FORM NRC-313 I (1-79) 10 CFR 30

U.S. NUCLEAR REGULATORY COMMISSION

APPLICATION FOR BYPRODUCT MATERIAL LICENSE
INDUSTRIAL

See attached instructions for details.

Completed applications are filed in duplicate with the Division of Fuel Cycle and Material Safety, Office of Nuclear Material Safety, and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555 or applications may be filed in person at the Commission's office at 1717 H Street, NW, Washington, D. C. or 7915 Eastern Avenue, Silver Spring, Maryland.

1. APPLICATION FOR: *(Check and/or complete as appropriate)*

- a. NEW LICENSE
- b. AMENDMENT TO: LICENSE NUMBER
- c. RENEWAL OF: (Combination) LICENSE NUMBERS 35-06776-04 & 35-06776-05 & SNM-957

2. APPLICANT'S NAME *(Institution, firm, person, etc.)*
The University of Tulsa
TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION
(918) 939-6351, x 515

3. NAME OF PERSON TO BE CONTACTED REGARDING THIS APPLICATION
Dr. W. P. Moran
TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION
(918) 939-6351, x 515

L 06776
30-16075

4. APPLICANT'S MAILING ADDRESS *(Include Zip Code)*
600 S. College
Tulsa 74104

5. STREET ADDRESS WHERE LICENSED MATERIAL WILL BE USED *(Include Zip Code)*
1133 N. Lewis, Tulsa 74110 and
600 S. College, Tulsa 74104

(IF MORE SPACE IS NEEDED FOR ANY ITEM, USE ADDITIONAL PROPERLY KEYED PAGES.)

6. INDIVIDUAL(S) WHO WILL USE OR DIRECTLY SUPERVISE THE USE OF LICENSED MATERIAL
(See Items 16 and 17 for required training and experience of each individual named below)

FULL NAME	TITLE
a William P. Moran (Ph.D.)	Assoc, Prof. of Physics
b Kenneth A. Kuenhold, (Ph.D.)	Assoc. Prof. of Physics
c Nancy J. Carpenter (Ph.D.)	Assoc. Prof. of Zoology (cont. on separate page)

7. RADIATION PROTECTION OFFICER
Dr. William P. Moran

Attach a resume of person's training and experience as outlined in Items 16 and 17 and describe his responsibilities under Item 15.

8. LICENSED MATERIAL (also see attached sheet)

LINE NO.	A ELEMENT AND MASS NUMBER	B CHEMICAL AND/OR PHYSICAL FORM	C NAME OF MANUFACTURER AND MODEL NUMBER *(If Sealed Source)*	D MAXIMUM NUMBER OF MILLICURIES AND/OR SEALED SOURCES AND MAXIMUM ACTIVITY PER SOURCE WHICH WILL BE POSSESSED AT ANY ONE TIME
(1)	Plutonium	16 grms Pu-Be Neutron Source	NUMEC-P	1 ci
(2)	Hydrogen 3		Tracer Lab (sealed source)	100 mCi
(3)	Cesium 137		Isotope Products Lab B506	50 mCi
(4)	Cobalt 60		Isotope Products Lab 31066-2	110 microCi

	E DESCRIBE USE OF LICENSED MATERIAL
(1)	Educational demonstrations and experiments in activation and decay; neutron transport; neutron shielding; thermal neutron cross- sections.
(2)	Photomultiplier calibration light source
(3)	Student training for laboratory experiments
(4)	Student training for laboratory experiments

FEE EXEMPT

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9. STORAGE OF SEALED SOURCES (See attached sheet)

LINE NO.	CONTAINER AND/OR DEVICE IN WHICH EACH SEALED SOURCE WILL BE STORED OR USED. A.	NAME OF MANUFACTURER B.	MODEL NUMBER C.
(1)	Vistflux Howitzer or NUMEC shipping container	Reactor Experiments Inc. Numec	Model I N/A
(2)	Light tight container	TRACER LAB	N/A
(3)	Vault	N/A	N/A
(4)	Lead housing inside vault	Tulsa Univ. Physics Department	N/A

