet, with fume hood vented to the exterior, 2 sinks, one to be designated for radioisotope disposal direct to the sewage system (see diagram) the area indicated will be used only for radioisotopes. Instrumentation includes a Logic series gamma counting system (model 211). Calibration of the instrument has been carried out using Ba-133 and Cs-137 according to the manufacturer's instructions. Calibration curves for this machine are attached. Calibrations using other radioisotopes will be carried out as required. Monitor to be purchased: Victoreen Model 493 survey meter with a model 489-35 GM probe. A liquid scintillation counter will be purchased as required for H-3 assay work. A refrigerator and a marked lockable metal storage cabinet will be used for storage of radioisotopes, prior to use, and radioisotopes to be disposed of respectively.

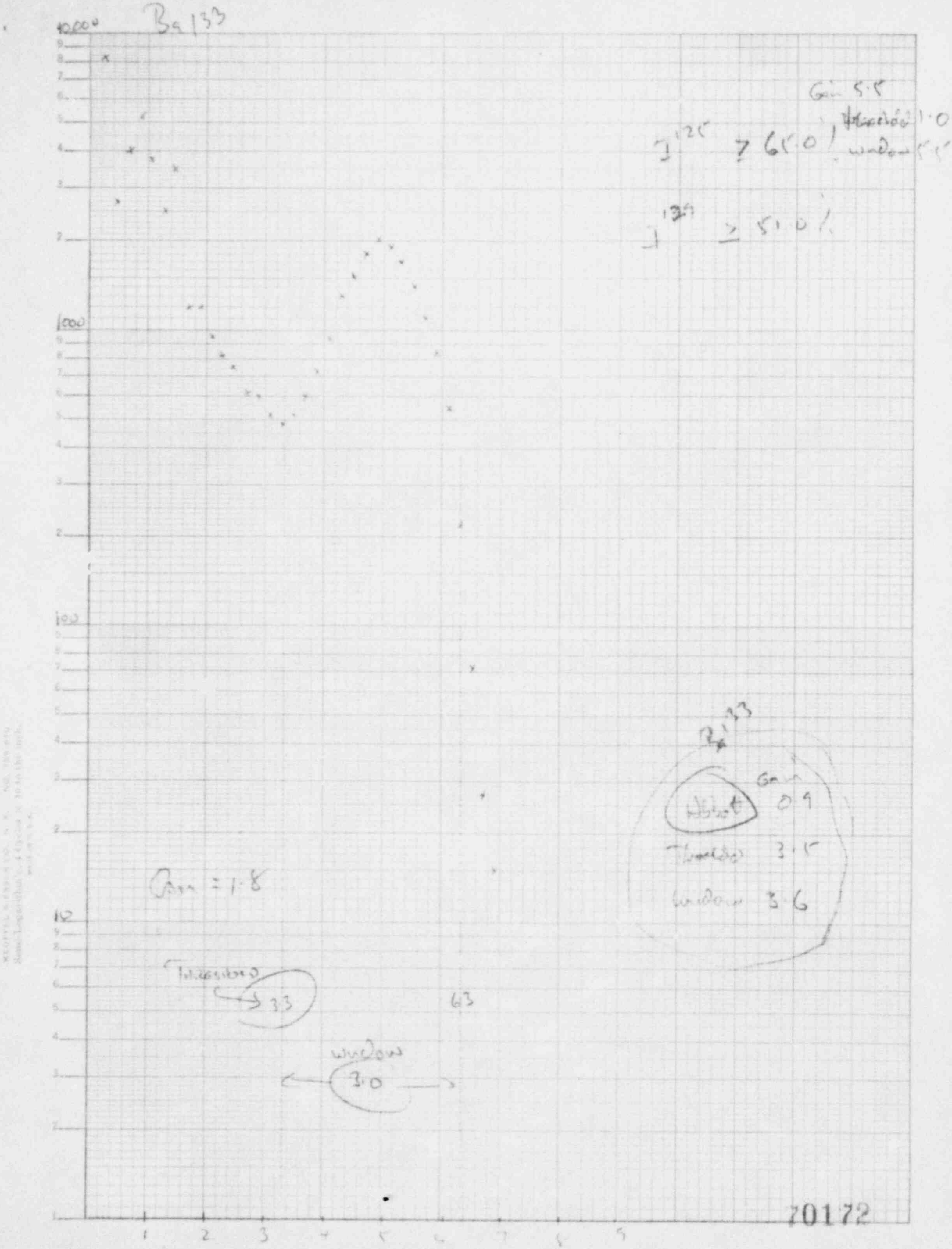

Exit
Vented
Freezer -20
Freezer -20
Freezer -20
Fume Hood
& sink
(Area 1)
(Sink Area 2)
storage (Radioactive waste)
Walk in refrig 4°C (Radioisotope storage)
Radioisotope Work Area.
(Area 4)
(Area 3)
- d counter
- monitor
Sink (Area 5)
Work Bench (2)
Cabinets
Sink
Work Bench (1)
Entry
Desk
Desk
Cabinets

