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BRADLEY UNIVERSITY
PEORIA, ILLINOIS

February 21, 1963

RECEIVED
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U.S. Atomic Energy Commission
DIVISION OF
LICENSING & REGULATION

U. S. Atomic Energy Commission
Source and Special Nuclear Materials Branch
Division of Licensing and Regulation
Washington 25, D. C.

Gentlemen:

Bradley University, Peoria, Illinois, hereby makes application for a special nuclear material license.

The following information is submitted in triplicate in fulfillment of the requirements of Section 70.22, Title 10, Code of Federal Regulations, Part 70, "Special Nuclear Material".

1. Bradley University, Peoria, Illinois, was founded in 1897 by Lydia Moss Bradley as a non-sectarian institution.

   The principal officers of the University are:

Name	Title	Address	Citizenship
Talman Van Arsdale, Jr.	President	1502 W. Bradley Peoria, Illinois	U.S.
A. G. Haussler	Vice President	1502 W. Bradley Peoria, Illinois	U.S.
George R. Beck	Comptroller	1502 W. Bradley Peoria, Illinois	U.S.

   There is no control or ownership exercised over the applicant by any alien, foreign corporation or foreign government.

2. The neutron source will be used in Bradley University's Nuclear Physics Laboratory course conducted in the Advanced Laboratory Area in the South Wing of Bradley Hall. The material will be used in the education and training of advanced undergraduate students. The source will be used in conjunction with a Nuclear of Chicago Model NH3 Neutron Howitzer to be located in a small infrequently used storage room that is to be kept locked. The following experiments are proposed:

2/26/63-RRG ACKNOWLEDGED

(a) Health Physics survey of Howitzer.

(b) Determination of fast neutron attenuation cross-section and nuclear radii.

(c) Measurement of Albedo of paraffin for thermal neutrons.

(d) Foil activation experiments.

3. The license is requested for a three (3) year period.

4. The source will consist of 32 grams of plutonium encapsulated as one 2 curie Pu-Be source. The source is to be obtained from Monsanto Research Corporation, Dayton Laboratory, Dayton, Ohio and will be constructed as shown in Appendix A.

5. The proposed program will be conducted by Dr. H. A. Moore, Associate Professor of Physics and Department Head. Dr. Moore obtained his M.S. in experimental nuclear Physics from Washington University, St. Louis, Missouri and his Ph. D. from the University of Florida in theoretical nuclear physics. Dr. Moore holds a special nuclear material license for 1 mc of Cs-137 used in the calibration of a scintillation spectrometer and has taught the nuclear physics portion of the advanced laboratory for the past three years.

   Dr. Bhagat Singh will be in charge of Radiation Safety. Dr. Singh possesses a Ph. D. in physical chemistry from the University of Illinois, Urbana, Illinois and has had experience in radiation measurements. Dr. Singh spent two weeks at the Nevada Testing Site, Mercury, Nevada observing and testing high intensity bomb fallout. Dr. Singh has also taught the local Civilian Defense Instructor's course three times. The course included radiation monitoring instruments, dosages, health physics, radiation absorption, radioactive decay laws, half-lives, etc.

6. Description of device and storage container

   A copy of the descriptive literature of the Nuclear of Chicago, Model NH3 Neutron Howitzer is attached as Appendix B. Calculations for the maximum neutron flux on the surface of the container are:

$$\frac{2 \times 1.7 \times 10^6}{4 \text{ pi} \quad (27)^2} \times 2 \frac{-27}{6} = 17 \ \text{n/cm}^2 \ \text{-sec}$$

where

2 = number of curies

1.7×10^6 = neutron emission rate per curie in neutrons per second

27 = thickness of paraffin shield (cm)

6 = paraffin half value thickness (cm) for neutron energy representative of Plutonium.

The following radiation protection instrumentation will be available:

Model Number	Radiation Detected	Range
*Model 2112-N Neutron survey meter	Fast and thermal neutrons	0-15,000 cpm
**OCDM Item No. CDV-700	beta, gamma	0-50 mr/hr
*Model D47 gas flow proportional counter	alphas	$0-10^5$ cpm

* Refers to instruments made by Nuclear of Chicago
** Refers to instrument made by Victoreen Instrument Company

Calibration of the radiation protection instruments will be accomplished quarterly and after any electronic component replacement in accordance with instrument manufacturer's instructions using Nuclear of Chicago Sk-1 standard source kit. Daily upon use, a check will be made to assure proper instrument operation. A permanent record of results will be maintained.

