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

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)*

Mount Vernon Nazarene College
800 Martinsburg Road
Mount Vernon, Ohio 43050

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

Mount Vernon Nazarene College
800 Martinsburg Road
Mount Vernon, Ohio 43050

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Joseph H. Lechner

TELEPHONE NUMBER: 614-397-1244,ext.398

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

8506060617 850520
REG3 LIC30
34-24478-01 PDR

10. RADIATION SAFETY PROGRAM.

11. WASTE MA

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
Stanton P Parry	Stanton P. Parry	Vice-President for Finance and Management	3/12/85

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

RECEIVED
MAR 20 1985
REGION III

TYPE OF FEE	FEE LOG	FEE CATEGORY	COMMENTS	APPROVED BY
applicable		EX 3M	FEE EXEMPT	
AMOUNT RECEIVED	CHECK NUMBER			DATE 4/2/85

PRIVACY ACT STATEMENT ON THE REVERSE

CONTROL NO. 78553

5. RADIOACTIVE MATERIAL.

Phosphorous ^{32} (5 millicuries)

6. PURPOSE FOR USE OF RADIOACTIVE MATERIAL.

The radioactive isotope of Phosphorous (^{32}P) will be used for the sequencing of DNA molecules. The isotope will be purchased as radioactive nucleotides, that arrive from the supplier as a solution (1mCi/.1 ml). The "labelled nucleotides are added to the ends of DNA molecules by an enzymatic reaction, in small 1.5 ml tubes, generally working with approximately 30 microcuries at a time. The radioactive DNA is then subjected to gel electrophoresis to determine the sequence of nucleotides in the DNA molecule. All handling of radioactivity will be behind plexiglass shields and the gels will be run within a plexiglass compartment.

7. INDIVIDUAL RESPONSIBLE FOR RADIATION SAFETY PROGRAM.

Due to the small size of this program, a full-time radiation protection officer will not be needed. These duties will be performed by Dr. Joseph Lechner, who is the principle user of the radioisotope covered by this application. Dr. Lechner received training in safe handling of radioactive materials from the Radiation Protection Office of Northwestern University Medical School, Chicago, Illinois. During 1978-1979, he participated in two research projects in the Department of Oral Biology at Northwestern University Dental School. One project involved injecting laboratory animals with [^{3}H] labeled amino acids, followed by isolation and amino acid analysis of radioactively labeled proteins. The other project involved labeling of unsaturated protein crosslinks with [^{3}H] sodium borohydride. During the months when radioisotopes are in use, Dr. Lechner will be devoting 100% full-time to the DNA sequencing project covered by this proposal. Therefore, he will have adequate time to supervise the handling of radioisotopes.

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

All individuals who work with radioactive materials will be required to have the following training before commencing work:

A. Completion of course number 43-144, General Chemistry II. This course includes lectures on nuclear chemistry which cover nuclear stability, types of ionizing radiation, and calculations involving rates of nuclear decay.

B. Supplementary radiation safety classes covering detection methods, radiation safety standards, biological effects of radiation, and laboratory techniques for handling radioactive materials. A written examination will be given at the conclusion of the classes.

8. C. On-the-job training in performing experiments with radioisotopes, with a subjective evaluation of performance by the radiation safety officer.

9. FACILITIES AND EQUIPMENT

A. All experiments involving radioisotopes will be performed in Room RH 229, a newly-constructed laboratory which will be used exclusively for the project covered by this application. *(EXHIBIT A)*

B. [^{32}P]-containing autoradiographs will be stored in a -70°C deep freeze located in Room FA 109. No experimentation involving radioisotopes will be performed in this room. The autoradiographs will be wrapped in protective material while stored here, and will be unwrapped only in Room RH 229 described in (A).

C. Radioactive [^{32}P] wastes will be stored in Room FA 226 *(EXHIBIT B)* until their levels of radioactivity have diminished to levels safe for disposal. Aqueous wastes would be released to the sanitary sewer via a sink located on the counter top. (See discussion of disposal below.)

10. RADIATION SAFETY PROGRAM

A. Detection Instruments.
We will have two survey meters which will be used for monitoring any radiation spills. The instruments are both made by Ludlum Measurements, Inc., Model 3. They are very adequate for detecting the high energy β particles emitted by [^{32}P]. They detect from 0-5k counts per minute. They will be used to monitor the work area immediately after the experiment is completed and also for our regular monitoring of the whole laboratory. The detailed description of the instruments is included in Appendix 1.

B. Calibration of Instruments.
Each instrument will be sent to the manufacturer (Ludlum) at a frequency of once per year for calibration. To be sure that each is accurate, they will be cross-checked with each other with a [^{32}P] source at monthly intervals. Ludlow calibration procedures have been filed with the Texas Department of Health, Bureau of Radiation Control under license number 4-1963.