70172

Monitoring

Date	Isotope	Background	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6

70172



10,000
Ba 133
Gain 5.5
window 5.5
1000
100
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Gain
0.9
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Gain = 1.8
10
3.3
63
window
3.0
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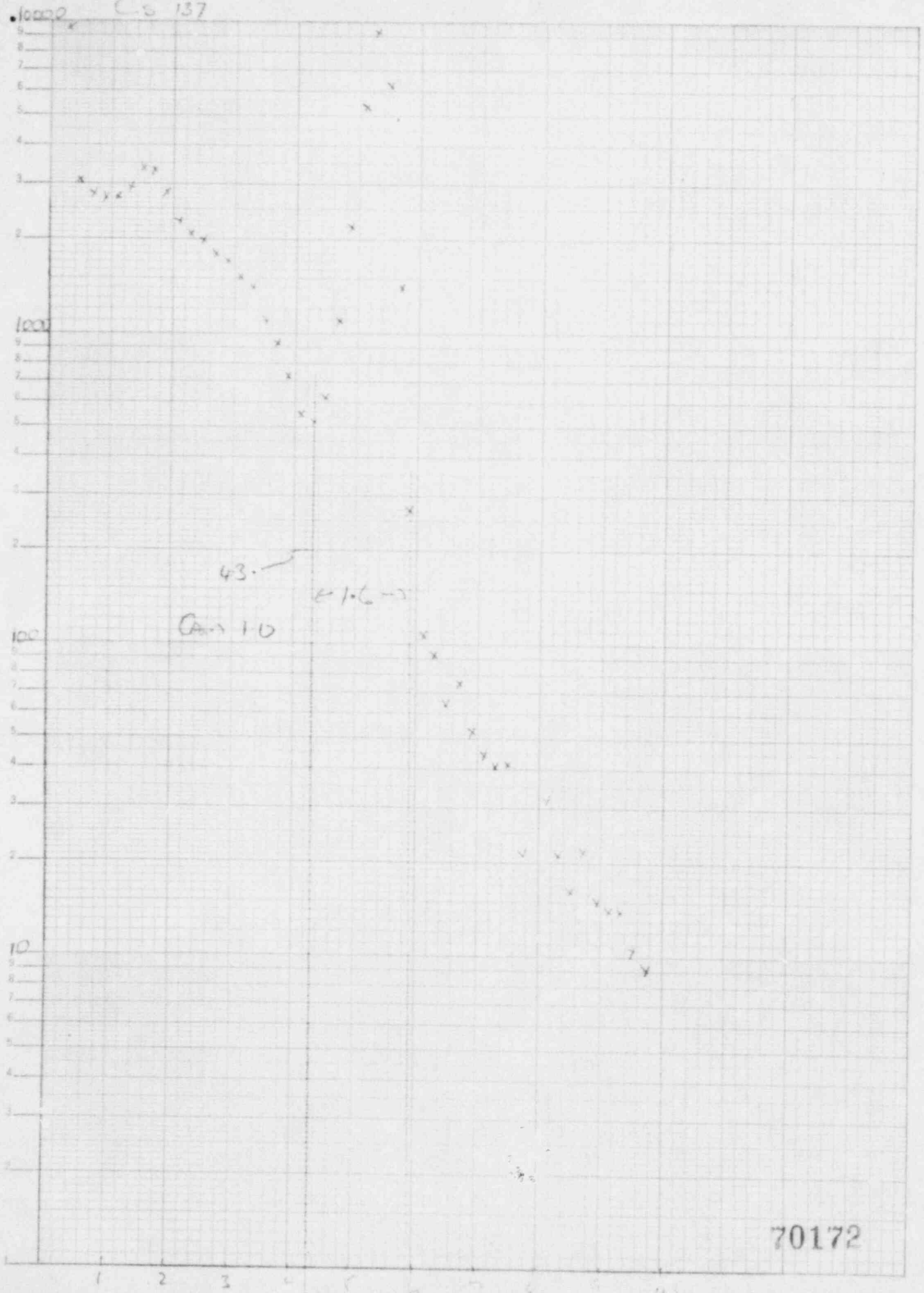
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10. Radiation safety:

1. Inform lab personnel about the correct laboratory procedures when using radioisotopes, and provide supervision to see that these procedures are carried out.

2. Instruct lab personnel in proper monitoring techniques for the areas in which radiosotopes are used and sure that instrumentation is properly calibrated.

3. Instruct lab personnel in the proper use of thermo-luminescent dosimeters (TLDs R.S. Landauer & Co.) and see that these are worn during all radiologic procedures.

4. Keep complete records of all radioisotopes received, used and disposed of (forms attached).

5. Provide appropriate liquid and solid waste containers.

6. Have radioactive waste properly packaged and labeled for removal to storage area.

7. Properly label and secure all radioactive materials. Lock laboratories and storage cabinets, to prevent theft or accidental use.

8. Contain, decontaminate, and monitor any spill. Adequate records of such events will be maintained.

9. Maintain records of personnel TLD results. Identify personnel achieving high levels. Determine source and correct procedures as required.

10. Maintain exposes as low as reasonably achievable through lab procedures, shielding and use of gloves and protective clothing.

11. Use all unsealed sources in a hood.

12. Perform physical inventory every three months of all radioisotopes used.

ISOTOPE _____ ACTIVITY _____ mCi/uCi DATE RECEIVED _____

CHEMICAL FORM _____ LOT # _____

CALIBRATION DATE _____ SUPPLIER _____

DATE	ACTIVITY mCi/uCi Removed	Remaining	USE	DISPOSAL	INITIALS

Date and Method of Final Disposal: _____

70172

Approved: 06/82

11. Waste Management:

1. Liquid waste. Low levels (less than 100μCi/L) in water soluble solutions will be disposed of into the sewage system. Toluene containing radioisotopes will be in marked containers stored and held for disposal.

2. Solid waste. Solids contaminated with I-125, P-32, Cr-51 will be stored for decay, monitored to ensure decay and disposed as normal trash. Solids contaminated with H-3 will be stored in marked containers and held for disposal.

Disposal: State of Washington low level radioactive waste disposal site Richland, Washington. Permit pending.