The following personnel monitoring devices are available to all personnel in the laboratory. Film badges are required of everyone handling radioactive materials. Dosimeters are to be required of those persons working directly with the howitzer.

Manufacturer	Type Instrument	Sensitivity	When Checked
Nuclear of Chicago	Film Badge	Beta, Gamma, Neutron	monthly
Nuclear of Chicago	Dosimeter NC-401	neutron	daily on use

7. The source will be stored when not in use in the "storage" position of the Nuclear of Chicago NH3 Neutron Howitzer. The irradiation port and lid closure plug will be secured by use of a lock, the keys being available only to the instructor and the chairman of the Physics Department to prevent unauthorized use or removal of the source for the Howitzer.

The manipulation of the source will be accomplished only by the laboratory instructor by the use of a threaded handling rod at least one meter long. The source will be removed only for leak testing. It is not expected that the exposure time (when the source is unshielded) will exceed 20 minutes per semester.

After receipt of the neutron source, an initial survey of each device and working area will be accomplished to determine the necessity for posting and labeling. If posting and labeling are required, it will be accomplished in accordance with the instructions contained in § 20.203 of 10 CFR 20. At the conclusion of each operation, surveys will be accomplished to assure the source has been returned to its storage position. Periodic surveys of each device will be accomplished to determine the integrity of the devices. Daily, upon use, surveys will be made to evaluate radiation dose received by using personnel.

The neutron source will be leak tested quarterly in the following manner:

(a) Remove lid closure plug.

(b) Thread handling tool into recessed hole of neutron source.

(c) Remove source from neutron Howitzer maintaining the source as far from the body as possible.

(d) Rotate source against filter pad.

(e) Return source to neutron Howitzer and place in storage position.

(f) Replace lid closure plug.

(g) Place filter pad in gas-flow proportional counter and determine alpha activity.

(h) If less than 0.005 microcuries of removable contamination is detected on the test sample record result of leak test in log book provided.

(i) If 0.005 microcuries or more of removable alpha contamination is detected on the sample, promptly evaluate personnel and area for contamination. Prevent further spread of contamination. Consider the source leaking until proved otherwise. Decontaminate source, store for at least 24 hours and repeat the leak test.

(j) If the repeated test shows greater than 0.005 microcuries of contamination, place the source in a leak proof container, seal container, place in shipping container and return to manufacturer for repair or replacement. Notify the Director, Division of Licensing and Regulation, U.S. Atomic Energy Commission, Washington 25, D.C., with a copy to the director of the nearest AEC Regional Compliance Office, as listed in Appendix D of 10 CFR 20, describing test results and action taken.

(k) If repeated test shows less than 0.005 microcuries, consider the contamination a result of improper clean-up of source following encapsulation. The source may be returned to normal use.

(l) Record results of all leak tests in log book.

Sincerely yours,

Talman Van Arsdale

Talman Van Arsdale, Jr.
President

ENDIX A

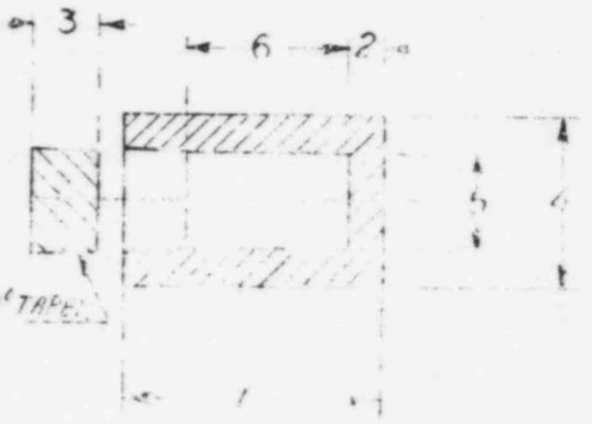
[illegible] DI

Range	1	2	3	4	5	6
1	1.05	0.100	0.200	0.934	0.814	[illegible]
2	[illegible]	0.100	0.200	0.934	0.814	[illegible].50
3	2.55	0.100	0.200	0.934	0.814	2.25
4	[illegible]	[illegible]	0.200	0.934	0.814	[illegible]
5	4.05	0.100	0.200	0.934	0.814	3.75
6	2.50	0.100	0.200	1.184	1.064	2.20
7	3.40	0.100	0.200	1.184	1.064	3.10
10	3.25	0.100	0.200	1.434	1.300	2.95

