NOV 30 1967

DML:IB:NB (56856)

Commanding Officer
U. S. Army Electronics Command
Fort Monmouth, New Jersey 07703

Dear Sir:

This refers to your application for renewal of License No. 29-01022-06.

Appendix II of ECOMR 385-9 relates to the categories of radiation hazards of radioactive materils. Several months ago we were asked by the Office of the Deputy Chief of Staff for Logistics to comment on this particular document. On March 3, 1967, we sent a letter to DCSLOG with our comments. These comments do not appear to have been taken into consideration. In order to continue our review of the application, we need clarification of the matters which we discussed in our letter of March 3, 1967.

Sincerely yours,

Original Signed by
Nathan Bassin

Nathan Bassin
Isotopes Branch
Division of Materials Licensing

Enclosure:
Cy ltr dtd 3/3/67 to DCSLOG

cc: DCSLOG/PRMA, w/cy encl.
bcc: CO, Region I

DISTRIBUTION:
1 --------- Addressee
2 & 3 ----- cc & bcc
4 --------- DML Reading File
5-6-7-8 --- IB Standard Dist.

Information in this record was deleted in accordance with the Freedom of Information Act, exemptions 6
FOIA- 2006-0238

OFFICE ▶	DML:IB					
SURNAME ▶	NBassin/rhw					
DATE ▶	11/29/67					

Form AEC-318 (Rev. 9-53) U.S. GOVERNMENT PRINTING OFFICE: 1966—O-214-629

DEPARTMENT OF THE ARMY
OFFICE OF THE DEPUTY CHIEF OF STAFF FOR LOGISTICS
WASHINGTON, D.C. 20310

7 SEP 1967

LOG/PE-ISB

U. S. Atomic Energy Commission
Division of Materials Licensing
Isotopes Branch
Washington, D. C. 20545

Gentlemen:

It is recommended that the attached applications dated 24 May 1967 and 20 June 1967, for renewal of and amendment to AEC Byproduct Material License No. 29-1022-6 for U. S. Army Electronics Command be approved.

Bioassay services will be available from the Army Surgeon General and Tracerlab. If a commercial firm is used for all bioassay procedures, duplicate samples will be sent to the Surgeon General for evaluation, especially to verify any abnormal results.

Sincerely yours,

1 Incl
as(in tripl)

C. M. Mc KEEN, JR.
Colonel, GS
Chief, PEMA Execution Division

Form AEC-313 (5-58)

ATOMIC ENERGY COMMISSION

APPLICATION FOR BYPRODUCT MATERIAL LICENSE

Form approved. Budget Bureau No. 38-R027.3.

INSTRUCTIONS.—Complete Items 1 through 16 if this is an initial application. If application is for renewal of a license, complete only Items 1 through 7 and indicate new information or changes in the program as requested in Items 8 through 15. Use supplemental sheets where necessary. Item 16 must be completed on all applications. Mail three copies to: U. S. Atomic Energy Commission, Washington 25, D. C. Attention: Isotopes Branch, Division of Licensing and Regulation. Upon approval of this application, the applicant will receive an AEC Byproduct Material License. An AEC Byproduct Material License is issued in accordance with the general requirements contained in Title 10, Code of Federal Regulations, Part 30 and the Licensee is subject to Title 10, Code of Federal Regulations, Part 20.

1. (a) NAME AND STREET ADDRESS OF APPLICANT. *(Institution, firm, hospital, person, etc.)*

U. S. Army Electronics Command
Fort Monmouth, New Jersey

(b) STREET ADDRESS(ES) AT WHICH BYPRODUCT MATERIAL WILL BE USED. *(If different from 1 (a).)*

See Inclosure 1

2. DEPARTMENT TO USE BYPRODUCT MATERIAL

See Inclosure 2 (List of Labs)

3. PREVIOUS LICENSE NUMBER(S). *(If this is an application for renewal of a license, please indicate and give number.)*

Renewal 29-1022-6 in its entirety

4. INDIVIDUAL USER(S). *(Name and title of individual(s) who will use or directly supervise use of byproduct material. Give training and experience in Items 8 and 9.)*

Persons designated by the USAECOM Isotope Committee. Mr. B. Markow, Chairman. (See Inclosure 3)

5. RADIATION PROTECTION OFFICER *(Name of person designated as radiation protection officer if other than individual user. Attach resume of his training and experience as in Items 8 and 9.)*

Dr. W. Ramm - Radiation Protection Officer
Lt. J. Ross - Alternate

(See Inclosure 3 for resumes')

6. (a) BYPRODUCT MATERIAL. *(Elements and mass number of each.)*	(b) CHEMICAL AND/OR PHYSICAL FORM AND MAXIMUM NUMBER OF MILLICURIES OF EACH CHEMICAL AND/OR PHYSICAL FORM THAT YOU WILL POSSESS AT ANY ONE TIME. *(If sealed source(s), also state name of manufacturer, model number, number of sources and maximum activity per source.)*
A. Any byproduct material with Nos 3-83 inclusive	A. Any physical and/or chemical form A. 1000 millicuries each
B. Cobalt 60	B. Sealed Sources B. 440 curies total with no single source to exceed 200 curies.
C. Cesium 137	C. Oak Ridge National Laboratories C. One source 125 curies sealed source.
D. Polonium 210	D. Any D. 10 millicuries
E. Polonium 210	E. Sealed Source E. 10 curies
F. Hydrogen 3	F. Tritiated Titanium Targets F. 100 curies no single source to exceed 10 curies.
G. Cesium 137 (Cont'd Inclosure 3A)	G. Oak Ridge National Laboratories sealed source G. 660 curies contained in 3 sources 220 curies each.

7. DESCRIBE PURPOSE FOR WHICH BYPRODUCT MATERIAL WILL BE USED. *(If byproduct material is for "human use," supplement A (Form AEC-313a) must be completed in lieu of this item. If byproduct material is in the form of a sealed source, include the make and model number of the storage container and/or device in which the source will be stored and/or used.)*

7a To be used for Research and Development, see inclosure 4

7b Storage Containers described in inclosure 8

98856

(Continued on reverse side)

Incl 3

TRAINING AND EXPERIENCE OF EACH INDIVIDUAL NAMED IN ITEM 4 *(Use supplemental sheets if necessary)*

8. TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (Circle answer)	FORMAL COURSE (Circle answer)
a. Principles and practices of radiation protection	See Inclosure 3		Yes No	Yes No
b. Radioactivity measurement standardization and monitoring techniques and instruments			Yes No	Yes No
c. Mathematics and calculations basic to the use and measurement of radioactivity			Yes No	Yes No
d. Biological effects of radiation			Yes No	Yes No

9. EXPERIENCE WITH RADIATION. *(Actual use of radioisotopes or equivalent experience.)*

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION OF EXPERIENCE	TYPE OF USE
		See Inclosure 3		

10. RADIATION DETECTION INSTRUMENTS. *(Use supplemental sheets if necessary.)*

TYPE OF INSTRUMENTS (Include make and model number of each)	NUMBER AVAILABLE	RADIATION DETECTED	SENSITIVITY RANGE (mr/hr)	WINDOW THICKNESS (mg/cm²)	USE (Monitoring, surveying, measuring)
		See Inclosure 5			

11. METHOD, FREQUENCY, AND STANDARDS USED IN CALIBRATING INSTRUMENTS LISTED ABOVE.

See Inclosure 6

12. FILM BADGES, DOSIMETERS, AND BIO-ASSAY PROCEDURES USED. *(For film badges, specify method of calibrating and processing, or name of supplier.)*

See Inclosure 7

INFORMATION TO BE SUBMITTED ON ADDITIONAL SHEETS

13. FACILITIES AND EQUIPMENT. Describe laboratory facilities and remote handling equipment, storage containers, shielding, fume hoods, etc. Explanatory sketch of facility is attached. *(Circle answer)* Yes (circled) No

See Inclosure 8

14. RADIATION PROTECTION PROGRAM. Describe the radiation protection program including control measures. If application covers sealed sources, submit leak testing procedures where applicable, name, training, and experience of person to perform leak tests, and arrangements for performing initial radiation survey, servicing, maintenance and repair of the source.

See Inclosure 9

15. WASTE DISPOSAL. If a commercial waste disposal service is employed, specify name of company. Otherwise, submit detailed description of methods which will be used for disposing of radioactive wastes and estimates of the type and amount of activity involved.

See Inclosure 10

CERTIFICATE (This item must be completed by applicant)

16. THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATE ON BEHALF OF THE APPLICANT NAMED IN ITEM 1, 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.

SEP 11 1967

Applicant named in item 1

Date: 24 May 67

By: Wolfgang J. Rau[illegible]

Boris Marlow [signature]
Chairman, Isotopes Committee

Radiological Protection Officer
Title of certifying official

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.

GPO 939373

Inclosure 1

Form AEC-313 question 1b

In addition to the address in 1a, by product material will be used at the following other locations:

1. Cobalt 60 sealed sources containing a total of not more than 200 curies to be used at Oakhurst Tower Station, Ocean Township, New Jersey; Nevada Test Site; Pacific Proving Grounds; Lakehurst Naval Air Station, New Jersey; and Fort Huachuca, Arizona.

2. Cobalt 60 sealed sources containing not more than 2 curies to be used at Fort Greeley, Alaska.

3. Strontium 90 light sources containing not more than 50 millicuries to be used at Oakhurst Tower Station, Ocean Township, New Jersey; and Thule, Greenland.

4. Two sealed tritium light sources containing not more than 250 millicuries each to be used in Fort Huachuca, Arizona and the Yuma Test Station in Yuma, Arizona.

5. One target replenishing cartridge containing not more than 140 curies of Hydrogen 3 and one tritiated titanium target containing not more than 10 curies to be used in the Kaman Nuclear Corp. Model A-1001 Neutron Generator at Fort Hancock, New Jersey. During target or replenishing cartridge replacement, two (2) cartridges or two (2) targets may be located at Fort Hancock for a short period of time.

Inclosure 2

Form AEC-313 question 2

The following laboratories of U. S. Army Electronics Command will use the byproduct materials:

1. Institute for Exploratory Research
2. Combat Surveillance & Target Acquisition Laboratory
3. Electronic Components Laboratory
4. Communications / ADP Laboratory
5. Avionics Laboratory
6. Atmospheric Sciences Laboratory
7. Electronic Warfare Laboratory

Inclosure 3

Form AEC-313 question 4, 8 and 9

Members of the Isotope Committee

Mr. Basil Markow, Chairman, Supv Radiation Facilities, Expl 'S'

Dr. Wolfgang Ramm, Radiological Protection Officer, Expl 'S'

Dr. H. H. Kedesdy, Director, Inst for Expl Rsch Div 'E'

Dr. Stanley Kronenberg, Director, Inst for Expl Rsch Div 'S'

Mr. Richard Rast, Physical Scientist, CS & TA Laboratory

Mr. Bernard M. Savaiko, Safety Director ESC

Capt. Ralph B. Carruthers, Chief, Preventive Medicine, PAH

Capt. Giles R. Locke, Radiologist X-ray Clinic, PAH

Lt. Col. J. H. Horton, Chief Logistics Div

Mr. Louis L. Kaplan, Deputy Director, ESSD

Lt. J. Ross, Alternate Radiological Protection Officer

Mrs. Lynda J. Rockhill, Secretary, Isotope Committee, Expl 'S'

A resume' of professional background of each member of the Isotope Committee is included.

Please place in
an accordian
folder and attach
29-010 22-06

CHECKLIST

1. License No. ______________________________

2. License Name: ______________________________

3. Latest Amendment No. ________________________

4. List any amendments duplicated _________________

   ____________________ ____________________

5. Were older amendments transferred from Region File to the "Official" file? Yes_____ No _____

6. All backup found in "Official" file? Yes____ No____

7. Inspection correspondence transferred to "Official" file?

   Yes _______ None ______

8. Miscellaneous correspondence transferred to "official" file"

   Yes _______ No ______

9. Transfer completed? Yes ____ or Explain ____________________

   ____

   ____

   ____

SUPPLEMENT D

Byproduct Material and Chemical and/or Physical Form and Maximum Number of Millicuries

Reference: Form AEC-313, Items 6(a) and 6(b).

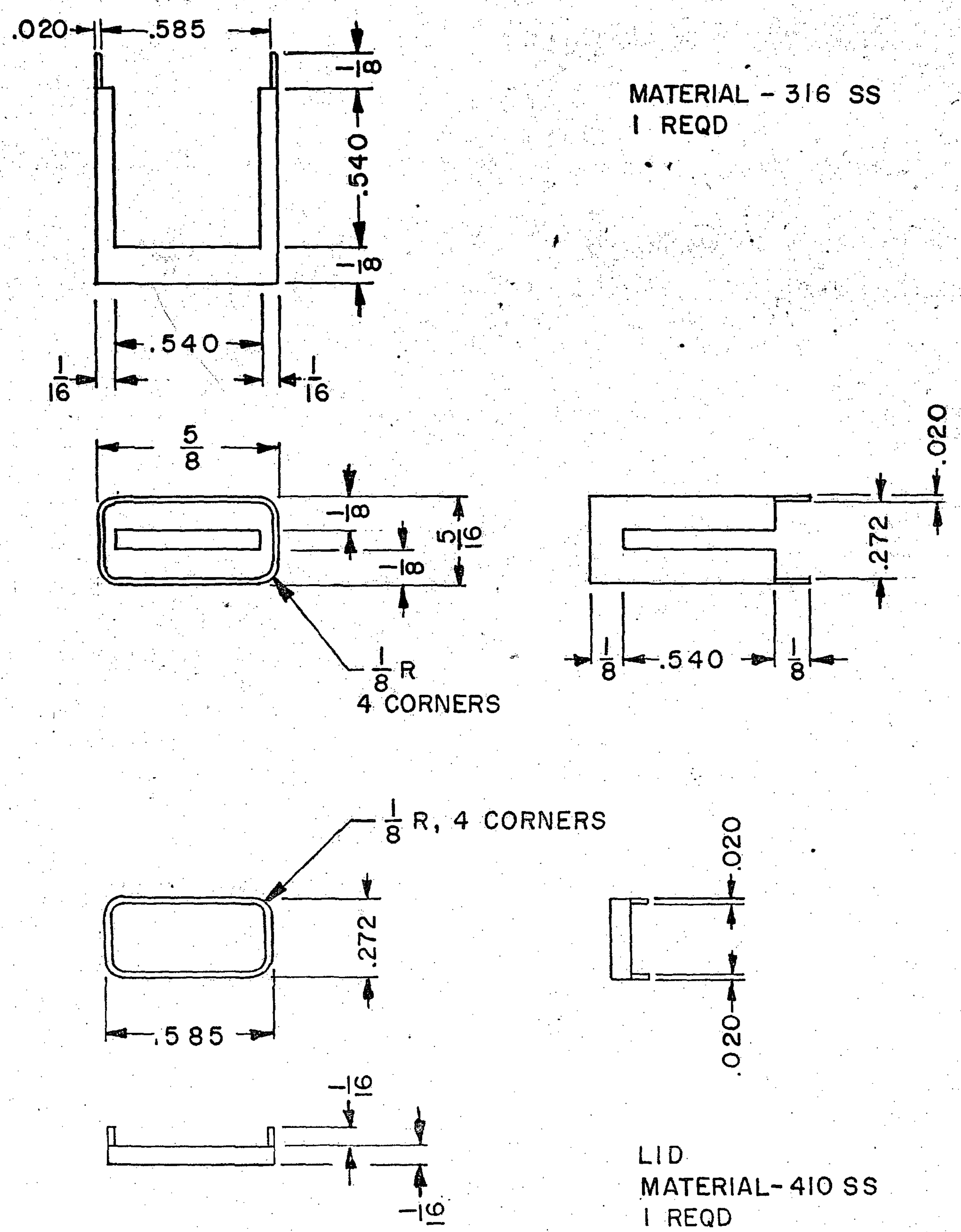
SUPPLEMENT D

SUBJECT: Byproduct Material and Chemical and/or Physical Form and Maximum Number of Millicuries

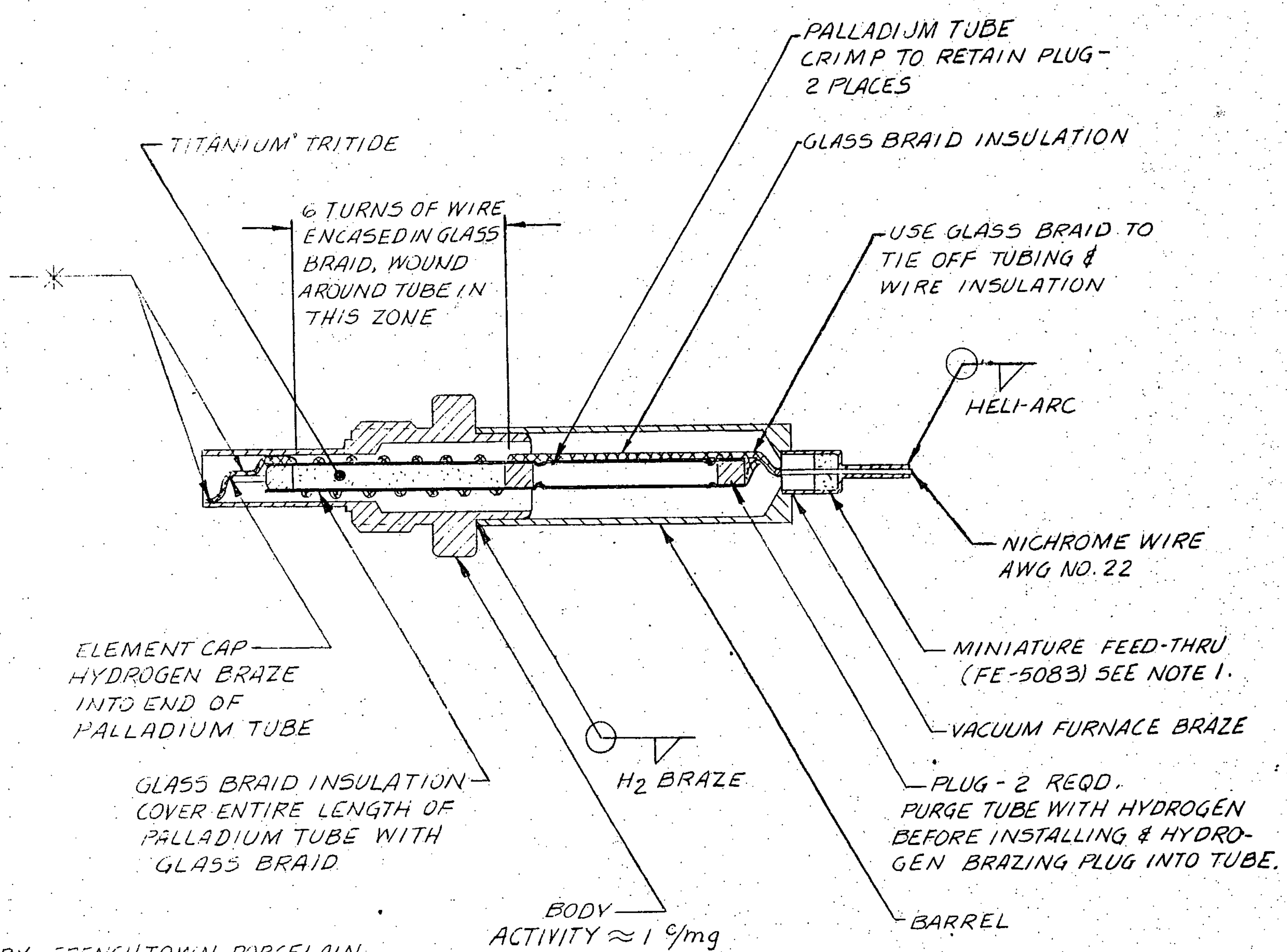
1. Reference: Form AEC-313, Items 6(a) and 6(b).