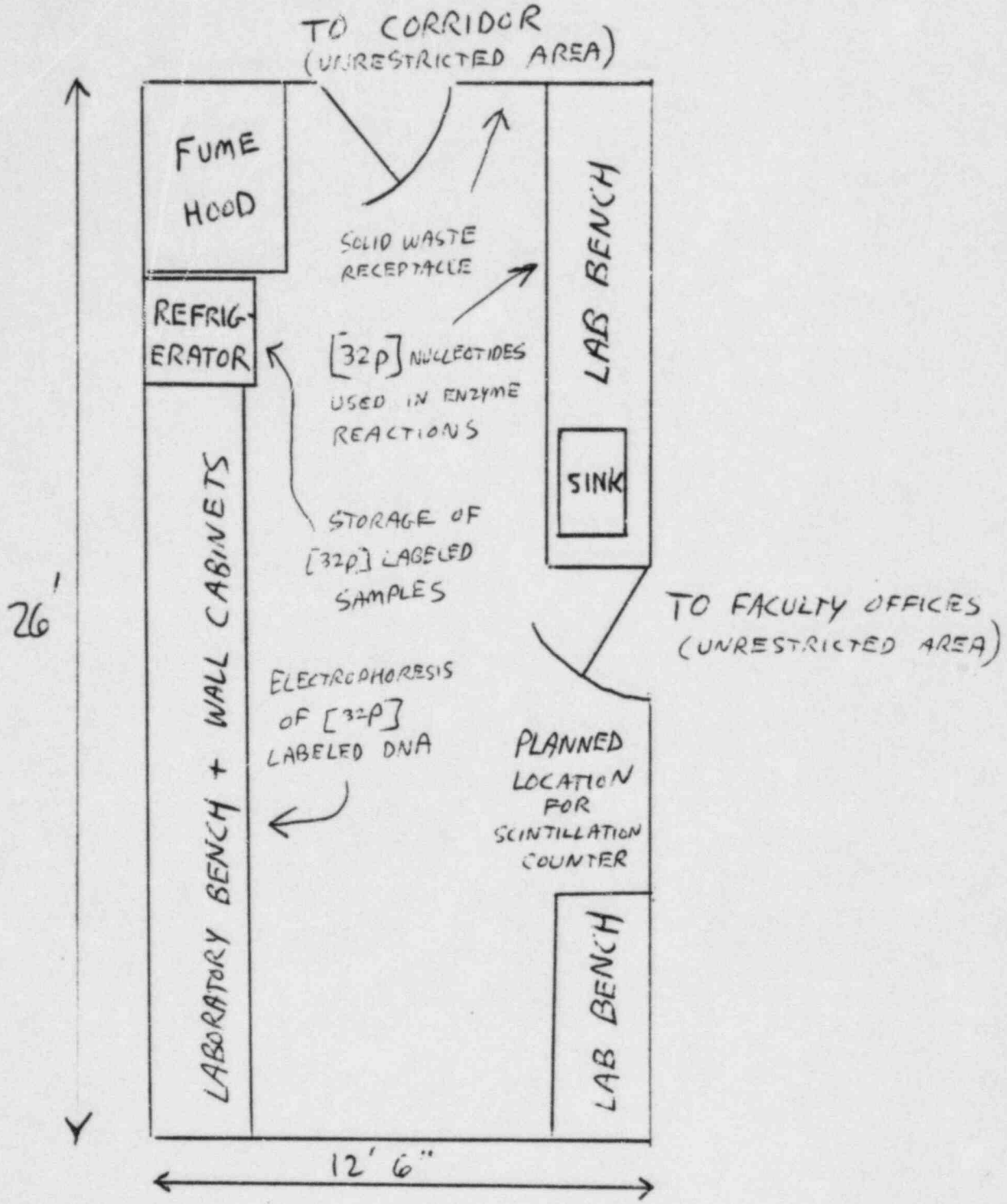
C. Personnel Monitoring.
All individuals working with radiation, or any other individuals working in the vicinity of the radiation will be required to wear a film badge. The badges will be furnished and monitored monthly by: ICN Pharmaceuticals, Inc., Life Sciences Group, Dosimetry Service, 26201 Miles Road, Cleveland, Ohio 44128.

D. Survey Program.
At a frequency of once per month, a thorough survey of the entire laboratory will be undertaken. This will be carried out using the survey meter, to check for radioactivity on all lab benches, in the fume hood and on the floor.
In addition, all personnel will be required to do a thorough survey of their entire work area, immediately after completing each experiment.
The results of each survey will be recorded in a log book. Professor Lechner will be responsible for seeing that the log book is being kept up-to-date.

E. Instructions to Personnel.
Appendix II contains the set of instructions which will be given to each person who will work with the isotope.