10. RADIATION DETECTION INSTRUMENTS

LINE NO.	TYPE OF INSTRUMENT A	MANUFACTURER'S NAME B	MODEL NUMBER C	NUMBER AVAILABLE D	RADIATION DETECTED (alpha, beta, gamma, neutron) E	SENSITIVITY RANGE (milliroentgens/hour or counts/minute) F
(1)	Scintillation crystals	*Harshaw, 5x5, *3x3, 2x2	*20MPH20 *12512,	*2 *1,1	* γ, β	*60c/mi *60c/mi
		Baird-Atomic 1-1/2 x 1, anthracene plastic	919-820 919-812 984-014, -017	2 1 2	γ, β α, n	60 c/mi 60c/mi 60c/mi
(2)	Survey meter	Victoreen	Cutie pie 740-1	1	γ, β	.5 mr/hr
(3)	Surface barrier	Ortec	5-735C	3	α (see attached sheet)	10/mi

11. CALIBRATION OF INSTRUMENTS LISTED IN ITEM 10

☐ a. CALIBRATED BY SERVICE COMPANY

NAME, ADDRESS, AND FREQUENCY

☒ b. CALIBRATED BY APPLICANT

Attach a separate sheet describing method, frequency and standards used for calibrating instruments.

Survey instruments are calibrated at each use against calibrated sources and against the nuclear counting equipment at least twice per year as part of our experimental program. The standards include sources of known activity from a variety of manuf.

12. PERSONNEL MONITORING DEVICES

TYPE (Check and/or complete as appropriate.) A	SUPPLIER (Service Company) B	EXCHANGE FREQUENCY C
☐ (1) FILM BADGE		☐ MONTHLY
☐ (2) THERMOLUMINESCENCE DOSIMETER (TLD)		☐ QUARTERLY
☒ (3) OTHER (Specify): Baird-Atomic Model 802N & 907-609		☐ OTHER (Specify):

13. FACILITIES AND EQUIPMENT (Check were appropriate and attach annotated sketch(es) and description(s).

☒ a. LABORATORY FACILITIES, PLANT FACILITIES, FUME HOODS (Include filtration, if any), ETC. (see attachments)

☐ b. STORAGE FACILITIES, CONTAINERS, SPECIAL SHIELDING (fixed and/or temporary), ETC. Mat'l #5-9 of part 8

☐ c. REMOTE HANDLING TOOLS OR EQUIPMENT, ETC.

☐ d. RESPIRATORY PROTECTIVE EQUIPMENT, ETC.

14. WASTE DISPOSAL

a. NAME OF COMMERCIAL WASTE DISPOSAL SERVICE EMPLOYED

not appropriate

b. IF COMMERCIAL WASTE DISPOSAL SERVICE IS NOT EMPLOYED, SUBMIT A DETAILED DESCRIPTION OF METHODS WHICH WILL BE USED FOR DISPOSING OF RADIOACTIVE WASTES AND ESTIMATES OF THE TYPE AND AMOUNT OF ACTIVITY INVOLVED. IF THE APPLICATION IS FOR SEALED SOURCES AND DEVICES AND THEY WILL BE RETURNED TO THE MANUFACTURER, SO STATE.

sealed sources - items 2, 3, 4. Disposal by return to manufacturer or transfer to another licensed University.

items 5,6,7,8,9 (See attached sheet)

INFORMATION REQUIRED FOR ITEMS 15, 16 AND 17

Describe in detail the information required for Items 15, 16 and 17. Begin each item on a separate page and key to the application as follows:

15. RADIATION PROTECTION PROGRAM. Describe the radiation protection program as appropriate for the material to be used including the duties and responsibilities of the Radiation Protection Officer, control measures, bioassay procedures *(if needed)*, day-to-day general safety instruction to be followed, etc. If the application is for sealed source's also submit leak testing procedures, or if leak testing will be performed using a leak test kit, specify manufacturer and model number of the leak test kit.

16. FORMAL TRAINING IN RADIATION SAFETY. Attach a resume for each individual named in Items 6 and 7. Describe individual's formal training in the following areas where applicable. Include the name of person or institution providing the training, duration of training, when training was received, etc.

    a. Principles and practices of radiation protection.

    b. Radioactivity measurement standardization and monitoring techniques and instruments.

    c. Mathematics and calculations basic to the use and measurement of radioactivity.

    d. Biological effects of radiation.