2. Continuation of Items 6(a) and 6(b).

6(a) Byproduct Material	6(b) Chemical and/or Physical Form and Maximum Number of Millicuries.
E. Cobalt 60	E. Sealed Sources, 440,000 millicuries total, no single source to exceed 200,000 millicuries. ORNL and commercial sources. Commercial sources double encapsulated. Capsules sealed by welding. First capsule sealed and leak tested prior to second encapsulation.
F. Hydrogen 3	F. Gas in acceleration targets (such as tritiated titanium), 200,000 millicuries total, no single target to have more than 20,000 millicuries.
G. Hydrogen 3	G. Gas, 300,000 millicuries total contained in three or more Kaman Nuclear Model R Replenishing Cartridges. (See Fig. D-2).
H. Hydrogen 3	H. Gas, 75,500 millicuries total, contained in hermetically sealed glass capsules. No single source to exceed 1500 millicuries. These capsules are self powered light sources such as Canrad Precision Industries, Inc. "Betalight" type R02/G/1300 (See Fig. D-3) or U. S. Radium Corporation Model LAB-706 Sealed Light Source (See Fig. D-4).
I. Polonium 210	I. 10 millicuries in any form.
J. Polonium 210	J. Two sealed sources, 20,000 millicuries total. No single source to exceed 10,000 millicuries.



. D-1-ORNL CAPSULE FOR 50 CURIES OF CESIUM 137

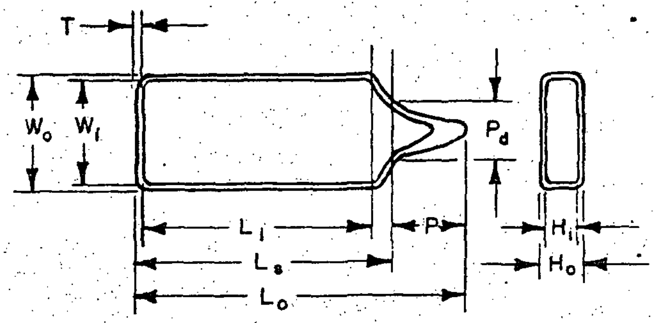


NOTE:
1. SUPPLIED BY FRENCHTOWN PORCELAIN CO., FRENCHTOWN, N.J.
2. ALL HYDROGEN & VACUUM FURNACE BRAZE SUPPLIED AS "CUSIL" AG-CU ALLOY BY WESTERN GOLD & PLATINUM CO., BELMONT, CALIF.

FIG. D-2 TARGET REPLENISHING CARTRIDGE, KAMAN NUCLEAR MODEL R

884 D3

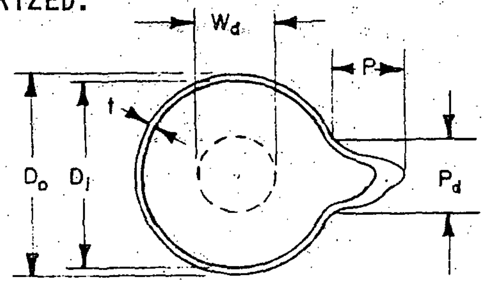
TYPE R RECTANGULAR TUBE



TYPE NO.	Lo	Ls	Li	Wo	Wi	Ho	Hi	T	P	Pd	STANDARD BRIGHTNESS	MAXIMUM BRIGHTNESS
R01/G/250	15.0	11.5	8.0	10.0	8.0	5.0	3.0	1.5	5.0	-	250	750
*R02/G/380	±1.5	±0.5	-	±0.5	±0.1	±0.5	±0.1	-	-	-	380	1300
R03/G/290	23.0	19.5	16.0	10.0	8.0	5.0	3.0	1.5	5.0	-	290	NA
R04/G/420	±1.5	±0.5	-	±0.5	±0.1	±0.5	±0.1	-	-	-	420	NA
R05/G/290	29.0	25.5	22.0	10.0	8.0	5.0	3.0	1.5	5.0	-	290	NA
R06/G/425	±1.5	±0.5	-	±0.5	±0.1	±0.5	±0.1	-	-	-	425	NA
R09/G/260	21.0	15.0	12.5	15.0	13.0	4.5	2.6	2.0	6.0	-	260	NA
R10/G/425	±1.5	±0.5	-	±0.5	±0.1	±0.5	±0.1	-	-	-	425	NA

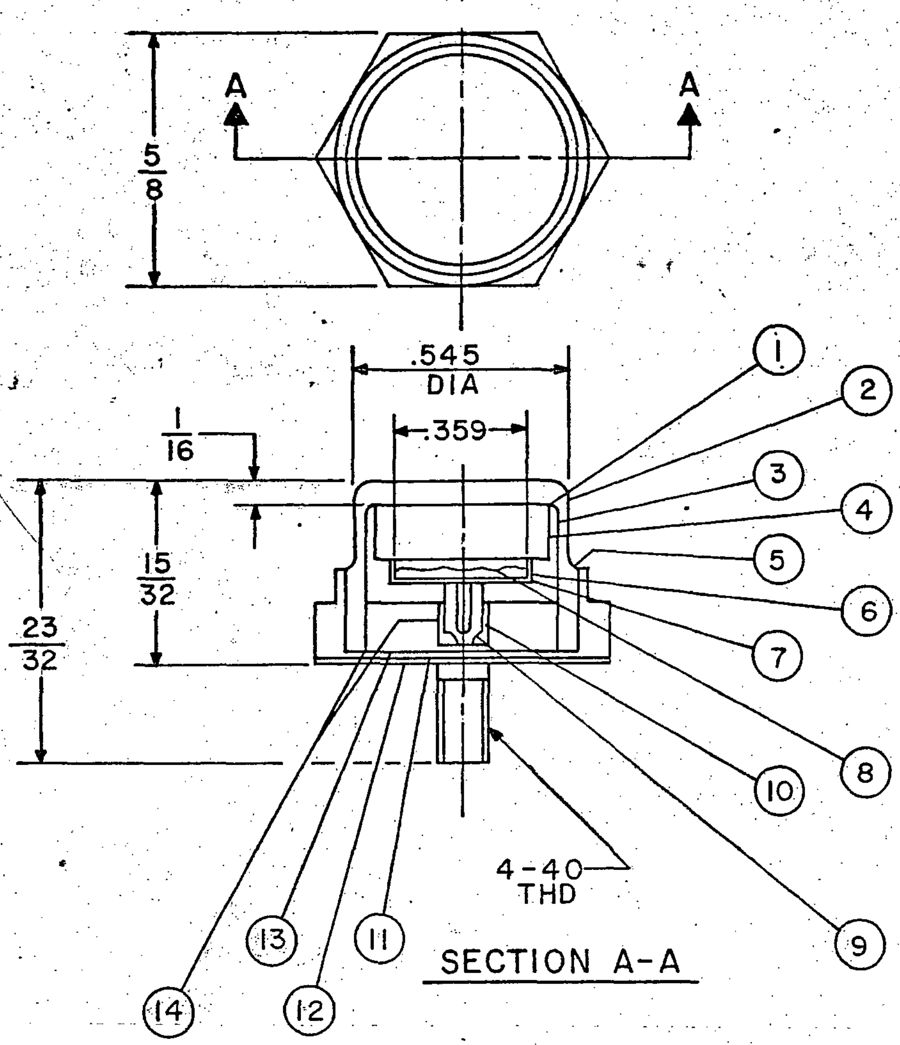
* TUBE ORDERED TYPE R02/G/1300 SAME AS TYPE R02/G/380 SHOWN ABOVE WITH FOLLOWING EXCEPTIONS: (1) SEALED OFF ON SIDE INSTEAD OF AT END. (2) TUBE IS PRESSURIZED.

TYPE S SPHERE



TYPE NO.	Do	Di	P	Pd	t	Wd	STANDARD BRIGHTNESS	MAXIMUM BRIGHTNESS
S01/G/210	8.0 ±0.2	6.0 ±0.25	5.0	4.0	1.0 ±0.25	-	210	750
S03/G/190	7.0 ±0.2	-	5.0	4.0	1.0 ±0.25	-	190	450
S06/G/700	7.0 ±0.2	-	5.0	4.0	1.0 ±0.25	3.5 ±0.25	700	1300
S07/G/350	11.0 ±0.2	-	6.0	5.0	1.0 ±0.25	-	350	NA
S10/G/1000	11.0 ±0.2	-	6.0	5.0	1.0 ±0.25	6.0 ±0.25	1000	NA
A12/G/900	12.0 ±0.2	10.0 ±0.5	6.0	5.0	0.75 ±0.25	10.0 ±0.5	900	NA

FIG. D-3 EXAMPLES— SELF POWERED LIGHT SOURCES



LEGEND

1. GLASS-METAL SOLDER SEAL
2. OUTER HOUSING-PLEXIGLAS
3. INNER HOUSING-C.R.S. (CAD. PLATED)
4. CERIUM GLASS WINDOW
5. CONTINUOUS EPOXY RESIN SEAL
6. ACTIVE GAS
7. ALUMINUM CUP
8. PHOSPHOR BED
9. FILLING TUBE-CRIMP & SOLDER DIP
10. SILVER SOLDER-1145-F
11. HOUSING ALUMINUM-GOLD ANODIZE
12. LABEL DATA
13. BACKPLATE-ALUMINUM
14. CONTINUOUS EPOXY RESIN SEALS

LABEL DATA:

1. CAUTION RADIOACTIVE MATL
2. RADIATION SYMBOL
3. ISOTOPE SYMBOL & CONTENT
4. SEALING DATE

SAFE OPERATING TEMP.
180°F (MAX)

FIG. D-4 MODEL LAB-706 SEALED LIGHT SOURCE

6(a) Byproduct	6(b) Chemical and/or Physical Form and Maximum Number of Millicuries.
K. Promethium 147	K. Four Sealed Sources (self-powered light sources), 1200 millicuries total. No single source to exceed 300 millicuries. Minnesota Mining & Manufacturing Co. P.O. No. DAAB07-69 MF333.
L. Strontium 90	L. 1600.4 millicuries total; contained in 40 sealed sources with a maximum of 40 millicuries per source, and 10 sealed sources with a maximum of 0.04 millicuries per source. The sources are Minnesota Mining & Manufacturing Co. type 3FIG or equivalent, as per ECOM Drawing No. SM-B-509057. Sources made for use in the Army Radiac Calibrator Set AN/UDM-2. Source details in application for AEC License No. 29-01022-08 issued to U. S. Army ECOM.
M. Strontium 90	M. Four Sealed Sources of 25 Millicuries each. Sources from Army Radiac Calibrator Sets TS-784-A. Details shown in application for AEC License No. 16-05033-01 issued to Lexington-Blue Grass Army Depot.

SUPPLEMENT E

I. Purpose for Which Byproduct Material Will be Used.

II. Storage Containers for Sealed Sources

Reference: Form AEC-313, Item 7.

SUPPLEMENT E

SUBJECT: I. Purpose for Which Byproduct Material Will be Used. II. Storage Containers for Sealed Sources

I. Purpose for Which Byproduct Material Will be Used.

1. Reference: Form AEC-313, Item 7.

2. The following are examples of the main portion of the RD&E research development and testing programs that utilize radioisotopes:

   a. Radiation detection instrument research and development.

   b. Radiation effects on electronic parts and components.

   c. Radiation power sources

   d. Self powered light sources

   e. Basic research

3. A large group is concerned with the design and development of radiation detecting instruments, both rate meters and integrating dosimeters. These instruments range from the ones that measure background to those that measure intensities such as those found in the fireball of atomic explosions. The instruments may be sensitive to gammas, betas, alphas, thermal or fast neutrons or combinations of these. It is this program that requires most of the high intensity sealed sources and accelerators. New detectors are also frequently irradiated at reactor facilities. This results in radioactivity in the instruments. These instruments must be brought back to RD&E for evaluation and further testing, and since it would be impossible to predict the exact isotopes that result, a broad license is necessary.

4. The groups devoted to research and development of electronic parts and components devote considerable effort irradiating parts and components with various sources of nuclear radiation, both in the laboratory and at other installations. They determine the effects of nuclear radiation on new parts and develop radiation resistant parts. As mentioned above, the nature of induced activity is not known and time spent to determine it would make experiments useless. A broad license is therefore required.

5. The use of isotopes in basic research is two-fold. Small amounts of radioactive material are needed in experiments requiring high energy ions such as alpha particles and fission fragments while other isotopes are used in experiments involving nuclear decay schemes.

6. Some byproduct material may be used in training programs for radiation workers, and emergency and security personnel that may encounter radiological hazards in the performance of their duties.

II. Storage Containers for Sealed Sources.

1. Reference: Form AEC-313, Item 7.

2. A variety of small lead containers are available for storing and moving small sources.

3. The following are some of the special containers that are used for large sources.

   a. The Radiac Calibrator Set AN/UDM-1 is designed for 10 curies of cobalt 60. It is manually operated. When in use the radiation from it is collimated in one direction. The set was designed for the Department of the Navy, Bureau of Ships, and calibrated by NBS. Operating procedure is described in the NBS manual that comes with the set.

   b. The Radiac Calibrator Set AN/UDM-1A was designed for 125 curies of cesium 137. It is also manually operated. When in use the radiation from it is collimated in one direction. It was designed for the Navy and calibrated by NBS. The technical manual that comes with the set and describes the system and gives operating instructions is Navships 93204.

   c. The Radiac Calibrator Set AN/UDM-2 is designed for a total of up to 160.04 millicuries of strontium 90. There are two calibrators in each set. One for ratemeters and one for pocket dosimeters. The one for ratemeters is designed for one source of up to 40 millicuries while the one for dosimeters will house three 40 millicurie sources and one 0.04 millicurie source. This calibrator set was designed by RD&E for use throughout the Army. Detailed information is given in the application for AEC license No. 29-01022-08.

   d. Radionics Inc. source container P60-30-2 is designed for 30 curies of cobalt 60.

   e. EON Corp. model EON894 Portable Field Calibrator (same as Office of Civil Defense Radiological Instrument Calibrator CDV-794 Mark III) is designed for 220 curies of cesium 137. Fig. E-1 shows the primary shield portion of the calibrator. The rails and side walls are made of "Mallory 1000" material. The slides and the rest of the shield is made of depleted uranium that is nickel plated and coated with epoxy paint. The open end of the

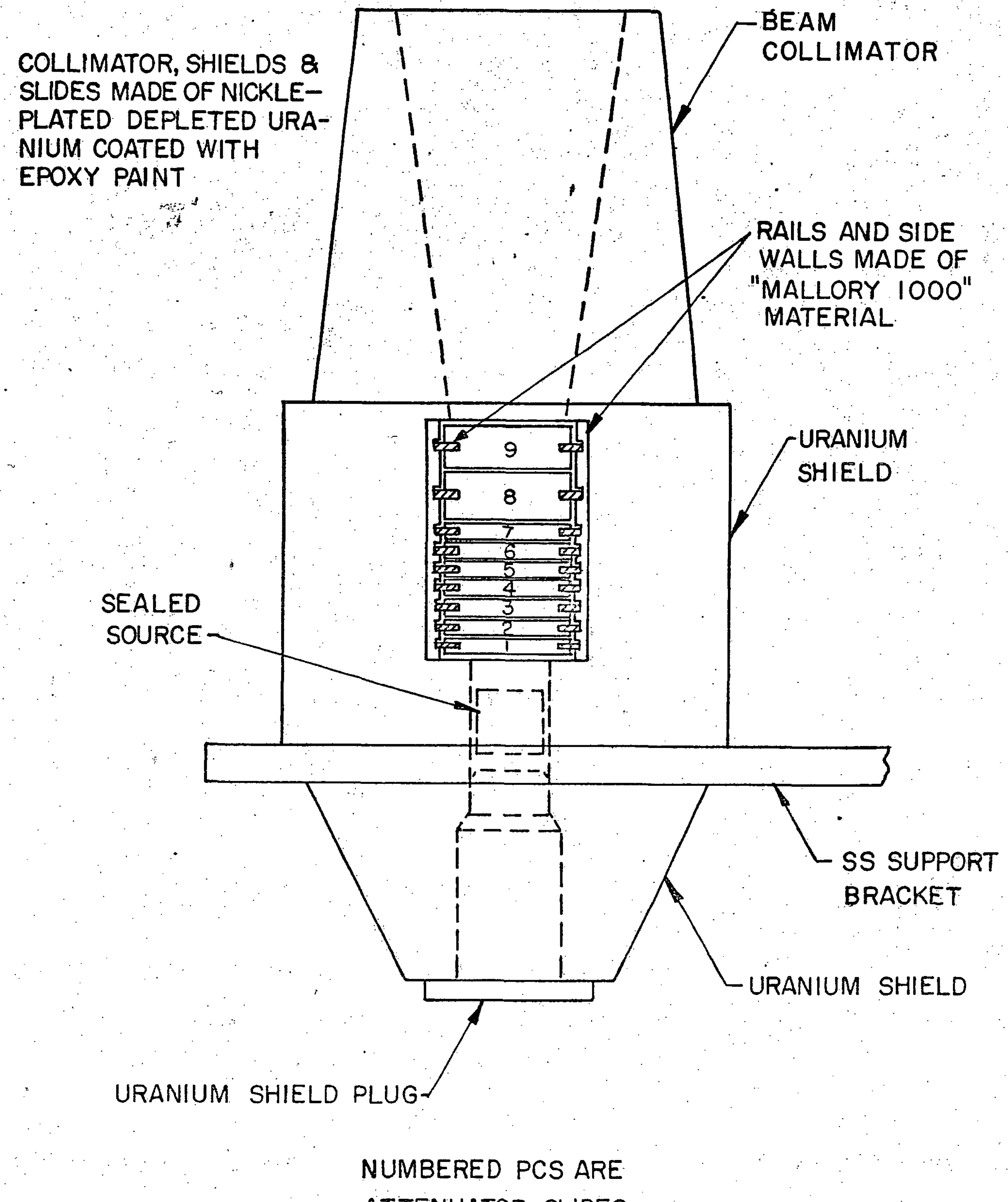


FIG E-1 PRIMARY SHIELD OF EON 894 PORTABLE FIELD CALIBRATOR portion of the calibrator shown in the drawing opens into a test chamber made of depleted uranium. This chamber has a door that may be opened when all of the uranium slides are in place. Under this condition the radiation intensity inside the box is less than 0.4 mR/hr. The chamber has a shield window so that the meter on an instrument may be read while it is in the chamber. The exposure rate inside the chamber is controlled by the number of uranium slides that serve as attenuators, that are between the source and the chamber.

f. Radiation Backscattering Devices. This device was made by ORNL. It contains a cesium 137 sealed source (See Fig. D-1). The portion of the device that holds the source and collimates the beam (See Figs. E-2 and E-3) is made of tungsten alloy. A lead cap is used to cover the end of the collimating slot when the device is not in use. The lead cap is held in place by machine screws. Mr. Frank Dyer and Mr. L. Bates of the ORNL Analytical Chemistry Division made an initial survey of the device. The highest radiation level at one foot from the center of the source was reported to be 30 mR/hr.

g. Shipping containers for Kaman Nuclear Replenishing Cartridge. Kaman Nuclear Model R Replenishing Cartridges (See Fig. D-2) are stored in their shipping containers (See Fig. E-4), or in air-tight glass jars. The containers are properly labeled when they contain a cartridge.

h. Storage containers, and devices in which sources will be both stored and used that are designed to meet AEC and DOT thermal and/or heating tests for shipping containers shall be used for sources made or obtained after the date of this application. The radiation intensity 6 inches from any exterior surface of a new storage container will not exceed 50 mrem/hr, or 10 mrem/hr at one meter from any exterior surface.