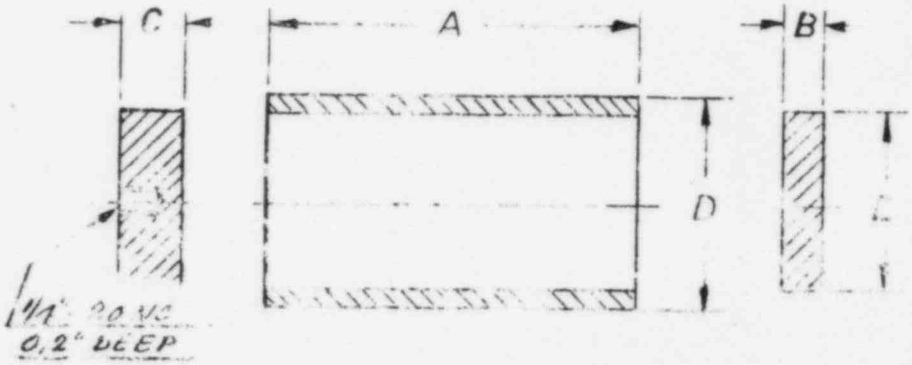
OUTER CONTAINER [illegible] SIONS (In [illegible])

A	B	C	D	E
1.40	0.100	0.25	0.998	0.938
2.15	0.100	0.25	0.998	[illegible]
2.90	0.100	0.25	0.998	[illegible]
3.65	0.100	0.25	0.998	[illegible]
4.40	0.100	0.25	0.998	[illegible]
2.85	0.100	0.25	1.248	1.188
3.75	0.100	0.25	1.248	1.188
3.6	0.100	0.25	1.498	1.438

All dimensions ± 0.002



INNER CONTAINER - TAN [illegible]



OUTER CONTAINER 304 STAINLESS STEEL

MONSANTO RESEARCH CORP
DAYTON, OHIO

Pu Be SOURCE
CONTAINER

SCALE NONE

DAYTON, O

DWG. N3 - 8

TRAINING INSTRUMENTS

A foil is inserted into a port drawer. Foils and samples can be positioned at various radii from the neutron source. Drawers slide easily into ports.

MODEL NH3 NEUTRON HOWITZER

- versatile training device for colleges and universities
- for study and experimentation with low-level neutron sources
- for activation analysis—production of low intensity, short-lived isotopes
- serves as a storage shield for neutron sources

The Model NH3 Neutron Howitzer is a compact, versatile training device for lecture demonstration and student experimentation with neutron sources. A vertical central storage tube holds as many as five one-curie plutonium beryllium sources. Foils, samples, and detectors can be exposed to the neutron flux [illegible] the Howitzer by insertion into either [illegible] two horizontal ports which extend from the outside of the vessel to the source at the center. The thermal neutron flux 3 cm from the central storage tube is ~ 4 x 10^4 n/cm²/sec with 5 one-curie sources.

The Howitzer permits activation of a variety of elements, and the low intensity, short-lived isotopes produced require only reasonable care in handling. Manuals with detailed and carefully tested experiments are supplied to carry the inexperienced student from simple radiation measurements through relatively complex neutron reaction studies.

SPECIFICATIONS

container—Polished aluminum, 22 1/2 in. diameter by 35 in. high. Hinged cover is provided with lock and key.

shielding—Blend of low-oil-content paraffin and microcrystalline wax fills the Howitzer to within 6 in. of the top. An aluminum plate covers the paraffin, and a central storage tube and two source transfer tubes penetrate into the paraffin.

central storage tube—0.035 in. aluminum wall, 1 5/16 in. diameter, 22 in. deep. Contains source positioning rod and source cup.

neutron source(s)—[illegible] NH3 is designed for use with up to five one curie low gamma emission plutonium-beryllium sources, 1.02 in. diameter by 1.3 in. long.

experiment ports—2 1/8 in. dia. ports extend from outside of vessel to central storage tube. Ports are separated by 120° to permit two simultaneous experiments without interference.

port drawers—2 in. diameter [illegible] in. long with lock and key.

shipping weight—[illegible] lbs

supplied with—[illegible] aluminum source cup, two detector [illegible] two port drawers with [illegible] spacers, 6 foil spacers, [illegible] source handling [illegible] 20 cadmium foil [illegible] 12 experiment manuals.