17. EXPERIENCE. Attach a resume for each individual named in Items 6 and 7. Describe individual's work experience with radiation, including where experience was obtained. Work experience or on-the-job training should be commensurate with the proposed use. Include list of radioisotopes and maximum activity of each used.

18. CERTIFICATE

(This item must be completed by applicant)

The applicant and any official executing this certificate on behalf of the applicant named in Item 2, certify that this application is prepared in conformity with Title 10, Code of Federal Regulations, Part 30, and that all information contained herein, including any supplements attached hereto, is true and correct to the best of our 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.

a. LICENSE FEE REQUIRED *(See Section 170.31, 10 CFR 170)* N/A	b. CERTIFYING OFFICIAL *(Signature)* J. Paschal Twyman
	c. NAME *(Type or print)* J. Paschal Twyman
(1) LICENSE FEE CATEGORY:	d. TITLE President
(2) LICENSE FEE ENCLOSED: $	e. DATE 7-25-79

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6. (cont.)

d) Steffen H. Rogers, (Ph.D.), Assoc. Prof. of Zoology
e) Marion E. Woolsey (Ph.D), Assoc. Prof. of Biology

8. (cont.)

	A	B	C	D
(5)	Hydrogen 3	Any		10 mCi
(6)	Carbon 14	Any		10 mCi
(7)	Phosphorus 32	Any		5 mCi
(8)	Iodine 125	Iodide		10 mCi
(9)	Iodine 131	Iodide		10 mCi

E. (cont.)

(5-9) Laboratory studies in plants and animals. Research by the individual users c., d., e., and by graduate students supervised by individuals (c,d,e) listed above.

9. (cont.)

(5)	Vault	N/A	N/A

10. (cont.)

	A	B	C	D	E	F
(4)	Gas prop.	Reuter Stokes	RSC-61 L280	1	γ, X	60/mi
(5)	Geiger	Baird Atomic		1	γ, β, X	.01 mR/hr. 10/min
(6)	He-3	Texas Nuclear	Custom	3	n	10/min
(7)	Si(Li)	Kevex		1	γ, X	10/min

(8) Nuclear electronics from Canberra, Kevex, TMC and Nuclear Data support these systems, includes 4 MCA, 2 SCA, precision amplifiers, pulse generators, power supplies, and scalers. Equipment is computer interfaced for analysis of data and printed records.

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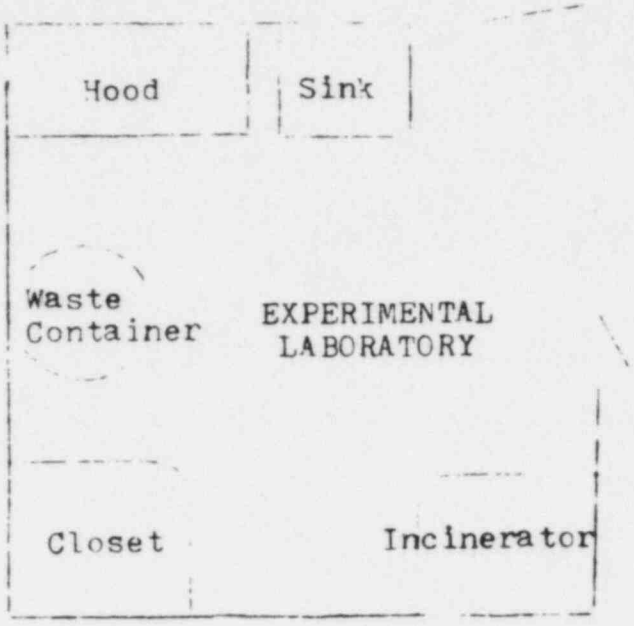
13. (a) Facilities and Equipment. All isotopes are labeled with radioactive warning tape and are stored in the physiology laboratory adjacent to the experimental laboratory. The experimental laboratory contains a ventilating hood, sink, and a waste container. The counting room contains a liquid scintillation counter and is equipped with a sink, waste container, and laboratory table. All of these facilities are equipped with disposable gloves, trays, absorbent paper, and similar equipment. Radiation warning signs are posted at each of these rooms. See attachment for the layouts of these rooms.