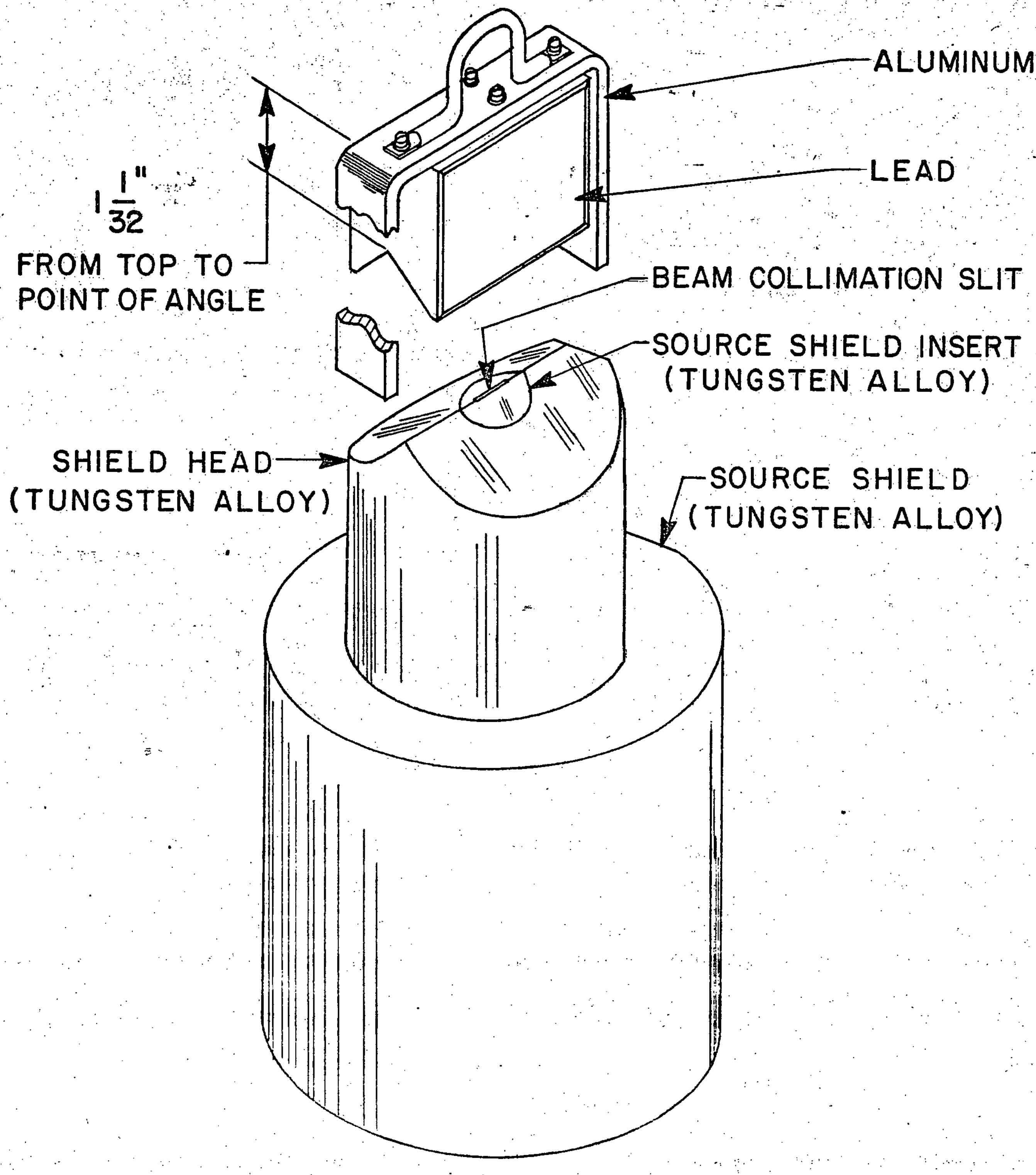
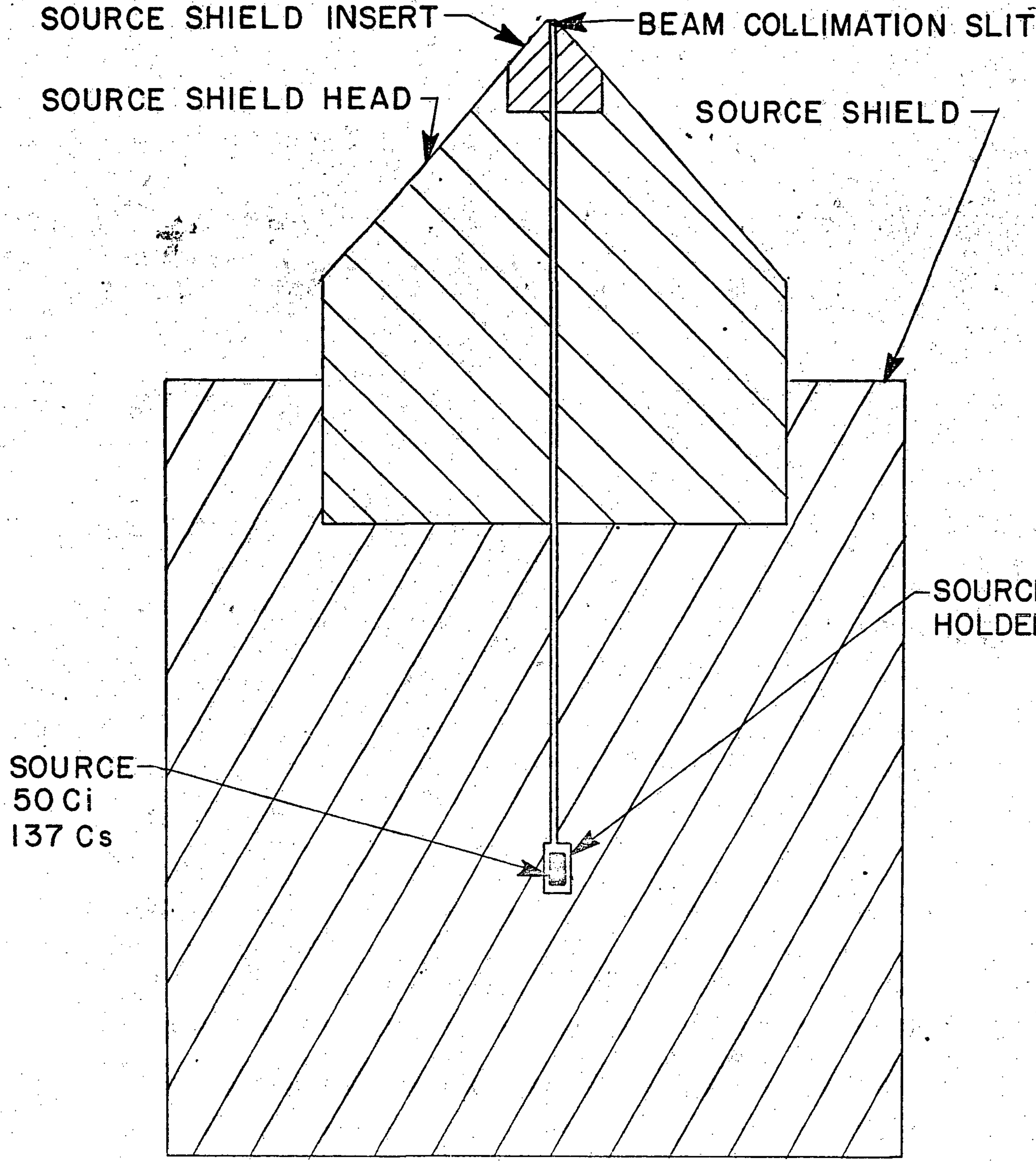
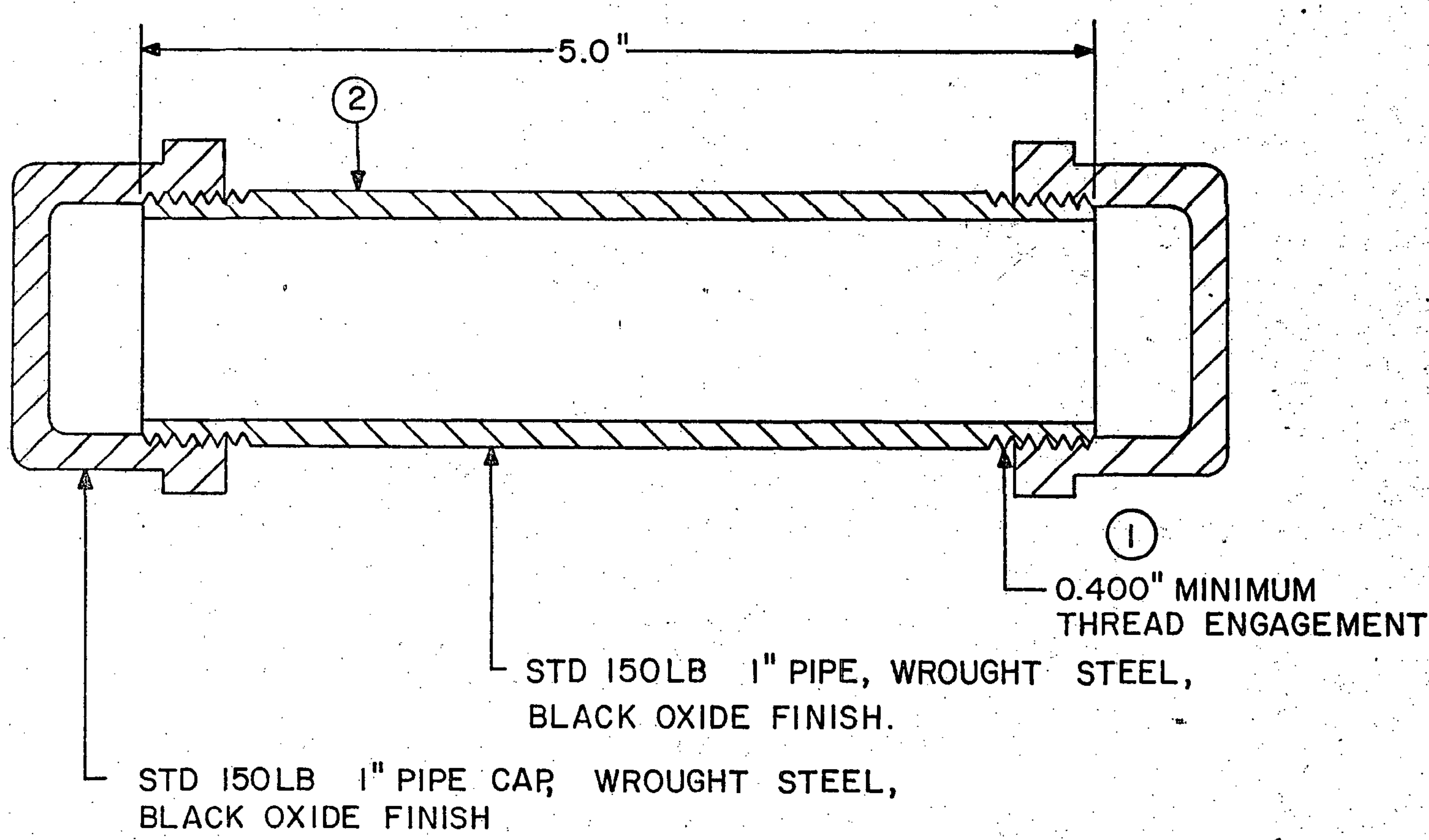


FIG. E-2 BACKSCATTERING DEVICE - ISOMETRIC DRAWING OF SOURCE CONTAINER AND COLLIMATOR



MATERIAL (TUNGSTEN ALLOY)

FIG. E-3 BACKSCATTERING DEVICE – CROSS SECTION VIEW OF SOURCE CONTAINER AND COLLIMATOR



(1) SEAL ALL OF ENGAGED THREAD WITH SODIUM SILICATE, USP. BOTH ENDS

(2) AFFIX AEC-ICC APPROVED RADIOACTIVE MATERIALS LABEL, LISTING ISOTOPE TYPE & ACTIVITY IN CURIES

(3) THIS CONTAINER TO BE SHIPPED IN OUTER CARTON HAVING DIMENSIONS GREATER THAN 4" x 4" x 6"

FIG. E-4 SHIPPING CONTAINER FOR KAMAN NUCLEAR REPLENISHING CARTRIDGE

SUPPLEMENT F

Training and Experience

Reference: Form AEC-313, Items 4, 5, 8, 9 and 14.

SUPPLEMENT F

SUBJECT: Training and Experience

1. Reference: Form AEC-313, Items 4, 5, 8, 9 and 14.

2. Members of the Ionizing Radiation Control Committee: Page No.

a. Dr. Wolfgang J. Ramm, Chairman of the Committee, Alternate RD&E RPO, and Principal Research Scientist, Nuclear Hardening Technical Area, ET&DL, RD&E — F-3

b. Mr. James M. Garner, Jr., RPO for RD&E — F-6

c. Mr. Louis Leo Kaplan, Deputy Director, R&D Technical Support Activity, RD&E — F-9

d. Dr. Horst H. Kedesdy, Leader, Luminescence Phenomena Research Team, Beam Plasma & Display Technical Area, ET&DL, RD&E — F-10

e. Dr. Stanley Kronenberg, Chief, Nuclear Hardening Technical Area, ET&DL, RD&E — F-11

f. CPT William A. Martin, Environmental Engineer and RPO for Medical Department Activities — F-13

g. Dr. Walter S. McAfee, (ECOM Commander Designated Committee Representative) Scientific Adviser to Director of RD&E — F-14

h. MAJ Bruce McClennan, Chief of Radiology, US Patterson Army Hospital, Fort Monmouth — F-15

i. Mr. Charles F. Pullen, Supervisor of Radiation Facilities, Nuclear Hardening Technical Area, ET&DL, RD&E, and Secretary of the Committee — F-16

j. Mr. Richard Rast, Physical Scientist, Radiac R&D Group, CS&TA, RD&E — F-18

k. Mr. J.A. Robertson, Chief, Equipment Mgt Div., R&D Technical Support Activity, RD&E — F-20

l. Mr. Bernard M. Savaiko, Safety Director, ECOM — F-21

m. Mr. Edward C. Thomas, Safety Specialist and RPO for Headquarters & Installation Support Activity — F-22

n. Mr. R.J. Verba, RPO for Maintenance Directorate — F-23

3. RD&E RPO, Alternate RPO, and Technical Staff of RPO:

a. Mr. James M. Garner, Jr., RPO for RD&E F-6

b. Dr. Wolfgang J. Ramm, Alternate RPO for RD&E F-3

c. Mr. Bartholomew F. Saviganac, HP Technician, Radiological Protection Office, RD&E F-24

4. Personnel to Perform Leak Tests:

a. Mr. Joseph Crotchfelt F-28

b. Mr. James M. Garner, Jr. F-6

c. Mr. Charles F. Pullen F-16

d. Mr. Bartholomew F. Savignac F-24

TRAINING & EXPERIENCE WITH RADIATION & RADIOACTIVE MATERIAL
OF

Dr. Wolfgang J. Ramm W.J.R.

TITLE: Supv. Research Scientist

POSITION: Principal Research Scientist, Chairman of the Ionizing Radiation Control Committee and Alternate RD&E RPO

EDUCATION: PhD (Physics) University of Leipzig, Germany

VOCATIONAL EXPERIENCE WITH RADIATION:

a. Research Associate, Kaiser Wilhelm Institute for Physics, Berlin, Germany, 1936-1947.

b. Worked in fields of radiation physics and nuclear physics, active in radiation dosimetry from 1937 to present time.

c. Physicist at USAEL from 1948 to present time. Theoretical and experimental work in radiation dosimetry during all this time.

d. Wrote chapter 6 "Scintillation Detectors" in Hine and Brownell "Radiation Dosimetry" published by Academic Press 1956.

e. USAEL Radiological Protection Officer 1957 to 1961 and again in 1961 to present.

FORMAL TRAINING IN RADIATION - Univ of Leipzig, Germany, 1926-36

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

ON THE JOB TRAINING: Kaiser Wilhelm Institute, Berlin, Germany, 1936-47; US Army Electronic Laboratories, 1948 to present.

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

ACTUAL USE OF RADIOISOTOPES: (See chart on following page)

ACTUAL USE OF RADIOISOTOPES:

ISOTOPE	MAX AMT	WHERE GAINED	DURATION	TYPE OF USE
Radium	2 curies	Kaiser Wilhelm Inst	1937-47	open,research
1.5 Mev Cockroft-Walton Accelerator bombarded elements	u curies	"	"	"
2.5 Mev Van De Graaff	u curies	USAECOM	1951-Pres	"
Co	3200 curies	"	1956-Pres	sealed irradiation
Sr	1 curie	"	1950-Pres	open & encapsulated
Cs	120 curies	"	1958-Pres	sealed
Mixed fission products	1 curie	"	1956-Pres	neutron irradiation materials

TRAINING & EXPERIENCE WITH RADIATION & RADIOACTIVE MATERIAL
OF

James M. Garner, Jr.
RD&E Health Physicist and RPO

A. EDUCATION:

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BS Degree, Daniel Baker College [ ]
Graduate work in Electronics, Atomic Physics and Nuclear Physics, University of Delaware (1945-1947).

B. SPECIAL HEALTH PHYSICS AND RELATED TRAINING:

1. Formal training:

   a. Health Physics, Oak Ridge National Laboratory (ORNL) 1949.

   b. Radiation Safety and Control, ORNL (1960-61).

   c. Field Training in Applied Health Physics, ORNL (1961).

   d. AEC Orientation Course on Licensing and Regulations, Bethesda, MD (1964).

   e. Safe Handling of Radioisotopes in Industry, sponsored by the Oak Ridge Society for Nondestructive Testing, (4 week course) 1964.

   f. Health Physics Training Course (11 wks) sponsored by the East Tennessee Chapter of the Health Physics Society, 1964.

   g. Several short courses and training conferences sponsored by Health Physics Societies, US Public Health Services, etc.

   h. During 1963 and 1964 attended the lectures and part of the laboratories for the following courses given by the Oak Ridge Institute for Nuclear Studies: Basic Research Course (8 wks), Medical Qualification (3 wks), Health Physics (10 wks), Advanced Health Physics (3 wks), Activation Analysis (2 wks), Radioisotope Applications to Highway Engineering (3 wks).

2. On the job training:

   a. Average of two hours per week special instruction by Senior Physicists and 20 hours per week special reading during first two years at the Biochemical Research Foundation (1942 & 1943).

b. Health Physics Division, ORNL, Seminars (1949-1961).

C. EXPERIENCE WITH RADIATION:

1. Types of Uses: Production and processing of radioisotopes; research and development involving medical application in man, studies with animals and plants; environmental studies and measurements; water cooled reactor core changes; effects of radiation on materials; design, evaluation and testing of radiation detection and measuring instruments; instrument calibration; design and fabrication of sources and irradiators; waste disposal; fallout studies; teaching; applied health physics; consultant on a number of studies and projects.

2. Where Experience was Obtained: Worked with radiation and radioactive material from November 1942 to present at the Biochemical Research Foundation, Oak Ridge National Laboratory, Army Nuclear Power Field Office, Oak Ridge Institute of Nuclear Studies, American Nuclear Corp., Auburn University, US Army Electronics Command (USAECOM) and RD&E of USAECOM. During employment with the above -- worked on special assignment for NS Savanna, and at Dougway Proving Grounds, Tennessee River System, Carswell Air Force Base and a special study of training programs at several universities and of several "Agreement State" programs.

D. ACTUAL USE OF RADIOISOTOPES:

Radioisotope	Unencapsulated	Sealed Sources
Co-60	100,000 Ci	25,000 Ci
Co-57	2 uCi	
Co-137	5 Ci	120 Ci
Ra & Ra-Be	uCi	10 Ci
Pu-238 & Pu-Be	MCi	12 Ci
Pu-239	2 uCi	
Po-210 & Po-Be	3 Ci	10 Ci
Sr-90	2 Ci	2 Ci
P-32	200 mCi	
I-129	1 uCi	
I-131	50 mCi	
C-14	mCi	
H-3	mCi's	25 Ci (targets)
S-35	uCi's	
Cl-36	uCi's	
Ca-45	uCi's	
Fe-59	50 uCi	
Zn-65	uCi	
Y-90	uCi's	
Au-198	60 mCi	
Nat Th	kg	
Nat U	10's of kg	
U-235	uCi	
Am-241	uCi	
Ir-192		10's of mCi
Mixed Fission and Activation Products	40 Ci	Spent Reactor Fuel Elements

TRAINING & EXPERIENCE WITH RADIATION & RADIOACTIVE MATERIAL
OF

Louis Leo Kaplan

POSITION: Deputy Director, R&D Technical Support Activity
Research, Development & Engineering Directorate
US Army Electronics Command
Fort Monmouth, NJ

EDUCATION: BA in Physics, Brooklyn College, Brooklyn, NY
Executive Technical Development Program, 160 hrs, Polytechnic Institute of Brooklyn (1967)

SPECIAL COURSES AND/OR TRAINING FOR RADIATION:

Nuclear Engineering Course, 40 hours, Stevens Institute of Technology (1958)

Nuclear Physics - one course at Brooklyn College (1936)

ACTUAL USE OF ISOTOPES:

(a) Supervised hardening program for electron tubes 1959 - 1962 at USAECOM. Tests conducted at pulsed nuclear reactors and at linear accelerators. 8 - 10 personnel involved plus contract supervision of 3 - 5 contracts.