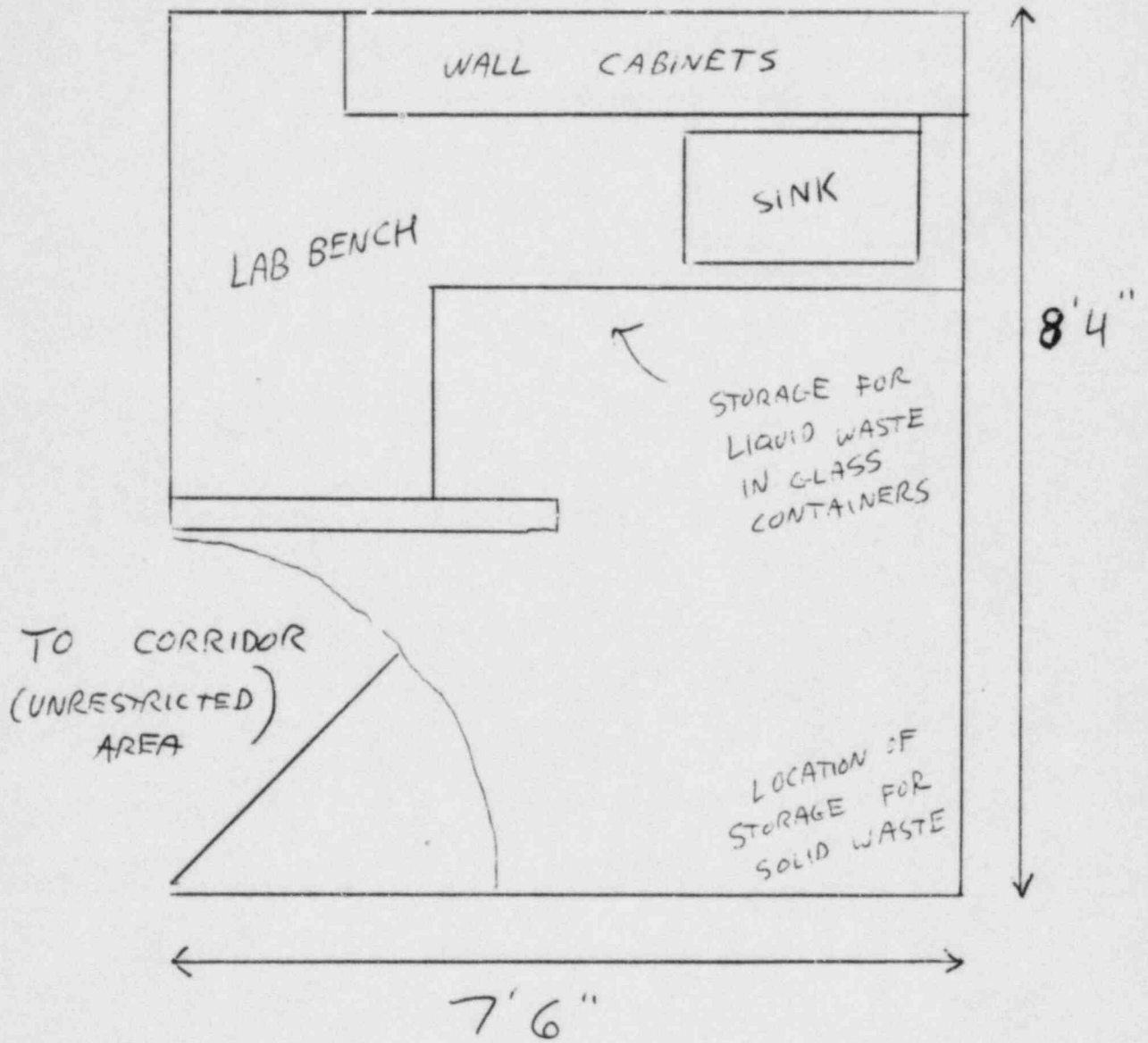
(EXHIBIT A)