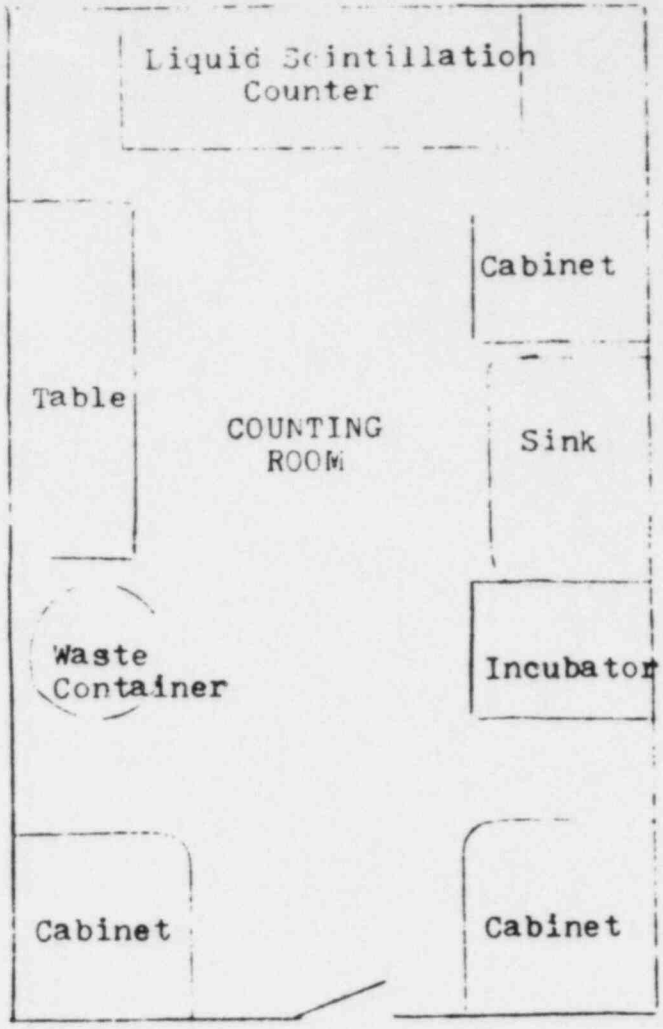
14. (b) Items 5,6,7,8,9 (cont'd.)

Waste Disposal. All dry radioactive waste material will be deposited in labeled metal cans lined with disposable plastic bags and provided in the laboratory and counting room. Short-lived solid waste material will be stored until it emits background levels of radiation and then will be disposed of in the regular trash. Long-lived solid waste material will be soaked until only background levels of radiation are emitted and the contaminated water will be flushed down the sink drain after adequate dilution. The solid material will then be disposed of in the regular trash. Liquid long-lived radioactive waste will be adequately diluted and flushed down the sink drain. Liquid short-lived waste will be disposed of after only background levels of radiation are emitted.

Sacrificed animals will be labeled as radioactive and stored in the freezer until the radioactivity has decayed to background levels and then will be disposed of in the regular trash. Excreta from experimental animals will be disposed of into the sanitary sewer in concentrations not exceeding those specified in Section 20.303 with a total disposal not exceeding 1 curie per year.

Attachment
Part 13a, covering Items 5-9 of Part 8





15. Radiation Protection Program.

The Radiation Protection Officer is charged with administering the provisions of the license(s). He also conducts briefings of staff and students on current inventories and uses of isotopes. Inspection of the activities of the individual users is made along with inspection of storage and handling procedures. He conducts sealed source leak tests. Use of x-ray equipment is also monitored.

All isotopes are procured by the business office upon approval of the department chairman (departmental funds) or the Office of Research (research funds).

ITEMS 5-9

In the counting room and experimental laboratories, laboratory coats and disposable gloves will be worn and absorbent paper and trays will be used when handling radioactive materials. Pipetting by mouth will be prohibited. All laboratory glassware and other apparatus will be decontaminated before being returned for general use. Any spills of radioactive material will be reported to the university radiation protection office. Monitoring with survey instruments will occur on a monthly basis. Tritium will be monitored by wiping work areas with filter paper discs and counting in the liquid scintillation counter.

Experimental animals are caged in the animal room next door to the experimental laboratory where injection of radioactive materials is done. Separate labeled cages are used only for injected animals.

16, 17. Per instructions of letter of February 7, 1979, training and experience of all personnel is contained in the applications and amendments of 35-06776-04, 35-06776-05, and SNM-957.