(b) USAECOM representative on DASA TREE subcommittee to establish and supervise DASA sponsored projects for nuclear hardening and weapons effects on all types of electronic parts 1958 - 1963.

(c) Acted as a consultant to DOD during the successful justification of the pulsed nuclear reactor now located at Aberdeen with appearances before Congressional Military Committee.

(d) Deputy Surety Officer USAECOM appointed 22 Jul 66 - to date.

TRAINING & EXPERIENCE WITH RADIATION & RADIOACTIVE MATERIAL
OF

Dr. Horst H. Kedesdy

POSITION: Leader, Luminescence Phenomena Research Team

TITLE: Senior Research Scientist

EDUCATION: B.S. in Physics, Technical Univ of Berlin, Germany
M.S. " " "
PhD " " "

1937 - 1937 - Research Assistant, Technical University of Berlin, Germany, electron optics and microscopy

1939 - 1947 - Max Planck Institute, Berlin, Germany, solid state, X-ray and electron diffractions

1947 - 1960 - US Army Electronics Laboratories, Fort Monmouth, NJ X-ray and electron diffraction semi-conductors, ferromagnetic materials

1960 - 1971 - Director, Institute for Exploratory Research Division E, Solid State Physics

1971 - Pres - Leader, Luminescence Phenomena Research Team, Beam & Plasma Technical Area, Electronic Technology and Devices Laboratory, USAECOM

TRAINING & EXPERIENCE WITH RADIATION & RADIOACTIVE MATERIAL
OF

Dr. Stanley Kronenberg

TITLE: Supv. Research Physicist

POSITION: Chief, Nuclear Hardening Technical Area
Electronics Technology & Devices Laboratory
USAECOM

EDUCATION: PhD in Physics, University of Vienna, [ ] Ex 6
Dr. Kronenberg did his doctorate in theoretical nuclear physics but participated actively during his study in the experimental work performed at the Institute for Radium Research in Vienna. After graduation he was employed by the General Hospital in Vienna to study radioisotopes in connection with medicine, therapeutic and diagnostic applications of X-rays and corpuscular rays.

Since 1953 he has been employed by the US Army Electronics Command and worked since that time with the nuclear physics group in Fort Monmouth, NJ. Research has been mainly in radiation dosimetry, nuclear effects testing, and basic research in nuclear and radiation physics.

He has published numerous papers in the above fields and holds several US patents in his area of interest. He has also participated in numerous nuclear weapon tests as project officer.

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ACTUAL USE OF RADIOISOTOPES:

Isotope	Max Amt	Place	Duration	Type of Use
i^{3}H	100 C	ECOM	1960	source assembly
^{22}Na	several mCi	"	1962	research
^{32}P	traces	"	1953-Pres	dosimetry
^{60}Co	3500 Ci	" & Vienna	1960-Pres	research
Kr	1 Ci	"	1963	research
Ag	traces	"	1955-Pres	dosimetry
^{90}Sr	1 Ci	ECOM & Vienna	1950,1958	source assembly
^{198}At	traces	" "	1955-Pres	dosimetry
^{137}Cs	150 Ci	" "	1958-Pres	research
Th All isotopes of the chain	several Kg	"	1970-Pres	research
^{235}U	several Kg	"	1958-Pres	Use of burst reactors in research
Pu	several Kg	"	1958-Pres	Use of burst reactors in atom bombs

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TRAINING & EXPERIENCE WITH RADIATION & RADIOACTIVE MATERIAL
OF

William Martin WaM

POSITION & TITLE: Environmental Engineer
Radiation Protection Officer
Fort Monmouth, MEDDAC

EDUCATION: B.S. degree, Civil Engineering, Northeastern University, Boston, Mass, Ex 6

FORMAL TRAINING IN RADIATION: Three month Radiological Health Course part of M.S. degree; Basic Radiological Health Course, Oct 1970 (2 wks), Public Health Service, Rockville, MD

ACTUAL USE OF RADIOISOTOPES: None.

TRAINING & EXPERIENCE WITH RADIATION & RADIOACTIVE MATERIAL
OF

Dr. Walter S. McAfee

POSITION: ECOM Commander's designated committee representative
and
Scientific Adviser to the Director of Research, Development & Engineering and of Laboratories
US Army Electronics Command, Ft Monmouth, NJ

EDUCATION:

B.S.	Mathematics	Wiley College,
M.S.	Physics	The Ohio State Univ
Ph.D.	Physics	Cornell Univ,

Ex 6

Radio Astronomy, Harvard Univ, 1957-58

RADIATION TRAINING AND EXPERIENCE:

a. Dosimetry in X-ray Lab, including measurement of the roentgen by use of a free-air chamber. Also Nuclear Physics Lab. Training in safe handling of radioactive materials, evaluation of dose and dose rate, etc.

b. Worked in the nucleonics program of this Command from August 1948 into October 1953. Also planned initial radiation and calibration facilities.

TRAINING & EXPERIENCE WITH RADIATION & RADIOACTIVE MATERIAL

OF

BRUCE LINCOLN MC CLENNAN, M. D.

TITLE: Chief of Radiology, U. S. Patterson Army Hospital, Fort Monmouth, New Jersey 07703

EDUCATION:

College - Union College, Schenectady, N. Y.
B.S. in Biology - [ ] Ex6

Upstate Medical Center, Syracuse, N. Y.
M.D. Degree - [ ] Ex6

Internship - Mary Imogene Bassett Hospital, Cooperstown, N. Y. Rotating Type 1967-1968

Residency - N.I.H. Fellowship in Diagnostic Radiology
Fellow in Radiology, Presbyterian Hospital
Columbia-Presbyterian Medical Center, New York City, N. Y.

Certification - Diplomat National Board of Medical Examiners - 1968
New York State License - 1968
New Jersey License - 1972
American Board of Radiology - June 1972

SCIENTIFIC PAPERS

1. The Roentgenographic Pathologic Correlation of Kerley's Lines, E. Robert Heitzman, M.D., B. Markarian, M.D., F. Zeiter, M.D., B.L. McClennan, M.D., & H. Sherry, M.D., Amer. J. Roentgen., July 1967.

2. Maligant Giant Cell Tumor of the Sphenoid, G. Potter, M.D., & B.L. McClennan, M.D., Cancer, January 1970.

3. Excretory Urography - Choice of Contrast Material, Experimental, B.L. McClennan, M.D., J.A. Becker, M.D., W. Berdon, Radiology 100:1971.

4. Excretory Urography - Choice of Contrast Material, Clinical, B.L. McClennan, M.D., & J.A. Becker, M.D., Radiology 100:1971.

5. Cerebrospinal Fluid Contrast Levels at Intravenous Urography, B.L. McClennan, M.D., & J.A. Becker, M.D., Amer. J. Roentgen., December 1971.

6. Venous Extravasation at Retrograde Urethrography: Precaution, B.L. McClennan, M.D., J.A. Becker, M.D., & T. Robinson, M.D., J. Urol. 106, September 1971.

7. Optimal Evaluation at Intravenous Urography, B.L. McClennan, M.D., Critical Reviews in Radiological Sciences, September 1971.

8. Overdose at Intravenous Urography - Toxic Cause of Death, B.L. McClennan, M.D., J.A. Becker, M.D., & E.G. Kassner, M.D., Radiology 105: November 1972.

9. Vascular Reactivity, Renal Excretion and Cerebrospinal Fluid Concentration of Polymeric Derivitives of Iothalamate, S. Hilal, M.D., B.L. McClennan, M.D., & H. Morgan, M.D., Investigative Radiology, (In press).

10. Splenic Hump vs Cyst - A Plea for Routine Tomography, B. Pressman, M.D., W. Green, M.D., & B.L. McClennan, M.D., (To be published).

11. Column of Bertin - Diagnosis by Nephrotomography, W. Green, M.D., B. Pressman, M.D., B.L. McClennan, M.D., & W. Casarella, M.D., Amer. J. Roentgen., December 1972.

12. Echinococcus Cyst of the Pelvis - Urologic Complications and Treatment, J. Birkhof, M.D., & B.L. McClennan, M.D., J. Urology, (In press).

13. Methylglucamine Iothalamate - Hyperosmolality. CLIN-ALERT, December 28, 1972 No. 243. McClennan, B.L., et. al.

14. Column of Bertin - B.L. McClennan, Winthrop Laboratories, Radiology Rounds, C.P.C. Vol 1. No 1. 1973 (In press).

TRAINING & EXPERIENCE WITH RADIATION & RADIOACTIVE MATERIAL
OF

Charles F. Pullen 8

TITLE: Research Physicist

POSITION: Supervisor, Radiation Facilities and Secretary of the Ionizing Radiation Committee

EDUCATION: BS Physics, Monmouth College, [ ] Ex4

Courses in Basic Radiological Health and Occupational Radiation Protection given by US Dept of Health, Education & Welfare.

EXPERIENCE: Worked on design, fabrication and encapsulation of isotopes for calibration systems to the 200 curie level. He participated in the research, design and development of radiation detection instruments AN/PRD39 ionization chamber survey meter, Im71/pd, IM70 and Im108 radiacmeter. Designed and fabricated an airplane landing device involving the use of a rotating source producing a vertical columated beam. Actively participated in weapon tests at Nevada Test Site. Operations: Upshot Knothole, Buster Jangle, Plumbob, Smallboy. Radiation measurements, monitoring, and recovery of test equipment from fallout areas. He has had experience in monitoring calibration of radiation detection instruments, wipe tests, and surveying. Since 1967 has acted as health physicist for R&D Laboratories at Fort Monmouth; in charge of radiation facilities and personnel monitoring in USAECOM since 1968.

ACTUAL USE OF RADIOISOTOPES:

Isotopes	Max Amt	Place	Duration	Type of User
C_s^{137}	220 Ci	ECOM	1960-Pres	research
Co^{60}	3500 Ci	"	1960-Pres	"
Si^{90}	1 Ci	"	1955 "	detectors
H^{3}	90 Ci	"	1965 "	replenisher
Po^{210}	10 Ci	"	1968 "	research
Am^{241}	100 uc	"	1965 "	"
RA^{226}	10.3 mc	"	1965 "	"
RaB	20 mc	"	1960 "	Calibration
Pu^{239}	2 uc	"	1963 "	research
Pm^{147}	300 mc	"	1965 "	"
Kr^{85}	50 mc	"	1965 "	"

TRAINING & EXPERIENCE WITH RADIATION & RADIOACTIVE MATERIAL
OF

Mr. Richard Rast

EDUCATION: BS Degree in Chemistry, Seton Hall University,
[.] Ex6

EXPERIENCE: Biological and Clinical Chemistry, Serology and Hematology (2 yrs), Monmouth Medical Center and Patterson Army Hospital, Ft Monmouth, NJ, 1950-52.

Health Physics, Research & Development and Calibration of radiation sensitive systems; design, fabrication and encapsulation of isotopes for calibration systems up to 200 curies level, 1952-62.

During past ten years in the Radiac R&D Group he has applied his knowledge of physics, health physics, mathematics, and electronics to the solution of engineering problems and equipment design relating to the radiac development program. Specifically, he has worked on field calibration devices, design of new portable radiac equipment, a Remote Large Area Radiac Training Set and a Recording Radiation Monitor and Automatic Radiation Alarm System, 1962-72.

Actively participated in Nuclear Weapons tests at Nevada Test Site (NTS); operations "Upshot Knothole," "Teapot," and "Small Boy." Also operations "Castle," "Redwing," and "Hardtack" at Pacific Proving Ground, Eniwetok, M.I.

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ACTUAL USE OF RADIOISOTOPES:

Isotope	Quantity	Place	Duration	Type of Use
Co^{60}	200 curies	Nevada	6 mos total	Equipment Calibration-Hi-range-
Co^{60}	200 curies	Eniwetok	8 mos total	-Dosimetry
Co^{60}	UDM-1(1-9 curies)	Evans	18 yrs(on an as needed basis	Calibration-Dosimetry R&D
Cs^{137}	UDM-1A(120 curies)	Evans	16 yrs(on an as needed basis	Calibration-Dosimetry R&D
Cs^{137}	Mrc 794(220 curies)	Evans	3 yrs	Calibratior Development
$Sr^{90}y^{90}$	Up to 2 curies	Evans	12 yrs	Calibratior Development
Co^{60}	3500 curies	Evans	5 yrs	Equipment Calibration-Hi-range Dosimetry R&D

TRAINING & EXPERIENCE WITH RADIATION & RADIOACTIVE MATERIAL
OF

J. A. Robertson

POSITION & TITLE: Chief of Logistics, R&D

EDUCATION: Civilian: Graduate of commercial college (2 yrs)

Military: Army Administration, Depot Operation Signal Supply, Army Logistics Mgmt

SPECIAL COURSES AND/OR TRAINING IN RADIATION: None

FORMAL TRAINING IN RADIATION: None

ACTUAL USE OF RADIOISOTOPES: None

BMS

TRAINING & EXPERIENCE WITH RADIATION & RADIOACTIVE MATERIAL
OF

Bernard M. Savaiko BMS

TITLE: Safety Director, USAECOM

EDUCATION: B.S. in Industrial Engineering
Columbia University, [ ] Ex6

VOCATIONAL EXPERIENCE: 20 years of safety experience, 4 years as an Air Force Safety Officer; 4 years with U. S. Steel, and 12 years at Fort Monmouth.

ON THE JOB TRAINING AND EXPERIENCE: Received on-the-job training and experience in radiation safety and measurements by supervising the work of radiation specialists for 4 years.

Training and Experience with Radiation and Radioactive Material

Of

Mr. Edward C. Thomas E.C.T.

TITLE: & POSITION: Safety Specialist and Radiological Portection Officer for Headquarters and Installation Support Activity (ECOM)

EDUCATION: High School/Special Courses:

Industrial and General Psychology and Math Refresher Classes/Blue Mt. College, Pendleton, Oregon

FORMAL TRAINING IN RADIATION: Radiological Monitoring Course Sponsored by Industrial Hygiene Sec. State Ind. Acc Comm., Pendleton, Oregon 1961

ON JOB TRAINING IN RADIATION: None

ACTUAL USE OF RADIOISOTOPE: Millicure Quantities Gamma Emitting Radio Isotopes -- Iso-Dose Plotting, Millicure Quantities of Gamma Emitting Radio Isotopes -- Instrument Operational Checks and Calibration.

TRAINING & EXPERIENCE WITH RADIATION & RADIOACTIVE MATERIEL

OF

RONALD J. VERBA

POSITION OR TITLE: Radiological Protection Officer for Maintenance Directorate.

Technical Manuals Writer & Editor.

EDUCATION: 2 years Business Management at Brookdale College.

TRAINING & EXPERIENCE IN RADIATION: Seven years writing manuals on the use, handling, and maintenance of Radiation Detection Equipment and Calibration Equipment.

On several task forces for radiation equipment.

Originator of TB 750-237, Identification of Radioactive Items in the Army Supply System. Active in this publication from 1966 to the present.

Worked directly with ECOM Safety Officer on letters, documents, and vehicles to assure safe handling, marking, and identification of ECOM items in the field.

ACTUAL USE OF RADIOISOTOPES: Experience with the following instrument calibrators and check sources (sealed sources):

TYPE NUMBER	RADIOISOTOPE	MAXIMUM AMOUNT	LOCATION
TS-784/PD	Sr-90	100 mCi	ECOM
AN/UDM-2	Sr-90	120 mCi	ECOM
AN/UDM-1	Co-60	10 Ci	ECOM
AN/UDM-1A	Cs-137	120 Ci	ECOM
MX-1083	Co-60	7 μCi's	ECOM
MX-7338/PDR-27R	Kr-85	5 mCi	ECOM

TRAINING & EXPERIENCE WITH RADIATION & RADIOACTIVE MATERIAL
OF

BARTHOLOMEW F. SAVIGNAC

POSITION: Radiological Protection Surveyor

TITLE: Health Physics Technician
RD&E Radiological Protection Office

EDUCATION:

a. St. John's Preparatory School, DAnvers, Mass, graduated [ ] Massachusetts College of Pharmacy, 1 year, 1932-33; Rutgers University College and University of Idaho, courses in General Chemistry, General Physics, College Algebra. Ex6

b. 1971 - Formal training in Health Physics at Oak Ridge Associated Universities. Completed 10 weeks course, certificate, April 1971.

c. Some Introduction to the use of counters for radioactive sources at Rutgers University College, 1950. Also, part of a course in Health Physics at the State University of New York at Buffalo, 1970.

EXPERIENCE:

1946 to 1953 US Army Engineers, Manhattan Project as Health and SAfety Inspector at US Government Sampling Plant, Middlesex, NJ., included training in Radiation Control at University of Rochester, New York and at Clinton Laboratories, Oak Ridge, Tennessee; Correspondence with Massachusetts Institute of Technology regarding radium residues and sources, also initiated some personnel dosimetry records and procured instruments until the Atomic Energy Commission, New York Operations Office Laboratories was established. Served as radiation protection officer of the National Bureau of Standards, New Brunswick, NJ Laboratory upon request on several occasions.

1953 to 1967. National Reactor Testing Station. Shift Health Physicist at the Chemical Processing Plant, and the Materials Testing Reactors. Later, Health Physicist for the SPERT Reactors, and for several other reactors in moth balls, i.e., Gas Cooled Reactor, MIL-1, SL-1, AMP, on loan at Experimental Breeder Reactors. On the job training.

Later, 1960, US National Reactor Testing Station Central Facilities, Health Physics Foreman, for a Chemical Engineering Laboratory, metallurgy laboratory, multicurie hot cells, burial grounds, warehouses, radioactive material shipping areas, a radioactive laundry, liquid wastes disposal plants, and other radioactive areas such as large burial grounds.

1969-71 As "Senior Radiophysicist" for the Industrial Hygiene Division, Radiological Health Unit, New York State Dept of Labor. Inspected licensed industrial Installations for compliance throughout the state including fuel processing areas, reactors, firms using sources and devices.

1972-73 to present. As ECOM Health Physics Technician, received verbal and written instructions in Army Administration Procedures, Army Radiation Control Procedures, terminology; assisted by collecting data for AEC licenses, Dept of the Army Authorizations, and ECOM reports. Some surveys of devices and sources. Assisting in the preparation of applications for Dept of the Army Radioactive Material Authorization or Permit and AEC License.