FLOOR PLAN, ROOM RH 229



CONTROL NO. 78553

FLOOR PLAN, ROOM FA 226



11. WASTE MANAGEMENT.

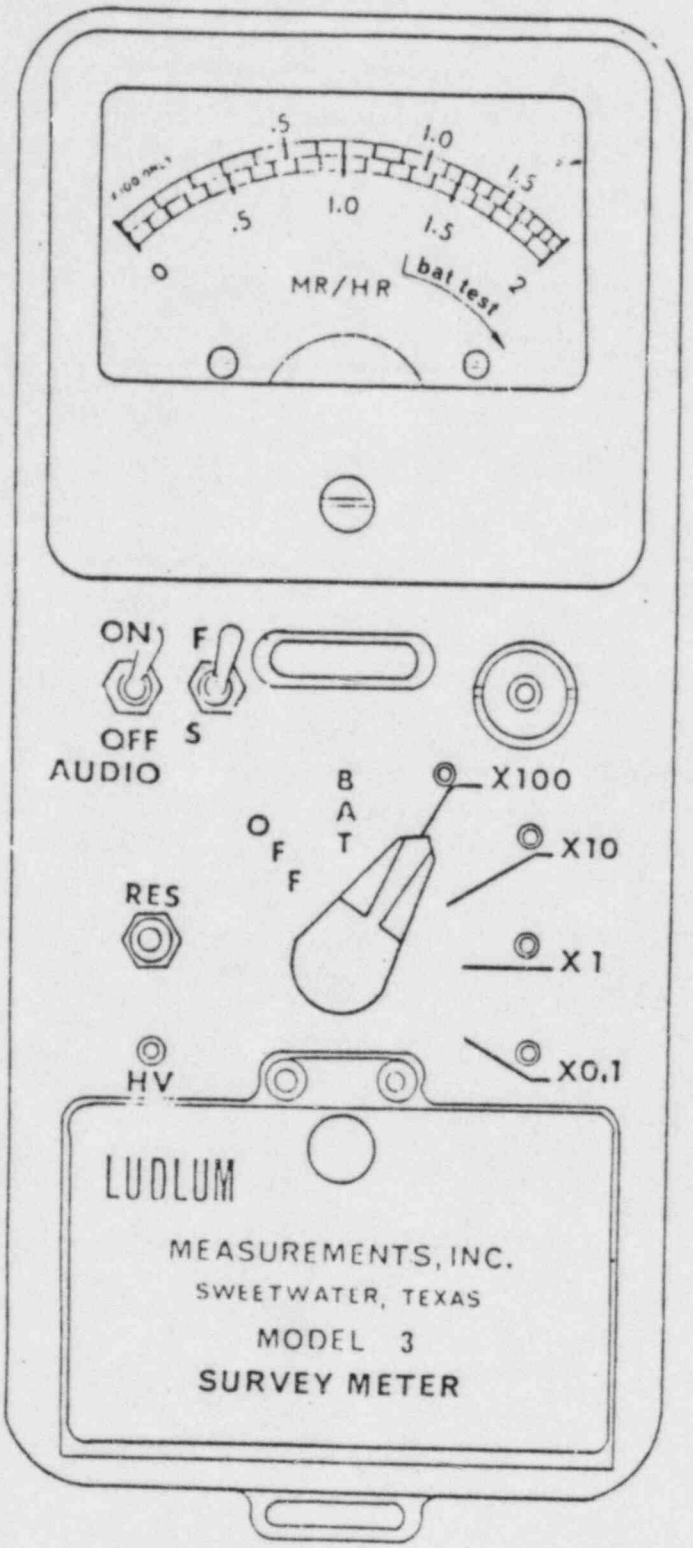
Aqueous waste will be disposed of through the sewage in conformance with 20.303 of 10 CFR, Part 20. No more than 100 microcuries of [^{32}P] will be disposed of in this manner per day and the isotope will be diluted to a level of 5×10^{-4} microcuries per ml. (100 microcuries per 200 liters of water).

Solid waste and scintillation vials will be disposed of through the radioactive waste disposal services of Teledyne Isotopes, 50 Van Buren Avenue, Westwood, New Jersey 07575.

12. LICENSE FEE.

The [^{32}P] will be used by our students as a part of their training in Molecular Biology. As we understand the fee structure, colleges using radioactivity for teaching purposes are exempt from the license fee.

APPENDIX I



LUDLUM MODEL 3 SURVEY METER

1. GENERAL

The Model 3 is a portable survey instrument that operates on two standard "D" cell flashlight batteries. The instrument features a regulated high voltage power supply adjustable from 400 to 1500 volts and provides a 4-linear range from 0-200 MR/Hr.

The unit body is made of cast aluminum, including the meter housing. The can is 1/16 aluminum. Other operating features of the instrument include a unimorph speaker mounted to the instrument can with an audio ON-OFF capability, fast-slow meter response, meter reset button and a 6-position switch for selecting battery check or scale multiples of X0.1, X1, X10 and X100. Each range multiplier has its own calibration potentiometer.

Any G-M probe offered by the company will operate on this unit as well as many of the scintillator-type detectors. The instrument is set for 900 volts G-M tube operation. For special requirements, it may be adjusted for operation with any G-M or scintillator tube between 400 and 1500 volts.

The unit is operated with two flashlight batteries for operation from 150° to approximately 32°F. For lower temperature operation, either very fresh or rechargeable NiCd batteries may be used. Battery drain averages 30 milliamperes.

2. SPECIFICATIONS

POWER: two standard "D" size batteries

FOUR LINEAR RANGES: from 0 to 200 MR/Hr; meter scale presentation - 0 to 2 MR/Hr with range multiples of X0.1, X1, X10, X100; 0 to 5K Counts per Minute option

SENSITIVITY: 40 millivolts

AUDIO: built-in unimorph speaker with an ON-OFF switch

HIGH VOLTAGE: externally adjustable from 400 to 1500 volts

RESPONSE: 3 or 11 seconds

LINEARITY: plus or minus 5% full scale

CALIBRATION STABILITY: less than 15% variance to battery end point

LUDLUM MODEL 3 SURVEY METER

METER: 50 Micro-amp, 2 1/2-inch scale, with taut-band suspension

CONNECTOR: Series "C", 706 U/G; BNC or MHV may also be provided

SIZE: 3.4 x 3.5 x 7.0 inches (H x W x L exclusive of handle)

WEIGHT: 3.5 pounds less detector

FINISH: drawn and cast aluminum, with computer beige polyurethane enamel and silk-screened nomenclature.