Copy of letter attached. (Lamastra - Feb. 7, 1979)

Item 2

Responses according to Items: 4.1, 4.2, 4.3, 4.5, 4.62, and 4.63 of Regulatory Guide 10.3

4.1 Specification of Applicant

University of Tulsa
600 South College
Tulsa, Okla. 74104

Officers of the corporation:

President: Dr. J. Pascal Twyman
Vice Pres.: John Hayes, John Dowgray, Arlan Fowler, Emory Turner and Frank Tenney
John Osborne, Comptroller, Assistant Sectretary-Treasurer
Harold Stairs, Assistant Secretary-Treasurer
All addresses the same. All are United States citizens.

4.2 Activities

The plutonium-beryllium source will be used for activation, neutron transmission, and neutron transport experiments in advanced undergraduate laboratories and in research. The source is housed either in a neutron howitzer or paraffin filled shipping container (see Item 9). The source is used in labroatories controlled by the physics department or in a research building controlled by the petroleum engineering department. The source is locked in when in either container. Access to all labs and buildings is by faculty key.

4.3 The Pu-Be source inventory of isotopes is as follows:

Numec 047-097-50-60

Serial 160A101

Pu - 239	86%
Pu - 240	11%
Pu - 241	2.37%
Pu - 242	.168%

Use of the source in howitzer or shipping container see 4.2.

4.5 Equipment

1. The source will be handled only in transferring it between the shipping container and the howitzer. A grab type handler 24" long is used to lift the sample from a socket in the paraffin filled drum to a socket in the howitzer.
2. Storage is in a locked shipping container. Surface activity is less than 2 mr/hr in either the howitzer or shipping container. The howitzer is also locked. The key is controlled by the Radiation Safety Officer.
3. Not applicable.
4. Not applicable.
5. The procedures of Appendix D Section one will be followed.

   Neutron dosimeters Bendiz Model 609 0-120 mrem (1)

   Gamma dosimeter Bendix 1M9E1PD 0-200 m rem (4)

   Other detection equipment under Item 10 NRC 313 I

   Calibration source Co-60-SN 31066-2 116μ C calibrated 7-1-76, activity 78.1 μ Ci on 7-1-79. This source produces approximately 1.2 m R/hr at 1 foot. Uncertainity is 4%. Na-22 SN31066-1 105μ Ci on 7-1-76, 47.2μ Ci on 7-1-79, Uncertainty is 4%.

   Calibrations are performed by either Dr. William P. Moran or Dr. Kenneth A. Kuenhold. Dr. Moran is Radiation Safety Officer. He has worked extensively with isotopes at the University of Notre Dame, with accelerators at Brookhaven and has taught and done research with nuclear instruments for 12 years. He has been a consultant on radiation safety and instrumentation to more than six companies and one medical school. Dr. Kuenhold is a specialist in experimental nuclear physics and performs research with

accelerators at Oak Ridge and with the Mossbauer effect at Tulsa University.

Health effects are minimal with these sources since personnel do not come within several feet of the source except to handle them by the plastic rod to which they are attached. Maximum level to the hand is 4 m R/hr for less than 5 minutes a few times per year. This is of the order of 1 mrem per year to the hand and a small fraction of that to any other portion of the body.

Leak test equipment for the sealed sources are checked against reference samples of 0.005 micro curie from ICN. These sources include CS-137 and plutonium since our sealed sources are of these isotopes. These sources are certified by the manufacturer (ICN) to $\pm$5%.

Leak tests are performed by swabbing any areas of the source holder which would conceivably pick up contamination. The detector is a thin window geiger tube RCL Model 10108/7618 with a mica window of 2mg/cm^2 operated at its plateau voltage. Pulses are counted by a scalar for fixed length of time. Background is of the order of 1cnt/sec. Counting is done long enough to discriminate a signal of 1 cnt/sec. This provides a detectability well below 0.005 microcuries of removable contamination.

Leak tests are performed by the Radiation Safety Officer, Dr. W. P. Moran or Dr. K. A. Kuenhold.