ACTUAL USE OF RADIOISOTOPES:

Isotopes	Max Amt	Where Experience Gained	Duration	Type of Use
Radium	4-10 microcuries	National Bureau of Standards, New Brunswick,NJ	2 yrs	4-10 uCi calibration sources
Radium & daughters	(300 milligrams per ton) 100 tons	US Government Sampling Plant, Middlesex,NJ	7 yrs	Residues from high grade uranium ore process. Also some 0.1 mCi sources
Natural Uranium	10 Curies or more	US Government Sampling Plant, Middlesex,NJ	7 yrs	High grade ore (60% uranium for process after sampling for assays.
Natural Thorium	1 Curie	" " "	7 yrs	
Plutonium	10 Curies or more	Idaho National Reactor Testing Station	5 yrs	1. Contaminated waste burial 2. Reactor fuel.
Mixed Fission Products	10^6 Curies	Idaho National Reactor Testing Station, Idaho Chemical Processing Plant and Reactor	16 yrs	Fission products stored in tanks or calcined for storage-wastes: material testing reactors. Spent fuel assemblies.
^{235}U ^{233}U	Criticality Amounts	National Reactor Testing Sta-Processing Plant and Reactors	10 yrs	Waste burials, expended reactor cores

^{131}I	10 Curies	National Reactor Testing Station - Chemical Processing Plants & Reactors	2 yrs	Iodine release during nuclear reactor fission breaks. Medical purposes.
^{85}~~KE~~ Kr	10 Curies	" "	1 yr	Samples from reactor experiments for analysis.
.40 Ba	Unknown	National Reactor Testing Station - Chemical Processing Plants & Reactors	2 yr	Classified-1955
.40 La	Millicurie amounts			
^{3}H	10 Curies	National Reactor Testing Station, also NY State watch dials manufacturers	6 yrs	Radioactive waste inspected, use in plastic seals and in watch dials.
^{60}Co	.01 to 100 Curies	National Reactor Testing Station and NY State Industrial Hygiene	2 yrs	Use for instruments calibration and industrial radiography
^{57}Co	15 mCi	ECOM, ET&DL	1 mo	Radiation Surveys
Ra D+E	10^{-4} uCi	Idaho Reactor Testing Station	16 yrs	Counter calibration sources
Nearly all types of licensee sources	uCi to Ci	Through most Industrial Areas, NY State	1 3/4 yrs	Variable; Lists too long for this report (from reactors, accelerators produced)

TRAINING AND EXPERIENCE WITH RADIATION & RADIOACTIVE MATERIAL
OF

Joseph H. Crotchfelt

TITLE: Engineering Tech

POSITION: Radiation Tech

EDUCATION: Courses in Basic Radiological Health and Occupational Radiation Protection given by US Dept of Health, Education & Welfare. On the job training at the Pacific Proving Ground and the Nevada Test Site.

EXPERIENCE: Mr. Crotchfelt has been working in the field of radiation measurement, handling and decontamination since 1956. He originally received instruction on the principles and practices of radiation protection, radioactivity measurement and monitoring techniques and instruments, calculations basic to the use and measurement of radiation at the Pacific Proving Ground in 1956. Since then he has had additional instruction and experience on-the-job in these laboratories in radiation measurement, instrument calibration, wipe tests, and decontamination. His experience in PPG & NTS include recovery, radiation measurement, decontamination and instrument calibration. He was responsible for the fabrication and mechanical design changes of the Biosel IM/111, a radiac meter designed to plug into Aircraft or be self-contained with batteries. Designed source holders and loaded same. Maintains, operates and assists in experiments on two (2) million volt Van de Graaff particle accelerator that has a dual capability of electrons or positive ions. Maintains, operates and takes part in experiments on the 3500 Ci Cobalt 60 Facility. Maintains, operates and conducts experiments on the Kaman Model A-1001 Neutron Generator. Is responsible for the quarterly calibration of all Radiac instruments in ET&DL.

ACTUAL USE OF RADIOISOTOPES:

ISOTOPES	MAX AMT	TYPE OF USE
Cs 137	220 Ci	research
Co 60	3500 Ci	research
Si 90	1 Ci	detectors
H3	90 Ci	replenisher.
Po 210	10 Ci	research
Am 241	100 uCi	research
Ra 226	10.3 mCi	research
RaBe	20 mCi	calibration
Pu 239	2 uCi	research
Pm 147	300 mCi	research
Kr 85	50 mCi	research

SUPPLEMENT G

Radiation Detection Instruments

Reference: Form AEC-313, Item 10.

Su

SUPPLEMENT G

SUBJECT: Radiation Detection Instruments

1. Reference: Form AEC-313, Item 10.

2. Table G-1 -- Radiation Detection Instruments is on the next three pages.

3. In addition to the instruments listed in the table, the following laboratory instruments are available:

   a. Scalers with shielded GM tube and scintillating type detectors

   b. Single channel pulse height analyzers

   c. Victoreen R meters with reader

   d. 400 channel analyzer

   e. Baird Atomic Spectrometer Model 530

   f. Sweep pulse height analyzer

   g. "Long Counter" for neutrons

   h. AN/PDR 39's for laboratory use.

TABLE G-1. Radiation Detection Instruments

Type of Instrument	Number Available	Radiation Detected	Sensitivity Range (mr/hr)	Window Thickness (mg/cm^2)	USE
Bendix #862	2 ea.	Gamma	200 mR	NA	Monitoring
Landsverk IM9EPD	5 ea.	Gamma	200 mR	NA	Measuring
JAN IM147	5 ea.	Gamma	0-50R	NA	Measuring
Bendix #884 Tissue Equivalent	4 ea.	Fast Neutron & Gamma	0-200 mrad	NA	Measuring
Bendix #609	4 ea.	Thermal Neutron	2 x daily toler. (120 mrem full scale)	NA	Measuring
Victoreen Model 440RF	1 ea.	Gamma	0-300 mR/h	1 mg/cm^2 mylar & 0.005 magnesium	Measuring
Victoreen Model 740 Cutie Pie Survey Meter	1 ea.	Alpha, Beta, Gamma	0-2500 mR/h	0.005 mylar	Measuring
Radiac Set AN/PDR-39 S.N. 1020,329	2 ea.	Gamma	0-50,000 mR/h	Thick walled ion chamber	Measuring
Nuclear Chicago Neutron Survey Meter Model 2671	2 ea.	Fast & Thermal Neutron	0-25,000 $n/cm^2/s$ 7 scales	BF_3 Proportional counter/removable moderator	Surveying Measuring
Radiac Meter Bendix #611	2 ea.	Gamma	5 R/h	NA	Monitoring
Radiac Set IM-141/PDR-27J S.N. 4846-E005	2 ea.	Beta Gamma	.5-500 mR/h	Jan 5980) type Jan 5979) Mil-E-1 GN tubes	Surveying Measuring

TABLE G-1. Radiation Detection Instruments, Cont.

Type of Instrument	Number Available	Radiation Detected	Sensitivity Range (mr/hr)	Window Thickness (mg/cm^2)	USE
Survey Meters Nuclear-Chicago Corp Model - 2610-A-P.15 S.N. 955-954	2 ea.	Beta Gamma	0-20 mR/h	Thin Walled GM Tube D50 (c K 1020)	Surveying
Survey Meters Nuclear-Chicago Corp Model-2612-P.16	2 ea.	Alpha, Beta, Gamma	.2-20 mR/h	GM Tube D-35(only) 1.4 mg/cm^2	Surveying M
Radiac Sets AN/PDR 46A IM-113/PDR S.N. 36;14;47	2 ea.	Beta Gamma	0-20 mR/h	Beta Window GM Tube	Surveying
Baird-Atomic 420E	2 ea.	Alpha, Beta, Gamma	0-12½ mR/h	End Window GM Tube	Surveying
Nuclear Chicago Alpha Survey Meter Model 2670	1 ea.	Alpha	0-150,000 cpm 7 scales (0-1875 alpha/cm^2/s)	Proportional Counter	Contamination Surveying
Chirpee Personal Radiation Monitor-Baird Atomic Model 904517	3 ea.	Gamma	1 chirp/ 0.1 mR	GM Tube	Warning
Chirpees Personal Radiation Monitor, Atomic Accessories Model PRM-253	5 ea.	Gamma	1 chirp/ 0.1 mR	GM Tube	Warning
Tritium Monitor Atomic Accessories Model TSM-91-C	1 ea.	Alpha, Beta, Gamma	0-30000 μCi in 4 decade scales	Air Conductivity 0 Window Thickness	Alarm and Continuous Air Monitoring

TABLE G-1. Radiation Detection Instruments, Cont.

Type of Instrument	Number Available	Radiation Detected	Sensitivity Range (mr/hr)	Window Thickness (mg/cm^2)	USE
Mighty Mite Air Sampler Model MS-343 Sample Counting System	2 ea.	Alpha, Beta, Gamma	Down to Background	0 or 2 mg/cm^2	Air Sampling

Supplement H

Instrument Calibration

Reference: Form AEC-313, Item 11

Su

SUPPLEMENT H

SUBJECT: Instrument Calibration

1. Reference: Form AEC-313, Item 11

2a. Survey instruments that respond to

   (1) gamma radiation,

   (2) beta and gamma,

   (3) alpha, beta and gamma,

   are calibrated in a standard gamma flux obtained from an AN/UDM-1(Co 60) or an AN/UDM-1A(Cs 137) calibrator. The calibrators were calibrated with Victoreen R-meters. The R-meters were in turn calibrated by the NBS and certified to 3%. The source intensities are corrected each month for decay.

b. The Nuclear Chicago Model 2670 Alpha Survey Meter was calibrated originally at the factory with a RaD+E standard. A secondary standard $U_3 O_8$ is incorporated in the instrument and may be used to calibrate it to ± 5%.

c. An Army Radiac Calibrator, AN/UDM-6, containing four standard plutonium 239 sources is also available for calibrating alpha instruments.

3. Counting systems for determining the amount of radioactive material in samples are calibrated with sources accurate to ± 7% or less. These are obtained from various commercial firms, such as, US Nuclear Corporation, Tracerlab Incorporated, Atomic Accessories, Baird Atomic, etc.

4. An NBS calibrated 2.92 mCi Ra 226-B_e neutron source (± 3%) is used to calibrate neutron instruments.

5. Calibrations are made after maintenance procedures that may result in a calibration change and at three month intervals.

6. When RD&E personnel take instruments to remote locations such as the Nevada Test Site or Fort Huachuca, Arizona, the instruments are calibrated prior to departure. If the instruments are to be gone for an extended period of time, arrangements are made to have them calibrated at the remote location, or the instruments are sent to a calibration facility, or appropriate sources or calibrators are taken to the remote location and the instruments calibrated on location.

7. The Atomic Accessories Model TSM-91-D Tritium Monitor is calibrated with a special source, Atomic Accessories Model TCS-179B, supplied with the monitor. The calibration procedure that came with the equipment is used.

SUPPLEMENT I

Film Badges, Dosimeters and Bio-Assay Procedures Used

Reference: Form AEC-313, Item 12.

SUPPLEMENT I

SUBJECT: Film Badges, Dosimeters and Bio-Assay Procedures Used

1. Reference: Form AEC-313, Item 12.

2. Lexington Bluegrass Army Depot Film Badge Service is used for personnel monitoring on a monthly basis for radiation workers and on as needed basis for visitors.

3. Quartz fiber dosimeters are issued on an as needed basis to visitors of radiation area. Dosimeters of this type are worn by both visitors and RD&E radiation workers in high radiation areas.

4. Individuals working in high radiation areas may also use Atomic Accessories Personal Radiation Monitors (chirpees) or other similar type devices.

5. Bio-Assay services are available through the Army Surgeon General as required.

6. RD&E radiation workers take their film badges with them when they will be exposed to radiation at remote locations. If their stay extends beyond a film badge change date fresh film is sent to them and they in turn mail the exposed film back to Fort Monmouth.

SUPPLEMENT J

Facilities and Equipment

Reference: Form AEC-313, Item 13.

Su

SUPPLEMENT J

SUBJECT: Facilities and Equipment

1. Reference: Form AEC-313, Item 13.

2. The following facilities are described.

   a. Evans Area:

      (1) Building 401

         (a) Irradiation Room

         (b) Van de Graaff

         (c) Neutron Generator

      (2) Building T-383 -- Radioactive Material Storage Vault

      (3) Building S-450 -- Decontamination and Processing Rooms

      (4) Area "G", Evans Area

   b. Oakhurst Station

   c. Accelerator at Fort Hancock

   d. Other Remote Locations

3. Most of RD&E's work involving byproduct material is in the Evans Area. However, small quantities are routinely used in the Charles Wood Area. Occasionally work involving byproduct material takes place at other sub-posts of the Fort Monmouth complex. The main areas are described in this supplement. In addition, work involving tritium is routinely performed at Fort Hancock. On rare occasions RD&E personnel use some of its sealed sources at remote locations. A description of the Fort Hancock facility is included in the supplement along with some information regarding the other remote locations used. Fort Hancock and the Lakehurst Air Station are less than thirty miles from Fort Monmouth.

4. Evans Area. The Evans Area is the southern most sub-post of the Fort Monmouth complex (See Fig. A-1). The area covers approximately 230 acres. About half of the area is surrounded by a twelve foot high security fence. The unfenced area has a very low population density, even during working hours. Most of the work involving byproduct material at the Evans Area takes place in Buildings 401, S-45 and T-383. These buildings and Area "G" are within the security area.

5. Evans Area - Building 401. With the exception of the heater room, vestibule and two offices, the inside of the building is a "restricted area". The building has three levels (See Fig. J-1).

a. Irradiation Room. The irradiation room (See Fig. J-2) has thick concrete walls. The wall between the irradiation room and the "Work Areas" contains three multilayered, round, high density glass windows. A low, wooden picket fence divides the room into areas referred to as the High Radiation Area and the Radiation Area. Near the fence on the High Radiation Area side are two Radiac Calibrator Sets, AN/UDM-1 and AN/UDM-2. One is located on each side of the room. Narrow gates, for personnel, are located on each side of the room. A large portion of the center part of the fence (referred to as the equipment gate) can be removed so that large equipment may be moved in or out. The gates and the calibrators are equipped with switches that are so arranged and wired that an audio alarm will automatically sound if a gate is opened when either of the calibrators are in use. In addition, a light near a calibrator and one at the door to the room comes on when a calibrator is put into operation.

The direction of the beams from the calibrators, when they are in use, is away from the fence. Normally only one calibrator is in use at a time; however, when both are on the highest air dose rate on the Radiation Area side of the fence is only 30 mR/hr. The air dose rate at the open door is 2 mR/hr. With door (covered with 1/8 inch of lead) closed the air dose rate is 0.5 mr/hr.

A proposal has been made to add a third calibrator, another AN/UDM-1A, at the location shown in Fig. J-2. While these calibrators were designed to calibrate Army and Navy radiac instruments, these particular ones are used more as sources of radiation for research, development and testing purposes. Considerable time is required to "set up" apparatus. The study or use of the "set up" may only utilize radiation for a short period of time, daily for a number of days. The addition of a second AN/UDM-1A will permit productive use of the shielded room a higher percentage of the time.

b. Van de Graaff Accelerator. A 2 MeV Van de Graaff type accelerator, made by High Voltage Engineering, is located on the second floor (See Fig. J-1). The accelerator target is located on the ground floor. Both areas have shielding walls. Entry into the target room

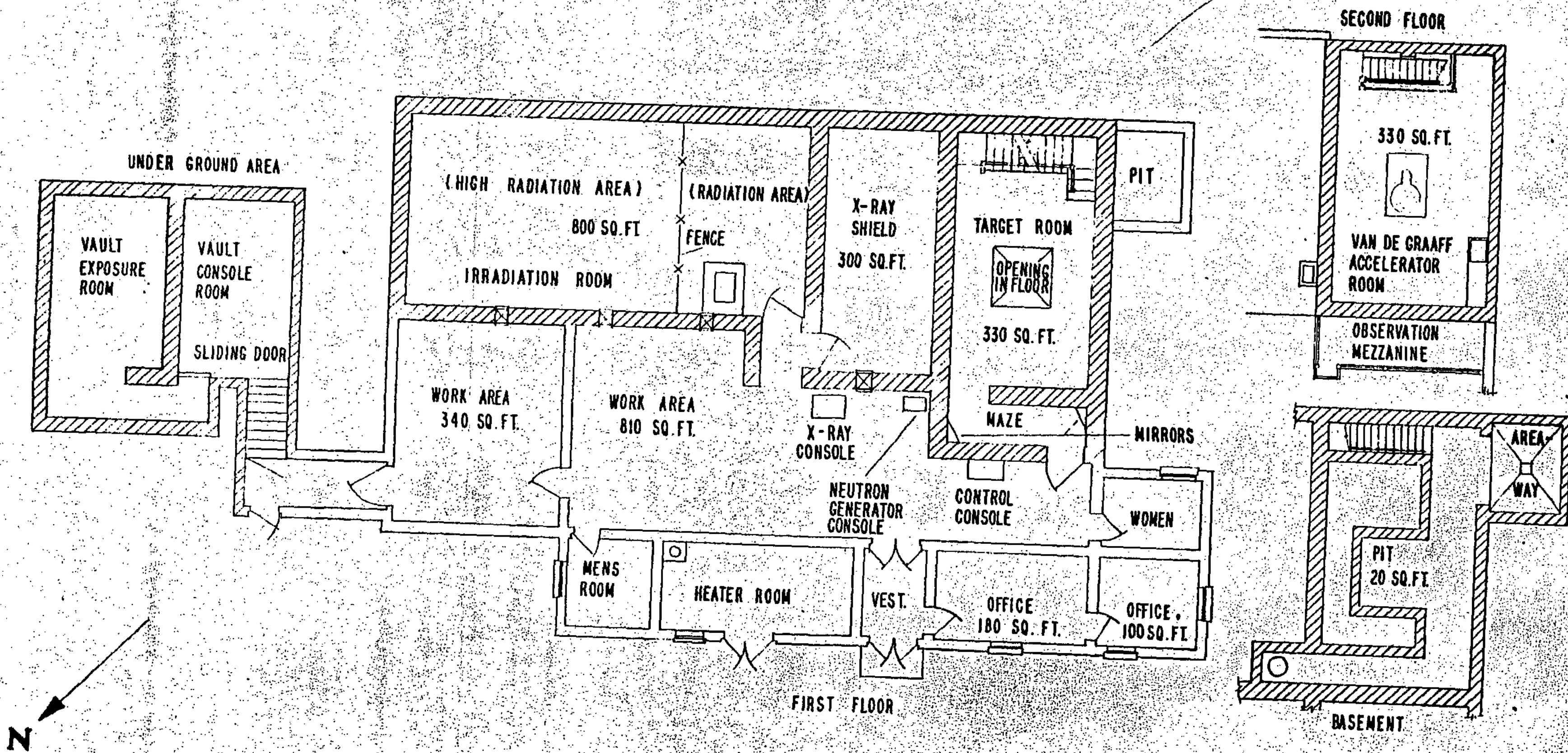


FIG. J-1 BLDG 401, EVANS AREA

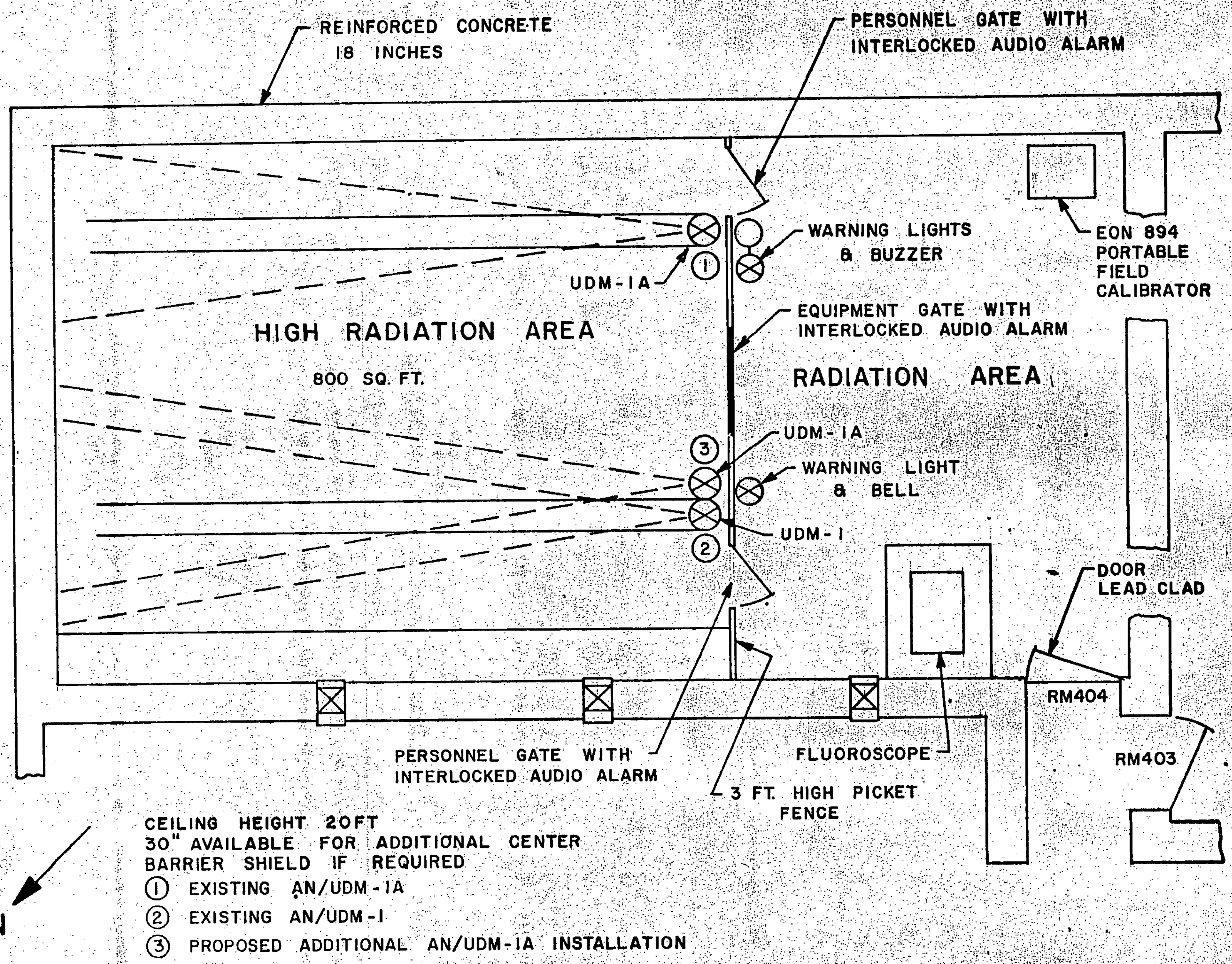


FIG. J2 IRRADIATION ROOM, BLDG 401, EVANS AREA is through a maze with a lead covered door at its entrance. Entrance to the second floor room where the Van de Graaff is located and to the basement area below the target room is through the maze and target room. Two mirrors are located in the maze, such that a person standing just outside the open maze door has a fairly good view of the target room. The door to the maze is equipped with a safety interlock that normally makes it impossible to operate the accelerator with the door open. When it is necessary to make target room observations from just outside the entrance to the maze, the interlock may be bypassed when an individual, approved by the Committee for this operation, is at the maze door and the RPO has been informed in advance and has approved of the operation. The control console is on the face of the maze.