3. DESCRIPTION OF CONTROLS AND FUNCTIONS

Range Multiplier Selector Switch is a 6-position switch marked OFF, BAT, X100, X10, X1, X0.1. Turning the range selector switch from OFF to BAT position provides operator a battery check of the instrument. A BAT check scale on the meter provides a visual means of checking the battery status. Moving the range selector switch to one of the range multiplier positions (X0.1, X1, X10, X100) provides the operator with an overall range of 0-200 MR/Hr (0-500K if the CPM scale is installed). Multiply the scale reading by the multiplier for determining the actual reading.

AUDIO ON-OFF Toggle Switch in the ON position operates the unimorph speaker, located on the left side of the instrument. The frequency of the clicks is relative to the rate of the incoming pulses. The higher the rate is, the higher the audio frequency. The audio should be turned OFF when not required to reduce battery drain.

Fast-Slow Toggle Switch provides meter response. Selecting the "F" position of the toggle switch provides 90% of full scale meter deflection of 3 seconds. In "S" position, 90% of full scale meter deflection takes 11 seconds. In "F" position there is fast response and large meter deviation. In "S" position there is a slow response and damped meter deviation.

RES Button, when depressed, provides a rapid means to drive the meter to zero.

High Voltage Adjustment provides a means to vary the high voltage from 400 to 1500 volts. The high voltage setting may be checked at the connector with an appropriate voltmeter.

Range Calibration Adjustments are recessed potentiometers located on line with each multiplier position. These adjustment controls allow individual calibration for each range multiplier.

4. OPERATING PROCEDURES

4.1 Slide battery box button to rear, open lid and install two "D" size batteries. Note (+) (-) marks on the inside of the lid. Match battery polarity to these marks.

NOTE: Center post of flashlight battery is positive.

DO NOT TWIST LID BUTTON - It slides to rear.

Close battery box lid.

4.2 Switch range switch to BAT. Meter should deflect to the battery check portion of the meter scale. If meter does not respond, recheck that batteries have proper polarity.

4.3 Connect cable to instrument and detector.

4.4 Turn instrument range switch to X100. Expose detector to check source. Speaker should click with AUDIO ON-OFF switched to ON.

4.5 Move range to lower scales until meter reading is indicated. Toggle switch labeled F-S should have fast response in "F", slow response in "S".

4.6 Depress RES switch. Meter should zero.

4.7 Proceed to use the instrument.

5. CALIBRATION

5.1 Detector Operating Point: Adjust HV control for 900 volts at instrument connector for G-M detectors.

NOTE: If an electrostatic voltmeter is not available, use an ordinary volt-ohm-milliameter (Triplett 630 or equal) with 20,000 ohms per volt meter resistance. Select the 6,000-volt scale and then adjust high voltage to read 850 volts on this scale.

Do not use a vacuum-tube-type voltmeter for this adjustment unless an external high voltage multiplier probe is used.

Turn instrument to X100. Expose the instrument to a calibrated gamma field and vary range calibration adjustment control for proper reading.

5.2 Special Use Calibration: For special G-M detector applications, the power supply may be adjusted for 450 volt and 1200-volt G-M tubes. Follow above procedure, only set the supply at the new operating voltage.

For scintillation counters, connect the scintillator. Expose the unit to a source and develop an operating voltage versus count-rate plot. Set the operating voltage at the flattest portion of this curve; then proceed to adjust each calibration control for the desired meter reading.

5.3 Calibrating CPM Scale: To calibrate CPM scale, a precision pulse generator is required. The pulse generator should be capable of providing a 40 millivolt or greater negative pulse with a rise time of 1 microsecond and a pulse width of 5 microseconds.

Connect pulse generator to the instrument and adjust pulse frequency to provide 4/5 scale deflection on the X100 range (400.000 CPM). Adjust X100 range calibration potentiometer as required. Decrease pulse frequency by decades and adjust each range calibration potentiometer according.

6. MAINTENANCE

NOTE: NEVER STORE THE INSTRUMENT OVER 30 DAYS WITHOUT REMOVING BATTERIES. ALTHOUGH THIS INSTRUMENT WILL OPERATE AT VERY HIGH AMBIENT TEMPERATURES, BATTERY SEAL FAILURE CAN OCCUR AT TEMPERATURES AS LOW AS 100 DEGREES FAHRENHEIT. NEGLECTED BATTERY SEAL FAILURE WILL SURELY CAUSE ONE AWFUL MESS!

Instrument maintenance consists of keeping the instrument clean and periodically checking batteries and calibration. Once initial calibration is performed, recalibration should not be required if batteries are maintained in good condition.