4.62 Personnel Monitoring

With the 1Ci source (approximately 2x10^{6}n/s) exposure to individuals will be much smaller than the limits in par. 2 of 4.6.2. Since the source is always in the howitzer or casts, distance is greater than 30 cm. Gamma levels are below 2 m R/hr and the maximum neutron exposure is 1.2 x 10^{2}n/cm^2-sec. Under worst case conditions this corresponds to 4mrem/hr. Thus since activities involving the sources

average less than 1 hr. per 40 hr. week at larger distances than than worst case above, doeses will be less than 0.2 mrem per calendar quarter.

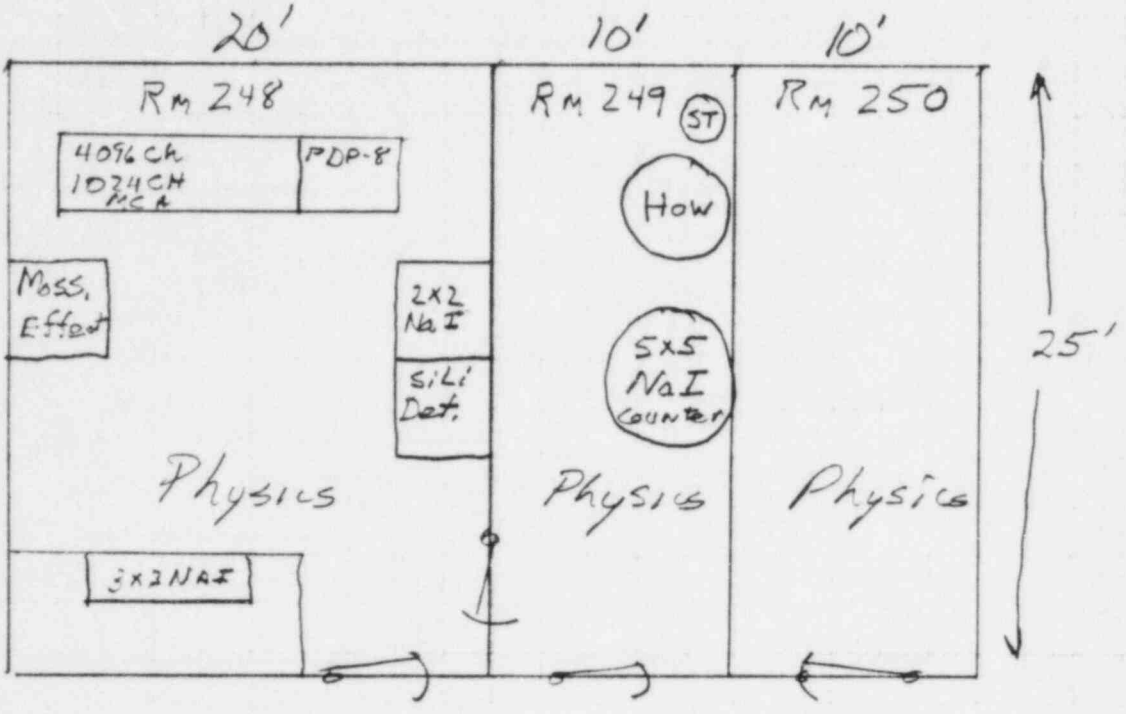
4.6.3 Radiation Survey Program

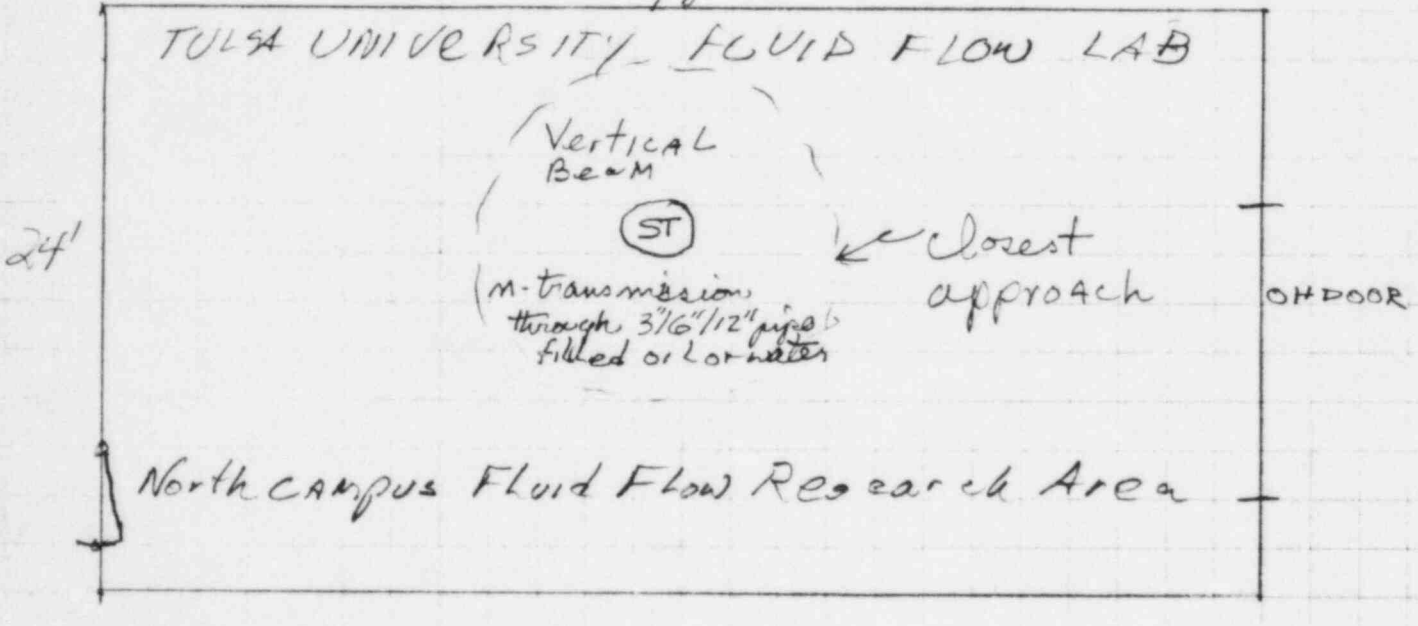
Since only a sealed source is used the provisions of paragraph two are follwed. The neutron and gamma field levels have been described above under 4.6.2. Operation does not involve any means of increasing these levels. Use of the source does not require personnel to be in close proximity to the howitzer or storage container for more than a few minutes in an eight hour day. Surveys are made with portable gamma and neutron detectors after each transfer of the source between howitzer and storage container.