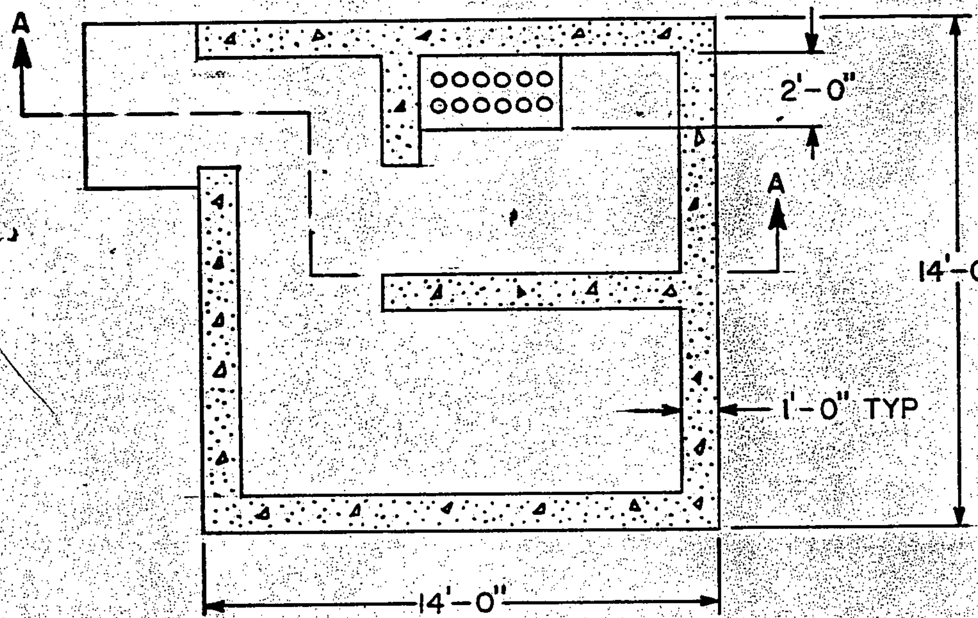
The Van de Graaff may be used to accelerate either positive ions or electrons at energies up to two MeV. The electrons are used to produce X-rays. Accelerated protons or deuterons are used to produce neutrons, radioactive material or used to study nuclear reactions.

c. Neutron Generator. The console for an Atomic Accessories Neutron Generator Model GN 312 is located in the main Work Area. This generator uses a Phillips Neutron Generator Tube 18600. The generator tube is located in the tunnel of the basement (See Fig. J-1). Interlocks are located at the pit entrance to the basement, at the Van de Graaff maze entrance and at the X-ray Shield entrance. The Neutron Generator cannot be operated unless these doors are closed. The Phillips Tube 18600 contains a 9.5 curie tritiated target that is in a hermetically sealed vacuum tube (not pumped).

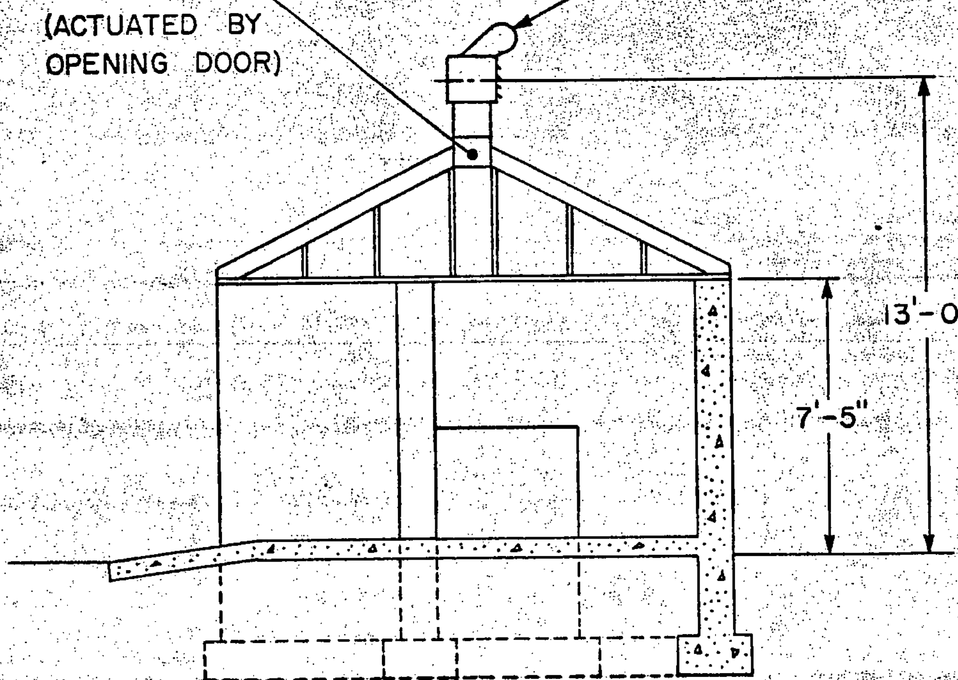
The fast neutron intensity, when the Neutron Generator is operating, at maximum output, is less than two millirem per hour at the console. A portable neutron survey instrument does not indicate a reading above background in the unrestricted areas around Building 401.

When all facilities are in use the radiation intensity in the work and office areas of the building is approximately 0.05 mR/hr from gamma and X-rays while the levels of other types of radiation is too low to detect with portable ratemeters.

6. Evans Area - Building T-383 -- Radioactive Material Storage Vault. Fig. J-3 shows the Radioactive Materials Storage Vault. One portion of the building is used to store radioactive waste for decay or until a waste disposal shipment is made. The remainder of the building is used to store radioactive material that will be used at a later date. The building is equipped with an exhaust fan that exhausts a volume of air approximately $2\frac{1}{2}$ times the volume of the building every minute. The fan comes on whenever the door is opened. The building is normally locked and access to the key is controlled. The building is not used for any purpose other than the storage of radioactive material.



FLOOR PLAN



SECTION A-A

FIG. J-3 BUILDING T-383 RADIOACTIVE STORAGE VAULT, EVANS AREA

7. Evans Area - Building S-45 -- Decontamination and Radioisotope Processing Rooms. Fig. J-4 shows the Decontamination Room and the Processing Room that are in Building S-45. Sample counting equipment and a Scott Air Pock, for emergency use, are located in other areas of the same floor of this building.

a. Room 15B -- Decontamination Room. The Decontamination Room, Rm. 15b, is equipped with a shower, a hand sink, and a floor drain. The three drains are connected to a 550 gallon "hot" waste storage tank that is buried NNE of the Radioisotope Processing Room (See Fig. J-4). The room is equipped with a toilet. In addition, coveralls, surgical caps, shoe covers, booties, gloves, etc., are stored in a cabinet in the room and lockers are provided for storage of an individual's personal clothing and belongings.

b. Room 15 - C -- Radioisotope Processing Room. The Radioisotope Processing Room is equipped with remote handling tools, a ventilated hood (100 linear feet per minute across opening when half open) and a glove box, and a "hot" stainless steel sink. (1) The hood and the glove box are both equipped with air filters. Air ducts from the filters lead to a tall stack. (2) The drains from the hood cup sink and the "hot" sink are connected to the "hot" storage tank mentioned in Para 7a above. In addition a second 550 gallon "hot" storage tank is also located NNE of the Radioisotope Processing Room. Liquid in the "hot" storage tank that the various "hot" drains are connected to can be pumped into the second "hot" storage tank. Tap water can be added to this second tank for dilution purposes. The tap water line is not directly connected to the tank -- water from the tank <u>cannot</u> siphon into the tap water line. Liquid from this second "hot" storage tank can be pumped into the sanitary sewer. The two "hot" liquid waste pumps are locked under a removable steel plate in the floor of the room. Gauges to measure the volume of liquid in the two tanks and switches for controlling the pumps are located on the NNE wall of the room. (3) Lead brick are available for constructing temporary work and storage shields.

8. Evans Area "G". Area "G" at Evans is located in a portion of the Evans Security Area that has a low work population density. Within Area "G" a special Irradiation Range has been established (See Fig. J-5). The range is used for experiments which require a minimum of scattering and for experiments that involve vertically collimated beams of gamma radiation. A fence incloses a circle having a 300 foot diameter. Appropriate warning signs are posted around the periphery.

9. Oakhurst Station. Fig. J-6 shows the Oakhurst Station. The station is equipped with a 400 foot tower that has an elevator. This unique facility makes it possible to safely examine collimated beams at considerable distances from sources on the ground.

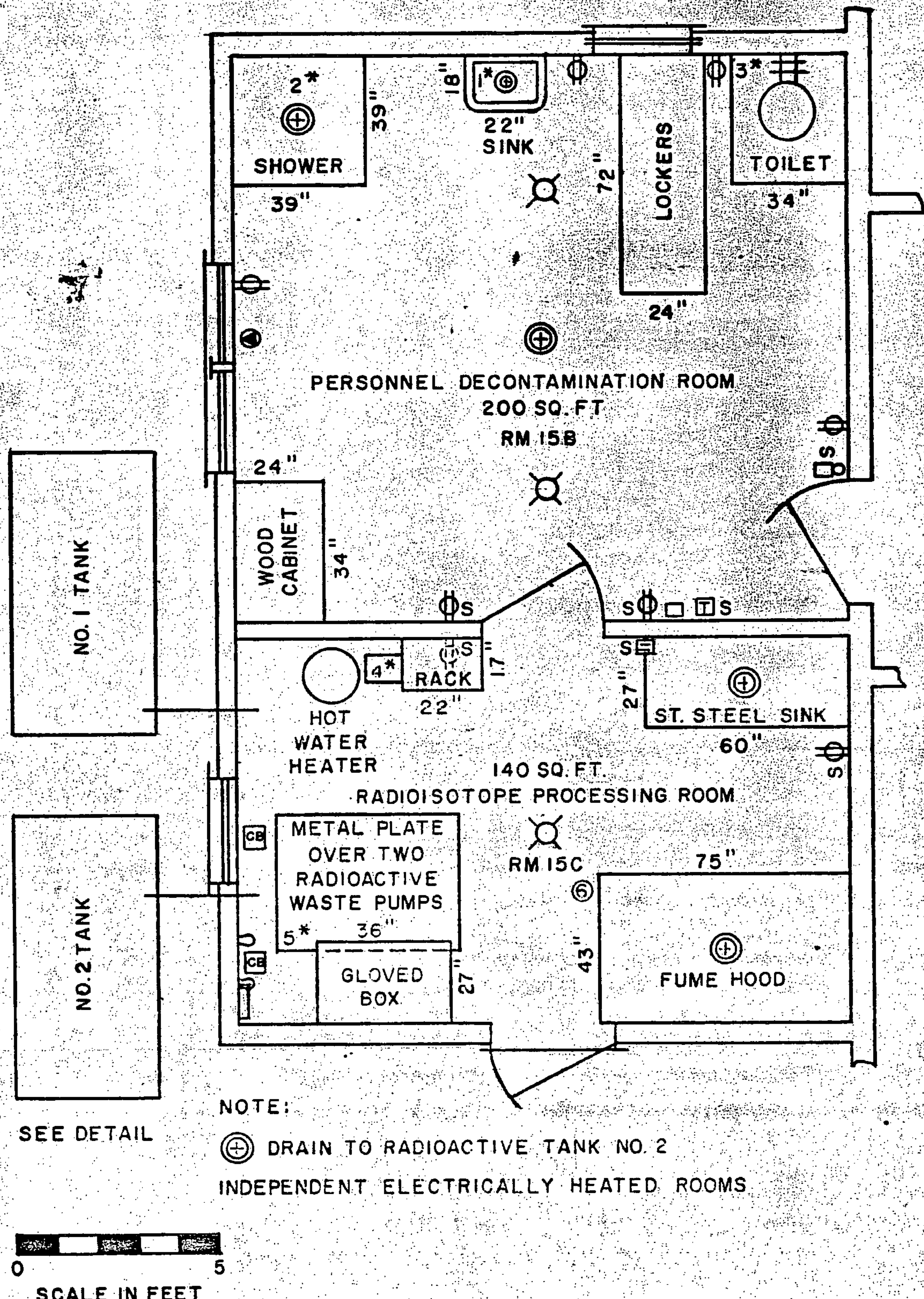


FIG. J-4 DECONTAMINATION AND PROCESSING ROOMS, BLDG S-45, EVANS AREA

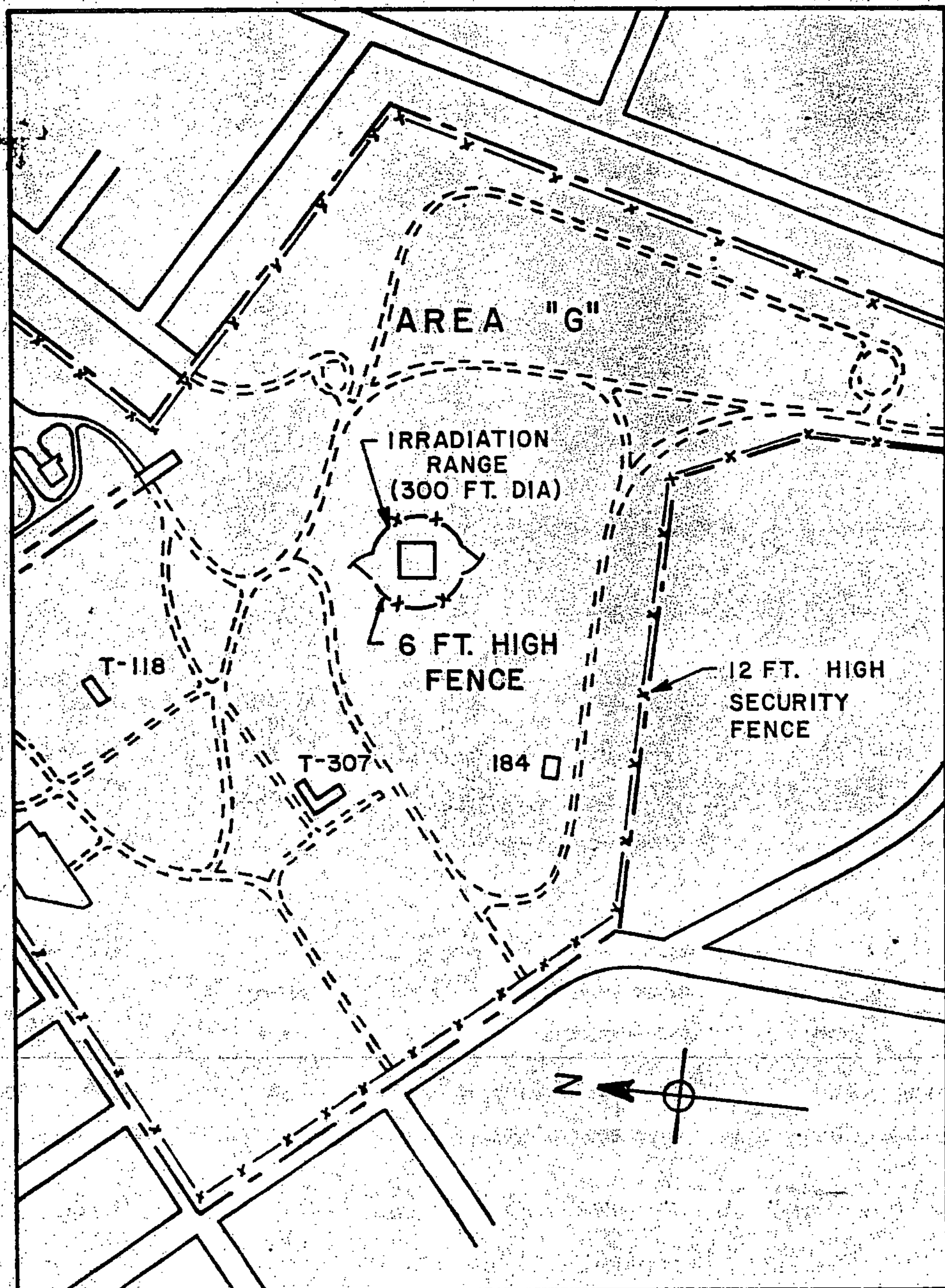


FIG. J-5 AREA "G", EVANS

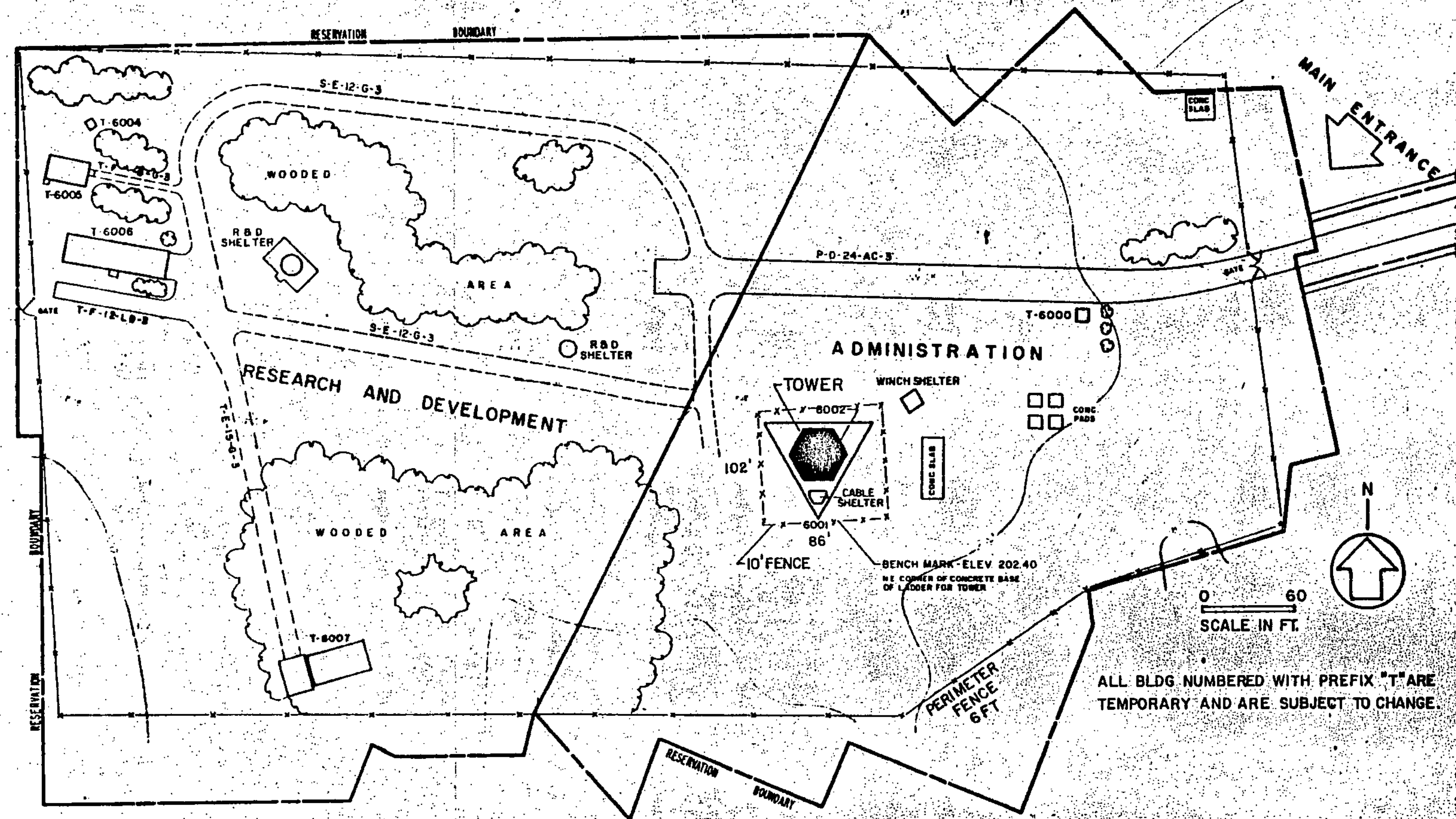


FIG. J-6 FORT MONMOUTH - OAKHURST STATION

10. Accelerator at Fort Hancock.

a. An ECOM RD&E accelerator, manufactured by the Kaman Nuclear Corporation (Neutron Generator Model A1001) is located in Building 539 at Fort Hancock. The main portion of Fig. J-7 shows Building 539 and its relation to the Atlantic Ocean and to other buildings. The insert map included in Fig. J-7 shows the building location in relation to the ocean, bays, and the mainland. Fort Hancock is located on Sandy Hook. Building 528 is the nearest one to Building 539 that is occupied. Facalities Numbers 180, 530, and 541 are not occupied. The population density of Fort Hancock is low.