LUDLUM MODEL 3 SURVEY METER

An instrument operational check should be performed prior to each use by exposing detector to a known source and confirming proper reading on each scale.

Under certain conditions, NRC requires instrument recalibration every three months. Check the appropriate regulations to determine recalibration schedule.

Also at three month intervals, the batteries should be removed and the battery contacts cleaned of any corrosion. If the instrument has been exposed to very dusty or corrosive atmosphere, more frequent battery servicing should be used.

Use a spanner wrench to unscrew the battery contact insulators, exposing internal contacts and battery spring. Removing the handle will facilitate access to these contacts.

APPENDIX II

INSTRUCTIONS TO PERSONNEL

1. ARRIVAL OF SHIPMENT.

Upon arrival, the order will be opened and tested for contamination by the radiation supervisor or his appointee. The order, if acceptable, will be logged in, added to the supervisor's inventory list and held for pick up. The supervisor will keep a written record of all additions to the inventory (date, activity).

2. STORAGE.

Radioactive materials may be stored only in designated area in Room RH 229 of Regent's Hall. Waste will be stored only in FA 226. The material must be shielded to reduce radiation exposure in adjacent accessible areas to as low as reasonably achievable and to a maximum of 2 mrem/hour.

The radioactive material must be secure from removal by unauthorized individuals. The door to the room must be locked when no one is present. Radioisotopes and food, drink, tobacco, and/or cosmetics must not be stored in the same area.

3. TRANSPORTATION.

Within the College -- Approval for the use of radioactive materials is granted for use in specified locations. Radioactive materials may be moved only between areas which have been approved to contain them. Movement of radioactive materials must be done within the following guidelines:

1. Containers should be chosen to insure no loss of material even in unusual circumstances. Two layers of containment are required for non-sealed radioactive material. One layer is sufficient for sealed sources.
2. The outer container must be labeled as radioactive.
3. The outer container must be wipe tested to demonstrate no surface contamination levels.
4. The container must not be left unattended while it is outside of a controlled area. The move must be accomplished as rapidly as possible.

4. RADIOACTIVE WASTE STORAGE.

General -- Radioactive waste containers must be located in the vicinity of all work areas. Radioactive waste must be segregated according to the criteria described below. Storage containers must be approved by the Radiation Supervisor. These containers must be clearly labeled "Caution--Radioactive Materials", and identify the radioisotopes and approximate activity they contain.

The locations of waste containers that are not in direct view must be identified by a warning sign in the areas. Workers are encouraged to use their initiative to minimize the volume of radioactive waste. With the exception of scintillation fluid, radioactive waste material whose chemical properties pose a greater hazard than its radioactive properties must be stored separately and have an appropriate warning label.

5. DRY WASTE.

Scintillation vials, containers of liquid, and unprotected hypodermic needles must not be added to dry waste containers. Dry waste containers should be covered between waste additions and should be lined with polyethylene bags to prevent contamination of the container itself. The container should be sturdy enough to prevent the loss of material while transporting a full container.

6. LIQUID WASTE.

Liquid radioactive waste must be segregated into that which is suitable for sewer disposal and that which is not (see section 7). Liquid scintillation fluid must be segregated from all other waste. Containers should inhibit the release of volatile radionuclides and minimize the potential for spills. Glass bottles are suitable if secondary spill containment is provided which will contain the liquid if the bottles break. Containers must not exceed 19 liters (5 gal.) in capacity. Waste scintillation fluid may be stored in counting vials if they are placed in their original trays or a sturdy polyethylene lined container.

All containers of liquid scintillation fluid should be stored in a well ventilated area. Aqueous solutions of non-volatile radioisotopes may be slowly evaporated to dryness prior to disposal.

7. SEWER DISPOSAL.

All releases of liquid radioactive waste to the sanitary sewer must comply with the following procedures:

a. The waste must be readily soluble or dispersible in water (scintillation fluid does not qualify).

b. The total daily activity released by a supervisor must be less than or equal to 50 microcuries.

c. Sewer disposal should be limited to one sink per user and all sinks receiving radioactive materials must be clearly labeled "Caution--Radioactive Materials Sink".

d. Radioactivity concentrations should be diluted to 1 microcurie per liter during disposal.

e. Disposal of any flammable solvent by sanitary sewer is specifically prohibited.

8. CONTAMINATION.

a. GENERAL -- Contamination is the presence of radioactive material in undesirable locations. It is a source of internal contamination and thus a health hazard. It may also result in the spread of contamination in the laboratory and jeopardize the success and accuracy of experiments. Good laboratory organization and operating procedures should be employed to minimize contamination. However, radiation surveys are necessary to confirm that contamination levels are acceptable and locate areas which require clean up.

8. b. CONTAMINATION MONITORING -- The radiation supervisor or his appointee will perform monthly contamination surveys of all areas in which unsealed radioactive materials are used. The results of each survey will be recorded on a "Contamination Survey Report" and kept in the supervisor's log book.