Other subparagraphs of 4.6.3 are not applicable.

UNIVERSITY OF TULSA 2168

Locations For Use of Pu Be Neutron Source 1133 N. Lewis, Tulsa OK July '79



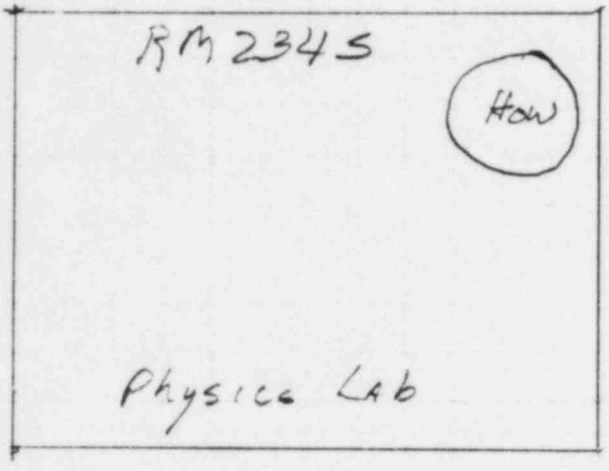


Dose at closest approach < .05 m Rem/hr

ST is the storage and shipping container

How is the howitzer

UNIVERSITY OF TULSA
Locations for Use of Pu-Be Neutron Source 1123 N Lewis, Tulsa OK July 79



Item 3 Bioassay Program

The only work done with other than sealed sources involves the Life Science department's use of tritium and iodine. The maximum licensed amount of tritium is 10 m Ci. This is 1/10 of the amount specified under open room HTO or other forms. The actual amount in process at any one time is well below 1 m Ci. The process amount corresponds approximately with the monthly amount since use of these isotopes is infrequent. Thus the use of tritium meets the criterion of paragraph B of Part I of the NRC guidelines of 10/77. No routine bioassary program is required at these levels of usage. In the event regular more frequent use of larger amounts of tritium is contemplated a bioassay program will be initaited if the criteria for required testing is met.