b. There is a six foot fence around the building and caution signs have been posted on each side.

c. Figure J-8 shows the electrical circuits for heat, lights, safety interlock and warning lights. When the generator switch is first placed in the "ON" position a warning bell rings for ten seconds before the accelerating voltage can be "run up". When the generator is "ON" red warning lights are turned on in the locations indicated in Figure J-8. The gate to the maze is interlocked so that the generator is shut off if the gate is opened.

d. Figure J-9 shows the locations of the shielding walls. The shaded portion was added to the original building in order to increase the shielding. Between the control room and the generator room there is a total of 64 inches of concrete block and poured concrete.

e. (1) The approximate dose rate an operator would receive from 14 MeV neutrons passing through the shielding would be as follows:

$$I \cong \frac{\phi}{f} = \text{mrem/hr}$$

$\phi \cong$ neutrons per square centimeter per second

$$\cong \frac{\phi_o}{4 \pi r^2} \cdot e^{-\mu x}$$

$\phi_o = 4\pi$ output of source $= 2 \times 10^{11}$ n/sec

n = neutrons

r = minimum distance from source to operator = 427 cm

μ = absorption coefficient for concrete block = 0.153 inches^{-1} (AERE-R-3920)

x = thickness of shield = 64 inches

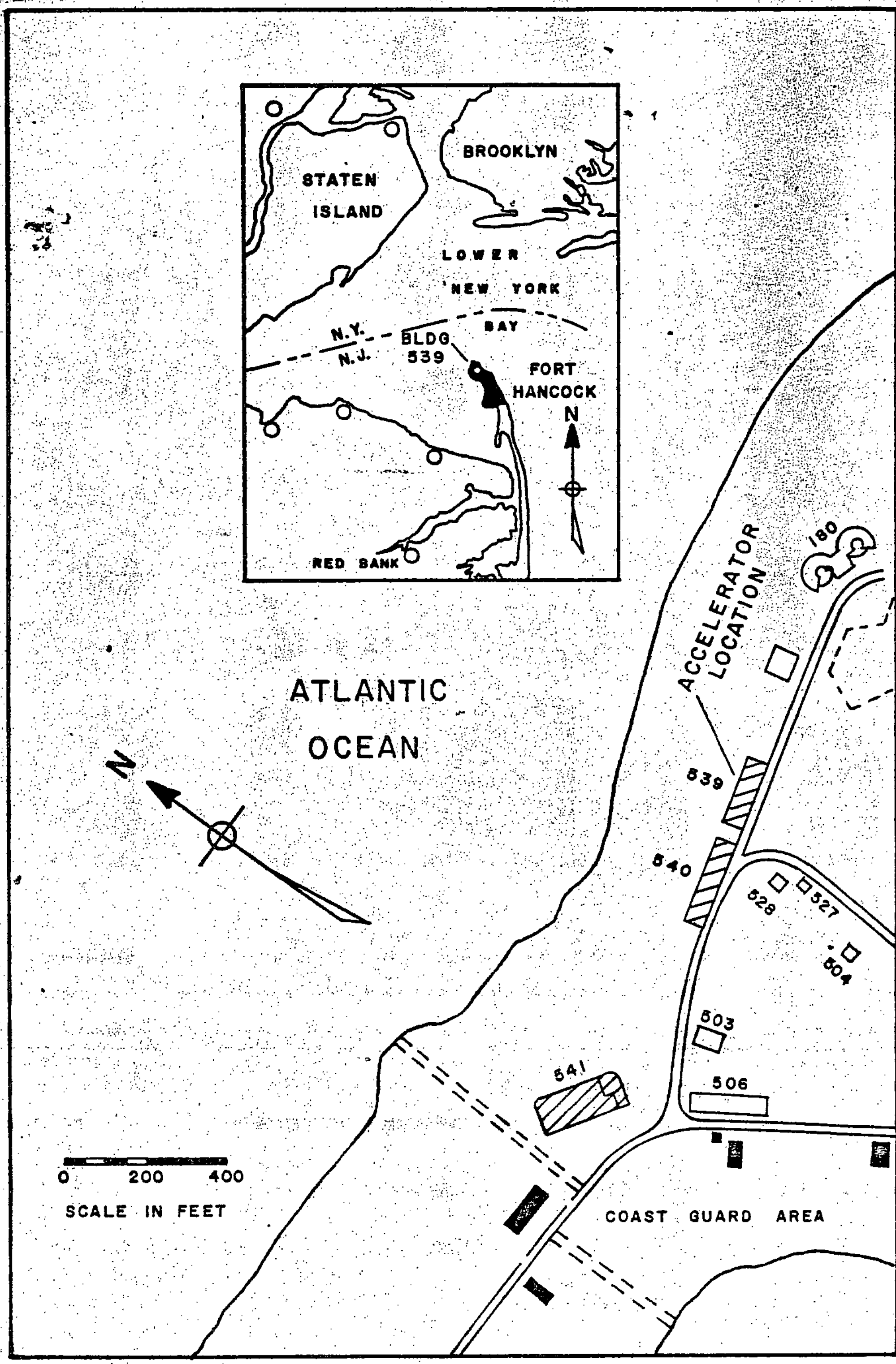
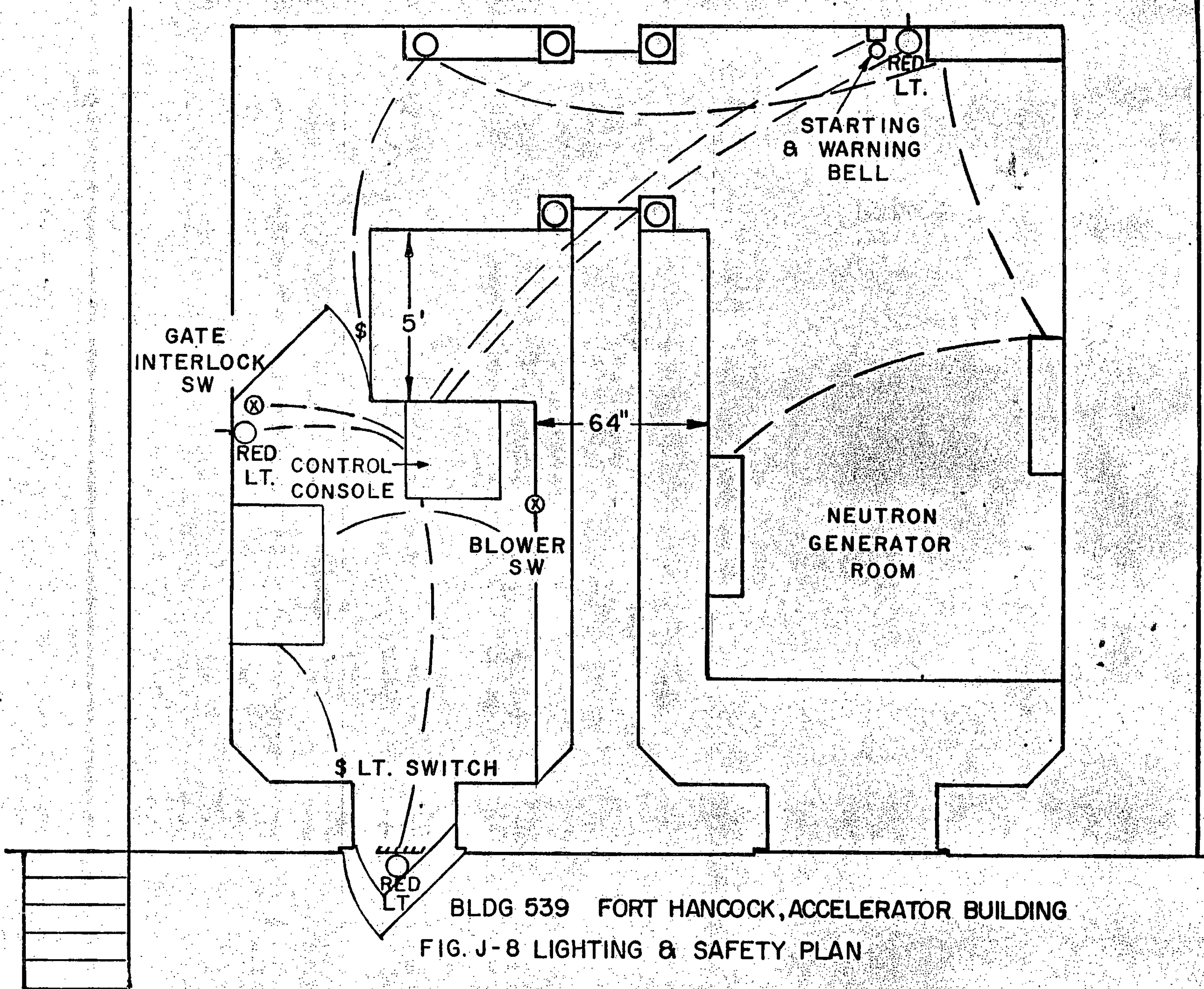
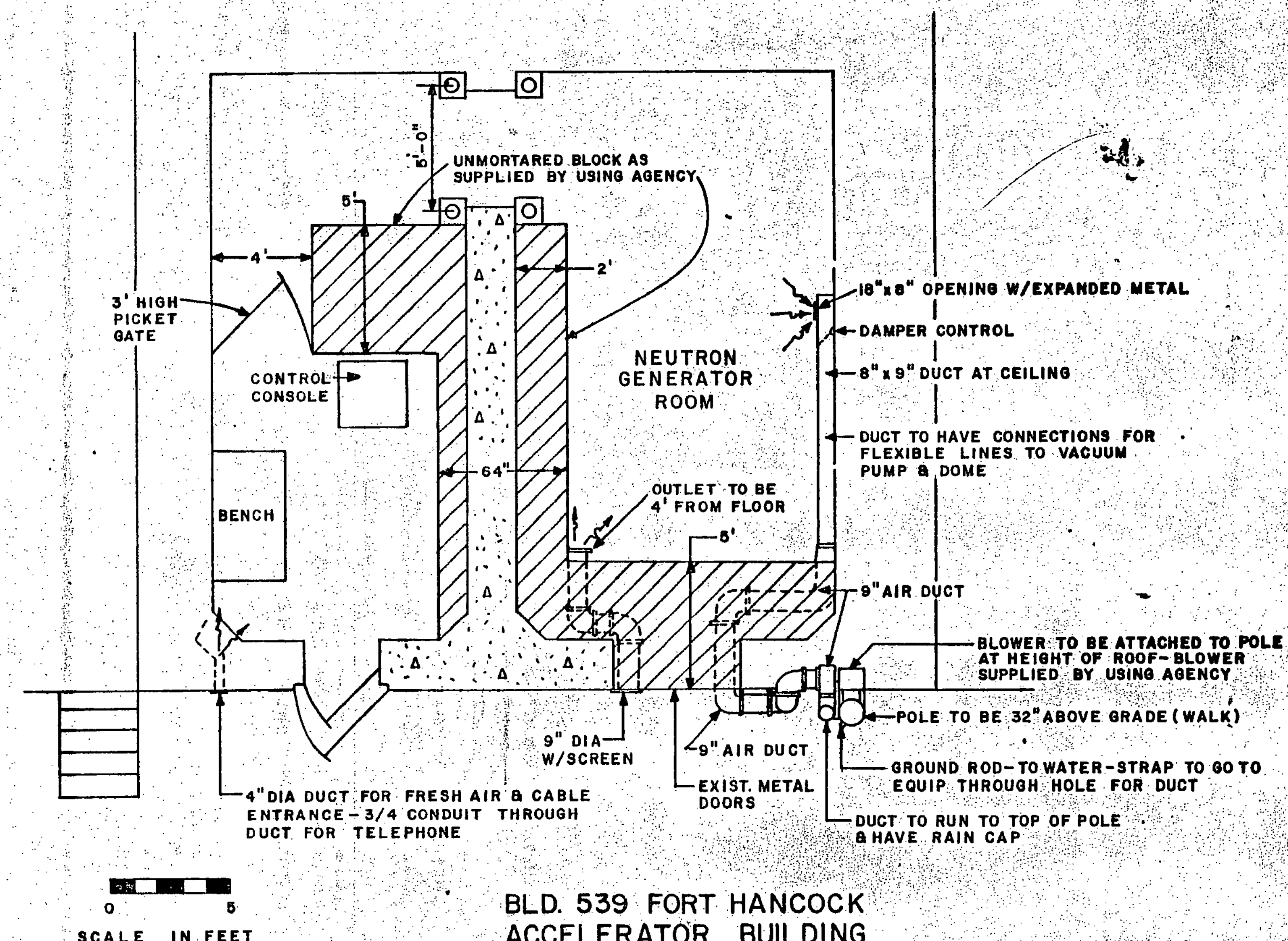


FIG. J-7 ACCELERATOR LOCATION AT FORT HANCOCK



BLDG 539 FORT HANCOCK, ACCELERATOR BUILDING

FIG. J-8 LIGHTING & SAFETY PLAN



BLD. 539 FORT HANCOCK
ACCELERATOR BUILDING

FIG. J-9 BLOCK & VENTILATION PLAN

$$f = \frac{n/cm^2/sec}{mrem/hr}$$

$$I \approx \frac{\frac{2 \times 10^{11}}{4 \times 3.14\ (427)^2} \times e^{-0.153 \times 64}}{4} = 1.2 \text{ mrem/hr}$$

(2) NOTE: (a) The equation does not take into consideration neutron buildup factors or neutrons scattered through the maze. (b) The "Operation Manual" for the generator states that the output from the source is 1×10^{11} neutrons per second. This value was increased by a factor of two for the calculation.

(3) Two instruments were used to determine the dose rate an operator near the control console would be exposed to. The readings obtained were:

Victoreen Instrument Division Model 4400RF	1.3 mR/hr
Texas Nuclear Corp. Model 9140 NEMO Special Neutron Dosimeter System	1.4 mrem/hr

f. Figure J-9 shows part of the ventilation system. Figure J-10 shows the overhead shielding and the ventilating duct elevation.

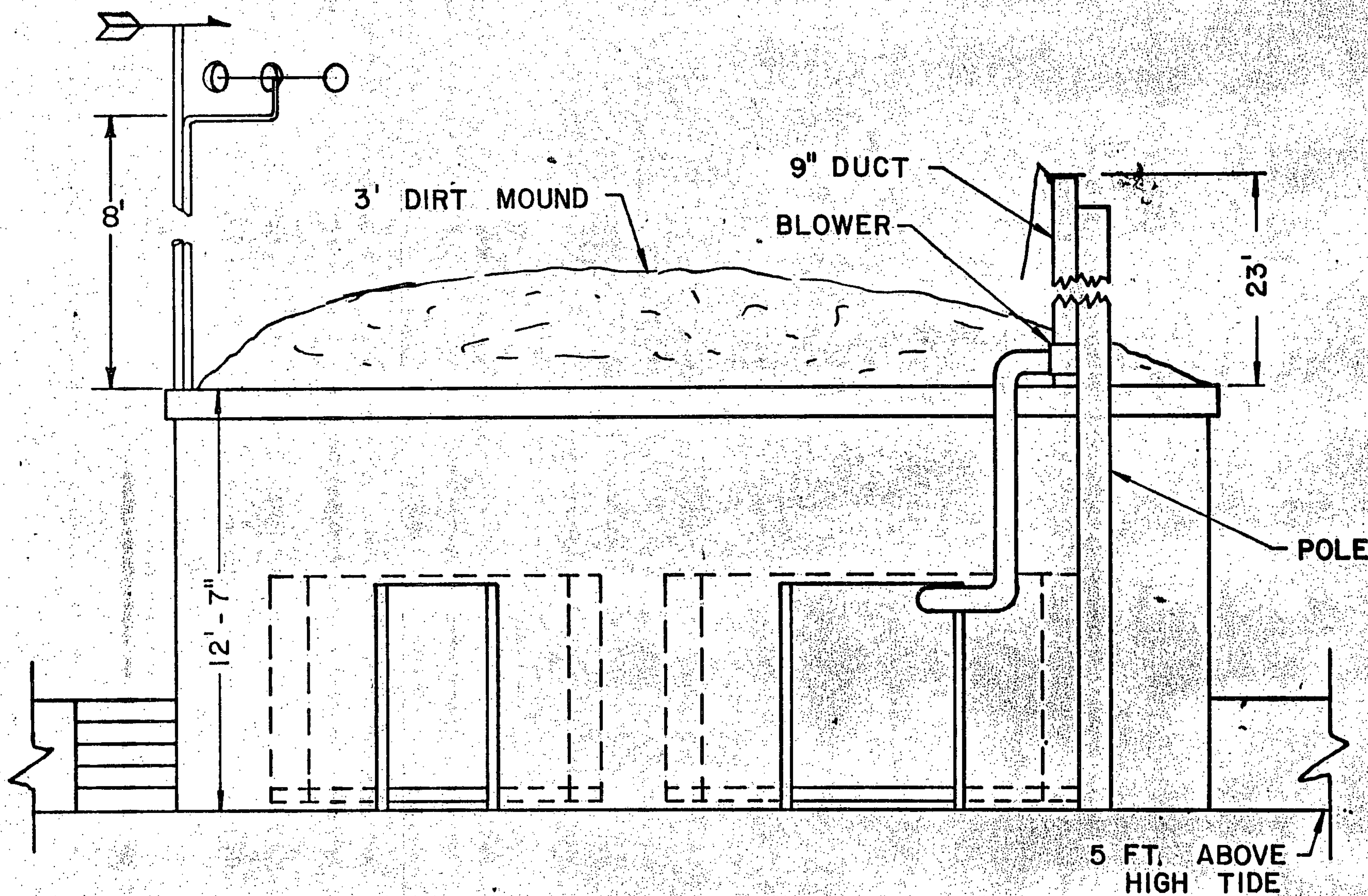
g. Ventilating system measurements gave the following results:

Location	Velocity	Volume Per Unit Time
Inlet duct	1440 ft/min	576 CFM
Outlet duct	1950 ft/min (9.91 m/sec)	950 CFM (4.5×10^5 mℓ/sec)

Obviously there is considerable air leakage around the doors and through the walls.

h. The volume of air being exhausted through the stack every two minutes is equivalent to the volume of the neutron generator room. The direction of air flow in the control room is toward the maze and generator room.

i. According to the Operation Manual for the Model A-1001 Neutron Generator the following total quantities of tritium are released under the circumstances indicated.