Personnel should check themselves and their work areas for contamination at the end of each radioisotope procedure. More frequent checks during longer procedures are encouraged.

c. DECONTAMINATION PROCEDURES -- The following decontamination procedures are recommended if the operation does not involve an extraordinary radiological health risk. These steps should be followed immediately after contamination is found. Contamination from spilled liquids will be harder to remove if the liquid is allowed to dry. If the contamination presents an extraordinary hazard, contact the radiation supervisor.

1. Don appropriate protective equipment (gloves, boots, lab coat).
2. Mark the extent of the contaminated area and confine clean up operations to this area.
3. Monitor the initial contamination level.
4. Use soap and water or a commercial decontamination product with a cloth or brush to loosen contamination. Soaking is also effective if done for several hours. Wipe dry and rinse clean.
5. Remonitor the area to measure the effectiveness of your efforts.

d. LABORATORY PROCEDURES FOR OPERATIONS WITH RADIOACTIVE MATERIALS --

External and internal radiation exposure can be minimized by careful planning and the exercise of good judgment. The following guides for dealing with radioactive materials should be implemented.

1. Work should be planned ahead whenever possible. A dry run using non-radioactive materials should be made to test the procedure.
2. The laboratory should be kept neat and clean. Equipment or material not being used should be sorted in a place away from the work area.
3. Radioactive materials must be labeled.
4. Caution and other warning signs must be posted and must not be removed without proper authority.
5. Contaminated equipment or surface contamination should be so labeled and kept in a labeled work area.
6. Smoking, eating, drinking and application of cosmetics are prohibited in radioisotope laboratories.
7. Protective clothing (gloves, lab coats) must be worn when working with radioactive materials other than sealed sources. Protective clothing should be monitored for contamination and disposed of if contamination is found.
8. Radioactive material in liquid form must be stored and transported in containers which retain their integrity when dropped.
9. Pipetting must not be done by mouth. Rubber bulbs, syringes, or other mechanical devices must be used when transferring radioactive materials.

8. d. 10. Telephone, door handles and other "clean" items should not be handled with contaminated gloves.

11. All injuries in areas containing radioactive materials no matter how minor, should be reported to the laboratory supervisor as soon as possible.

12. An "Emergency Procedure" must be posted. It must include the names and telephone numbers of all personnel to be contacted in case of an emergency.

13. Flammable liquids such as ether, benzene, or acetone should be segregated as much as possible away from stored radioactive materials.

14. Pressure bottles or tanks containing gas must be secured to the wall, bench, floor, or other rigid objects.

15. All items coming into contact with unsealed radioactive material must be checked, and if necessary cleaned.

16. Floors, benches and other surfaces in unsealed radioisotope work areas must be smooth, non-porous and easily decontaminated. Manipulations of unsealed radioactive material should be carried out on absorbant paper backed by plastic. The use of edged trays is encouraged.

9. PERSONNEL MONITORING.

a. GENERAL -- The intent of the Personnel Monitoring Program is to assure that sufficient precautions are being taken to protect all individuals from unreasonable radiation exposure. Radiation monitoring devices (film badges) are employed to determine the amount of exposure to external radiation. Bioassays (urine analysis, thyroid counts) can be used to measure internal contamination. The information obtained is maintained as part of the individual's permanent exposure history.

b. EXTERNAL RADIATION EXPOSURE -- External radiation exposure results from the use of radioisotopes or radiation equipment which produce gamma rays, x-rays, high energy beta particles or neutrons which have the potential to penetrate the protective epidermal layer of the skin and deliver a dose to the underlying tissue. To limit the dose from these types of radiation individuals should take the following steps.

1. Limit the time spent in the vicinity of the radiation source.

2. Maximize the distance between yourself and the radiation source.

3. Install shielding to reduce the amount of radiation reaching you.

c. INTERNAL RADIATION EXPOSURE -- The greatest potential hazard from operations involving small quantities of unsealed radioactive material is posed by introduction of these isotopes into the body. A number of radioisotopes are bioconcentrated into specific tissues and thus may deliver much of their decay energy to a small fraction of an individual's body. Internal contamination may result from inhalation, ingestion penetration of sharp objects into the body, and absorption through the skin. Bioassays will be required of individuals working with quantities of radioisotopes which could produce a significant internal dose. The need for such procedures will be decided by the Radiation Supervisor on a case by case basis. Bioassays should be requested by any individual who believes that he/she may have been internally contaminated.

10. MAXIMUM PERMISSIBLE DOSE EQUIVALENT LIMITS.

Radiation doses are to be kept at the lowest practicable level at all times. This is in keeping with the philosophy expressed by the National Council on Radiation Protection and Measurements (NCRP Report No. 43), which emphasizes that all radiation exposure entails some health risk. The limits given below are the maximum dose equivalents which will be allowed. These are less than or equal to legally prescribed limits.