Use of iodine isotopes also falls below one tenth of the bioassay criterion of 10 m Ci (bound to nonvolatile agent in fume hood) in process at any one time. Use of these isotopes is infrequent and no one individual would be involved in the processes more than a couple of times. There are no regularly scheduled or large uses of iodine planned. Should use of iodine isotopes in excess of the criteria of the NRC guide be contemplated a broassay program would be established.

Item 4 Storage of the plutonium-beryllium neutron source.

The source is stored in a paraffin filled locked drum of 30 gal. capacity. Surface dose is less than 3 m rem/hr. The drum is kept in a restricted laboratory room with access only by faculty key. No unrestricted area receives more than .03 m rem/hr.

Use of the source in the howitzer occurs in the same room. Surface dose is less than 2 m rem/hr. Occupancy of the room by anyone individual is generally less than 20 hrs. in a calendar quarter. Distance to the source exceeds 10 feet. Total dose to anyone individual is less than 0.5 m rem per calendar quarter.

Item 5 Ordering Materials

The only materials ordered in a form other than sealed sources are H-3, C-14, P-32, I-125, and I-136. Orders are placed once a year or less frequently. The University does not accept deliveries except during business hours. Orders are placed only by individuals named on the license. Order and delivery are confirmed with the RSO. Procedures for accepting delivery are: Delivery is to the Life Science Office, licensees are notified, visual inspection is made of package for accepting delivery, package is moved to the laboratory and placed in the locked refrigerator. Procedures of Appendix E and F of 10.8 are followed from that point.

Item 6

This is covered by the procedures in Item 5.

Item 7 Instructions to Personnel

The use of radioactive materials under this license does not produce conditions in which the dose to individuals would exceed the limits of 10CFR-20-105. Thus the areas of use do not constitute restricted areas. All activities under this license particularly the use of unsealed sources are conducted only by the individuals named on the license.

a. Students perform only tasks such as counting. Their involvement is limited to a few hours in a calendar quarter in labroatory courses or individual projects. Student training consists of a 1-2 hr. introduction to the isotopes and radiation levels involved in their work, witnessing surveys or wipe tests to familiarize them with the method and equipment, and instruction in disposal of wastes if they deal with labelled samples.

b. Housekeeping and Security - Instruction is limited to enforcing access restrictions to laboratories or store rooms. This is done routinely for access by anyone except faculty to University facilities.

c. Receiving personnel are not involved since shipments are delivered directly to the named licensee.

d. Laboratory technicians. There are no laboratory technicians involved with licensed materials.

A five hour series of lectures has been developed by the RSO covering the essentials of radiation types, decay schemes, definitions and calculations for exposure, dose and absorbed dose for external and internal exposure, and a review of all sections of the CFR applicable to our license and a review of all license provisions themselves. This sequence has been given to University personnel, oil industry personnel, and the faculty and staff of the Oklahoma Oesteopathic Medical School. It is scheduled to be given in Fall of 1979 to all persons listed on the

University license and any others involved in projects or laboratories utilizing isotopes. This sequence will be given to new personnel and repeated and expanded annually.

Item 8

The only personnel dealing directly with isotopes are those on the license. Their instructions come from the license itself, the annual refresher course, and guidelines such as actions in the case of spills, and Appendix G of 10.8 except for the use of personnel monitoring devices. Our uses do not exceed the levels of 10CFR 20.202.

Item 9

a. b. Spill handling instructions follow Appendix H of 10.8

c. Radiation Safety Officer: Dr. William P. Moran
(918) 939-6351 Ext. 515
off-duty (918) 742-3411

Item 10

Animal Care - No animals are used in research with radioisotopes. Cell cultures are treated with labelled compounds.

Item 11

Calibration - This is described in the response to Item 2 response to paragraph 4.5.5 of regulatroy guide 10.3.

Item 12

Dosimeters

a. These have been described in Item 2 response to paragraph 4.5.5 of regulatroy guide 10.3. These are used by personnel working with either the neutron source or the Cs-137 source. They are read at the end of each use or at the end of the day. Calibration is against the standard sources for gammas or by exposure to the neutron source and comparison to He-3 or scinitillation neutron detector or by comparison to activation flux monitors.

b. No millecurie amounts of P-32 will be ordered or used at anyone time.