MAXIMUM DOSE EQUIVALENT LIMITS

I. RADIATION WORKERS

	In Any 13 Week Period (rem)
a) Whole body, gonads, lens of the eye	1.25
b) Skin of whole body, thyroid, other organs	3.75
c) Hand, forearms, ankles, feet	18.5

II. GENERAL PUBLIC

a) Not to exceed either 0.5 rems whole body in any 52 consecutive weeks or 2.0 mrem/hr.

11. CAUTION SIGNS AND LABELS.

a. GENERAL -- Caution signs and labels should be posted wherever the situations described below exist. They should not be used when these situations do not exist. The materials necessary to meet posting requirements are available free of charge. Appropriate warning signs should be posted at each entrance to the controlled area for each situation which exists. Specific storage area (cabinets, refrigerators) should also be posted. Labels must be applied in a secure manner directly to the object to which they apply.

b. WARNING LABELS --

SITUATION	WARNING LABEL
Container used to store or transport radioactive materials.	- Caution Radioactive Materials - Isotope(s)/Date - Activity of each isotope
Work area containing stored radioactive materials, contaminated objects or contaminated surfaces	- Caution Radioactive Materials

12. ACCIDENTS.

a. GENERAL -- Occasional accidents (unplanned events) involving radiation equipment or radioactive materials are inevitable. A set of remedial measures cannot be compiled which will be adequate in all situations. Therefore, it is essential that all persons working with radiation consider the possible accident situations which might arise and plan proper remedial action in advance. The information in this section is meant as a guide.

The primary objective of all counter measures to radiation accidents is minimizing the radiation exposure of personnel. Limiting damage to equipment or facilities is a secondary concern. All accidents should be reported to the radiation supervisor. Serious accidents (those which pose a radiological health risk in excess of that encountered in routine operations) must be reported immediately. Individuals at the scene of an accident should initiate procedures to minimize the problem, provided that they can be done safely.

b. PREVENTIVE MEASURES --

1. Anticipate problems before they happen. Dry run new procedures without radioactive material to identify possible hazards.
2. Wear appropriate protective clothing (gloves, lab coats, respirators, lead aprons, etc.) any time work involves radiation or radioactive material.
3. Use appropriate radiation monitoring techniques (film badges, survey meters, wipe tests). Check for contamination and radiation exposure.
4. Work with adequate supervision. All new experiments and major variations of experiments involving radiation must be reviewed. Minor variations in established procedures should be cleared with the radiation supervisor in charge.
5. Follow approved laboratory operating procedures.

c. MINOR SPILLS -- (No extraordinary radiological hazard)

1. Advise persons in the area of the situation.
2. Don protective clothing and arrest the spread of contamination.
3. Collect liquid radioactive material with absorbant material. Dry radioactive material should be collected on damp absorbant material. Do not spread contamination over a larger area.
4. Mark the extent of the contaminated area.
5. Place the absorbant material in a plastic bag, mark its contents and treat it as radioactive waste.
6. Inform the radiation supervisor. Decontaminate immediately. Note the accident in the supervisor's radiation log book. Monitor all persons involved in the cleanup for contamination.

12. d. MAJOR SPILLS -- (A radiological hazard in excess of that encountered in routine operations)

1. Advise all persons in the area of the situation. Request that they move to a safe area nearby, and remain there until checked by the supervisor.
2. Request one individual to contact the radiation supervisor.
3. Remove yourself to a safe location but stay in control of the accident area. Do not allow persons into the areas. Without risk to yourself, take whatever measures possible to halt the spread of contamination (i.e. close lab doors, toss absorbant material over the spill). Remove all contaminated clothing immediately and deposit them in the accident area. Adequate alternate clothing (ex: clean lab coat) should be available for use at such times.
4. Clean up and decontamination will be done only under the supervision of the radiation safety officer.

e. EXTERNAL PERSONNEL CONTAMINATION --

1. Remove all contaminated clothing immediately and don alternate clothing.
2. Monitor the level of contamination.
3. Immediately wash the contaminated area with a mild soap and warm water. Confine cleaning operations to the contaminated area as much as possible. Wash for 3 minutes, rinse and remonitor the area to judge the effectiveness of the procedure. Continue washing up to 4 times as necessary to achieve a nondetectable level. Do not take any action which causes skin abrasion. Do not use organic solvents.

f. INTERNAL PERSONNEL CONTAMINATION --

Internal contamination results from the ingestion or inhalation of radionuclides, from wounds caused by contaminated objects and from absorption through the skin. Medical attention may be required. If internal contamination is known or suspected, contact the supervisor at once. Bioassays will be performed to measure the extent of the hazard. If the accident involves a minor wound, immediately spread edges and wash the wound for 5 minutes in a strong stream of warm water and allow bleeding to flush the wound. In the event of a serious injury, other concerns (shock, bleeding) take precedence over radiological concerns. Record all information useful in assessing the extent of the hazard (radioisotope(s) involved, activity, chemical form, etc.).