BLDG. 539 FORT HANCOCK
ACCELERATOR BUILDING
FIG. J-10 ELEVATION VIEW

(1) Target changes (with isolation valve closed), 1.8×10^{-6} curies (1.8×10^{-3} mCi).

(2) Replenishing cartridge change (with isolation valve closed), 1.8×10^{-6} curies (1.8×10^{-3} mCi).

(3) Evacuation of entire accelerator (ion pump off), 3.5×10^{-5} curies (3.5×10^{-2} mCi).

(4) Breakage during replenishing, 2.07×10^{-4} curies (2.07×10^{-1} mCi).

(5) Breakage at other time, no tritium released.

(6) Evacuation of entire accelerator (ion pump on using Kaman Sorption Pump), no tritium released.

J. Condition (4) above would release the most tritium and it would take place in the shortest time. The tritium would be released into the Neutron Generator Room. To remove all of the tritium from the room an air volume equal to several times the volume of the room would have to pass through the room. However, to simplify calculations it is assumed that all of the tritium released into the room would be removed in the length of time it would take the blower to exhaust a volume of air equal to the volume of the room, 2 minutes or 120 seconds. The average release rate would be.

$$\frac{2.07 \times 10^{-1}}{120 \text{ sec}} = 1.7 \times 10^{-3} \ \mu\text{Ci/sec} .$$

The average concentration would be

$$\frac{2.07 \times 10^{-1} \text{ mCi} \times 10^{3} \ \mu\text{Ci/mCi}}{4.5 \times 10^{5} \text{ m}\ell\text{/sec} \times 120 \text{ sec}} = 3.84 \times 10^{-6} \ \mu\text{Ci/m}\ell .$$

10 CFR 20 limits the yearly average MPC_{air} for release of tritium to 2×10^{-7} μCi/mℓ and the average MPC_{air} for radiation workers to 2×10^{-6} μCi/mℓ. If a break occurred during the process of replenishing a target by the use of a replenishing cartridge the concentration for radiation workers may exceed 2×10^{-6} μCi/mℓ for a few moments; however, the average for the day would be within acceptable limits.

k. To evaluate the likelihood of someone other than a radiation worker being exposed to a concentration exceeding 2×10^{-7} μCi/mℓ one must take into consideration dilution by turbulent diffusion from the time the tritium is released from the stack until it returns to the surface. The equations used are from Herman Cember's book, Introduction to Health Physics, published by Pergamon Press. The equations were derived from Sutton's equation for estimating the ground level concentration of a gaseous effluent from a chimney or stack.

(1) The formula used to determine the effective stack height, h, takes into consideration the actual stack height h_a, a factor due to the exit velocity, and a temperature factor:

$$h = h_a + d \left(\frac{\upsilon}{\mu}\right)^{1.4} \times \left(\frac{\Delta T}{T}\right) = \text{meters}$$

where

h_a = actual height of stack, 11 meters,

d = stack outlet diameter, 0.23 meters,

υ = exit velocity of gas, 9.9 m/sec,

μ = mean windspeed, 2.2 m/sec (5 MPH),

ΔT = difference between ambient and gas temperatures, $-17^{o}C$,

T = absolute temperature of gas, $273 + 21 \cong 290^{o}K$.

The values given above have been rounded off to two significant figures. The mean windspeed of 5 MPH is on the low side for this location. However, this low windspeed will result in a lower dilution factor. The use of a temperature of 21°C for the stack gas and an ambient air temperature of 38°C are the worst temperature conditions likely to ever occur in the area. Their use in the calculations give the lowest effective stack height and dilution factors

$$h = 11 + 0.23 \left(\frac{9.9}{2.2}\right)^{1.4} \times \left(1 + \frac{-17}{290}\right) \cong 12 \text{ meters} .$$

(2) The point of maximum ground level concentration, X_m, will occur at

$$X_m = \left(\frac{h^2}{C^2}\right)^{\frac{1}{2-n}} = \text{meters}$$

where

C = virtual diffusion coefficients in lateral and vertical directions, the value varies with h and with n,

n = dimensionless parameter that varies with atmospheric stability.

The value of n, 0.2, is the one given for a superadiabatic lapse rate, the one that will result in the least amount of dilution. The value for C^2, 0.050, was obtained by extrapolating values given in the above referenced book, for a number of different stack heights, to a stack having an effective height of 12 meters.

$$X_m = \left(\frac{12^2}{0.05}\right)^{0.56} \cong 88 \text{ m} \quad (\sim 290 \text{ ft}).$$

(3) The maximum ground level concentration, $\bar{X}_{max}$ in mCi/m^3 is

$$\bar{X}_{max} = \frac{2\,Q}{e\,\pi\,\mu\,h^2}$$

where

Q = emission rate, 1.7×10^{-3} mCi/sec

e = 2.718.

$$\bar{X}_{max} = \frac{2 \times 1.7 \times 10^{-3}}{2.7 \times 3.14 \times 2.2 \times 12^2} = 1.2 \times 10^{-6} \text{ mCi/m}^3 .$$

(4) The maximum concentration on the ground, in terms of $\mu Ci/m\ell$ is

$$\frac{1.2 \times 10^{-6} \text{ mCi/m}^3 \times 10^3 \text{ } \mu\text{Ci/mCi}}{10^6 \text{ m}\ell/\text{m}^3} = 1.2 \times 10^{-9} \text{ } \mu\text{Ci/m}\ell .$$

(5) According to Herman Cember, Sutton's equations are for effective stack heights ≥ 25 meters and that the true concentration can be expected to lie between
$\bar{X}/10$ and $10\,\bar{X}$ 96 times out of 100. The 1.2×10^{-9} $\mu Ci/m\ell$ value is a factor of 170 below the maximum permissible yearly average release concentration for tritium of 2×10^{-7} $\mu Ci/m\ell$.

(6) A remote wind velocity and direction indicator is located in the control room. Target replenishing, target change or total system pump down is not performed unless the wind velocity is 5 MPH or higher.

1. A tritium air monitor with an alarm is used to insure that the air in the accelerator building, where operating and maintenance personnel are located, is below the MPC_{air} limit of 5×10^{-6} $\mu Ci/m\ell$ for radiation workers.

11. Other Remote Locations. When sealed sources covered by an RD&E license are used at locations outside the Fort Monmouth complex by individuals(s) approved by the Committee on a project approved by the Committee, the facilities of the remote location are used if they are adequate. The shipping container usually serves as both the storage and use container. If the shipping container if not suitable for use as both storage and use containers and suitable containers are not available at the remote location then suitable ones are supplied by RD&E. If they are needed and are not available at the remote location RD&E supplies radiation signs, fence posts, rope, survey instruments, etc.

SUPPLEMENT K

Radiation Protection Program

Reference: Form 313, Item 14.

SUPPLEMENT K

SUBJECT: Radiation Protection Program

1. Reference: Form 313, Item 14.

2. The radiation protection program is described in the draft copy of ECOM Regulation 385-9 (see inclosure one).

3. The primary sealed source leak test method will be smear tests, however, bubble leak tests, vacuum leach tests or other types of tests may be used occasionally on some sources. The amount of radioactive material removed by wipe or water used in the vacuum leach test will be determined by procedures and equipment capable of measuring 0.005 microcuries of the type of radioactive material in the sealed source being tested.

4. Sealed source leak tests will be performed by one or more of the individuals listed in Para. 4 of Supplement F. Resumes of their training and experience may also be found in Supplement F.

5. Initial radiation surveys will be made by the RPO, a technical member of his staff, by individuals approved by the committee to make such surveys, or AEHA.

6. Sealed sources that are found to be leaking will be sealed inside a storage container and placed in storage until arrangements can be made for their disposition. They will either be repaired by a "person" licensed to make such repairs or disposed of as radioactive waste.

HEADQUARTERS
UNITED STATES ARMY ELECTRONICS COMMAND
FORT MONMOUTH, NEW JERSEY 07703

*ECOM REGULATION
No. 385-9

Typed 2 May 1973

Safety

IONIZING RADIATION CONTROL

Paragraph

Purpose---1
Scope---2
Definitions---------------------------------------3
Policy--4
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Appendix I--
Appendix II---------------------------------------

1. Purpose. This regulation defines guide lines, standards, procedures, and responsibilities for control of ionizing radiation health hazards on Fort Monmouth. It establishes criteria for the operation of all ionizing radiation producing equipment and all production, transportation, handling, storage, possession, and disposal of radioactive materials on Fort Monmouth, or licensed by ECOM organizations headquartered at Fort Monmouth, except those involved in disaster control operations.

2. Scope. This Regulation applies to all who possess, use, or handle sources of ionizing radiation within the confines of Fort Monmouth or under provisions of AEC licenses administered by ECOM organizations headquartered at Fort Monmouth. It is distributed to all activities for information.

*Supersedes ECOMR 385-9, 15 Nov 66, Prevention and Control of Radiation Hazards and Change 1 thereto

3. Definitions. Definitions of terms used herein are those appearing in the Code of Federal Regulations (CFR), title 10, chapter 1, "Atomic Energy". In addition the following pertain:

a. Ionizing radiation. Electromagnetic or particulate radiation capable of producing ions, directly or indirectly in its passage through matter. For purposes of this regulation alpha and beta particles, gamma rays, X-rays, and neutrons are examples of ionizing radiation. This type of radiation does not include sound or radio waves, visible, infrared, or ultraviolet light or lasers.

b. Ionizing Radiation Control Program. Encompasses the measures established by management to assure safety of operations, training, identification of hazards, conformance with procedures and standards for users of ionizing radiation sources, to effect ECOM assignments.

c. ECOM Ionizing Radiation Control Committee (IRCC). A group of knowledgeable individuals appointed by the commander who are competent to review the total radiation program from all safety and health aspects and to advise the commander on policy and required actions.

d. Radiological Protection Officer (RPO). An individual designated by the commander to provide consultation and advice on the degree of hazards associated with ionizing radiation and the effectiveness of measures to control these hazards. This individual shall be technically qualified by virtue of education, military training, and/or professional experience to associated capability commensurate with the assignment. The term "radiological protection officer" is a functional title, and is not intended to denote a commission status or job classification within the Armed forces.

4. Policy. It is ECOM policy that:

a. Use of ionizing radiation will be controlled so that the radiation exposure for individuals within ECOM is no greater than limits prescribed in Appendix I.

b. Safety of operations will guide transactions concerning handling, storing, disposing and repairing items which contain radioactive material or produce ionizing radiation and which are to be stored or used at Fort Monmouth.

c. Control and approval of APPLICATIONS FOR AEC licenses, DA authorization and permits and procurement of ionizing radiation sources is assigned to the IRCC.

5. EXEMPTIONS. The following materials, equipment, and conditions of exposure are exempt from the controls established by this regulation.

a. Natural radioactive materials of an equivalent specific radioactivity not exceeding that of natural potassium (i.e., 0.0001 microcuries per gram) and byproduct radioactive materials in quantities or concentrations not greater than those specified in the schedules of applicable Atomic Energy Commission (AEC) and Department of the Army Regulations provided they are not used in such a combined quantity that any person might receive a radiation dose exceeding 1/10 the applicable Radiation Protection Guide (RPO) in Appendix I.

b. Electrical Equipment such as high voltage units (e.g., klystron tubes) that is not intended primarily to produce ionizing radiation and which operates in such a manner that no person can receive a radiation dose exceeding 1/10 the applicable RPG.

6. Responsibilities.

a. The Chief, ECOM Safety Office exercises staff supervision over the ionizing radiation control program.

b. The IRCC functions in accordance with 10CFR 33, AR 700-52, AMCR 385-25 and AMCR 385-30. The member assigned as the Commanding Officer's designated representative will authenticate APPLICATIONS FOR AEC licenses, DA authorizations and permits.

c. Commanders and Directors of Activities requiring use of ionizing radiation are responsible for implementing the Ionizing Radiation Control Program within their purview and will:

(1) Provide surveillance of all radiological health controls, maintain an inventory of all radiation sources within their Directorate and confirm adherence to applicable license criteria.

(2) Provide enforcement of radiological controls at all their areas.

(3) Review all construction, siting, and operational plans involving the storage or use of radiation sources or equipment for compliance with radiation protection regulations and good health practices and advise the Chief, ECOM Safety Office and the ECOM IRCC of potential personnel hazards.

(4) Maintain liaison with the Fort Monmouth Fire Department and security guard force on locations of radioactive material and where hazards to personnel may be created as a result of fire involving radioactive material.

(5) Perform radiation surveys in compliance with AR 700-52 at least once every 30 days.

(6) Maintain records in accordance with 10CFR30, AR 700-52 and TM-38-750.

(7) Report to ECOM Safety Office any probable overexposure received when personnel monitoring equipment was not utilized.

(8) Appoint a Radiological Protection Officer.

d. All supervisors of users of radiation sources will:

(1) Insure compliance with the requirements of this regulation.

(2) Insure control and posting of radiation areas in accordance with APPENDIX I of this regulation.

(3) Provide appropriate exposure measuring devices (dosimeter, film badges, etc.) protective clothing and respirators for personnel working in radiation areas, AS REQUIRED.

(4) Insure that proper storage facilities and arrangements for handling all radioactive materials are provided according to criteria and procedures set forth in APPENDIX II of this regulation.

(5) Notify through the organization RPO, the ECOM Safety Office:

(a) When a radioactive source or ionizing radiation producing device is being moved onto or from Fort Monmouth if the source is 5 curies or stronger, or in the case of special nuclear material if it is more than 5 pounds.

(b) When deviation from approved procedure or planned schedules could involve radiation safety. If in the judgement of the organization RPO it is not likely that overexposure or contamination spread will occur, the ECOM Safety Office need not be notified.

(c) Immediately in the event of any accident/incident involving a potential overexposure of personnel or release of radioactive contamination that might result in overexposure of personnel.

e. Radiation workers will be responsible for:

(1) Knowing and following SOP's, rules, and special instructions.

(2) Using safety equipment properly.

(3) Reporting to the supervisor any accident; unusual incident; personal injury, however slight; suspected overexposure and/or suspected internal exposure; as soon as possible after the occurrence.

f. Installation Surgeon (Patterson Army Hospital) will be responsible for providing medical assistance and advice as established by AR 40-4 and 40-5, and in addition will be responsible for the following:

(1) Assuring safe condition and safe operation of X-ray machines used for dental and medical diagnostic and treatment purposes.

(2) Posting personnel radiation exposure records as prescribed in AR 40-14 and para 1a(1) of APPENDIX I.

(3) Making reasonable effort to obtain prior radiation exposure records of new personnel.

g. Installation Transportation Officer is responsible for insuring that shipping procedures as delineated in paragraph 8 of Appendix II are followed.

7. References.

Title 10 Code of Federal Regulations
AR 40-4
AR 40-5
AR 40-14
AR 700-52
AR 755-15
AMCR 385-25
AMCR 385-30
TM 3-261
TM38-750

APPENDIX I

STANDARDS FOR RADIATION EXPOSURES AND CONTAMINATION

The following guides are based on the recommendations of the Federal Radiation Council, the National Committee on Radiation Protection, the International Commission on Radiological Protection, and the regulations of the AEC and the US Army.

1. Radiation Protection Guides (RPG) for External Exposure

a. Occupation

(1) When any person accepts employment in radiation work, it shall be assumed that he has received his age-prorated dose up to that time unless satisfactory records show to the contrary, or it can be satisfactorily demonstrated that he has not been employed in radiation work. The assumed exposure for calendar quarters prior to 1 Jan 61, shall be 3750 mrem and 1250 mrem after 1 Jan 61. A reasonable effort will be made to obtain reports of previously accumulated occupational dose. This is not to imply that such an individual should be expected to routinely accept exposures at radiation levels approaching the quarterly maximum of 1250 mrem up to the time he receives his age-prorated limit.

(2) The exposure limit to the whole body, head and trunk, active blood forming organs, lens of eyes, or gonads is 1250 mrem per calendar quarter. With the approval of Commander, ECOM, the weekly, quarterly, and yearly exposure limits for these critical body parts may be increased to 3000 mrem per quarter if the individuals total exposure does not exceed 5000 (N-18) mrem where N is the age at last birthday and is greater than 18 years. The following guides for external

exposure are applicable.

RADIATION EXPOSURE GUIDE

EXPOSURE PERIOD	CRITICAL BODY PARTS	SKIN	HANDS AND FOREARMS FEET OR ANKLES
Weekly	100 mrem	600 mrem	1500 mrem
Quarterly	1250 mrem	7500 mrem	18750 mrem
Yearly	5000 mrem	30000 mrem	75000 mrem
Accumulated	5000 (N-18) mr		

b. General Population. Ionizing radiation exposure limits to individuals of the general population shall be 500 mrem per year.

c. Medical dose. Radiation exposure resulting from necessary diagnostic and therapeutic medical, and dental procedures need not be included in the determination of the radiation exposure status of the individual concerned.

2. Radiation Portection Guide (RPG) for Airborne Activity

a. Restricted Area. Concentration above natural background of radioactive material in breathing air in restricted areas shall not exceed levels listed in 10CFR 20, Appendix B, Table 1.

b. Unrestricted Area. Concentration above natural background of radioactive materials in air in unrestricted areas shall not exceed levels listed in 10CFR 20, Appendix B, Table 2.

3. Radiation Protection Guide (RPG) for Waterborne Activity. Concentration of waterborne radioactive materials above natural background released to unrestricted areas shall not exceed the limits listed in 10CFR20, Appendix B.

4. Radiation Surface Contamination Guide. The surface contamination limits as specified in AMCR 385-25 apply to items and areas to be released for unrestricted use without prior approval of Health Physics Division, ECOM Safety Office.

5. <u>Respiratory Protection Equipment Guides.</u> The following respiratory protection will be used by personnel in an Atmosphere with the indicated particulate radioactive contamination:

Alpha	10^{-12}	uCi/cc	None
	10^{-8} to 10^{-12}	uCi/cc	Military Mask M9A/or equiv
	10^{-8} or higher	uCi/cc	Supplied Air Mask
Beta-gamma	10^{-10}	uCi/cc	None
	10^{-6} to 10^{-10}	uCi/cc	Military Mask M9A/or equiv.
	10^{-6} or higher	uCi/cc	Supplied Air Mask

6. <u>Area Delineation and posting</u>

a. <u>Radioactive Material Storage Containers and Areas.</u> Areas and containers that require posting in accordance with 10CFR20 shall be posted with a magenta and yellow sign bearing the radiation symbol and the words "CAUTION-RADIOACTIVE MATERIALS."

b. <u>Radiation Area.</u> A radiation area is any area accessible to personnel with a radiation level such that a major portion of the body could receive in any one hour a dose in excess of 5 millirem, or in any 5 consecutive days a dose in excess of 100 millirem. It shall be posted with a magenta and yellow sign(s) bearing the radiation symbol and the words "CAUTION-RADIATION AREA."

c. <u>High Radiation Area.</u> A high radiation area is any area accessible to personnel in which there exists radiation of such level that a major portion of the body may receive in any one hour a dose in excess of 100 millirem. It shall be conspicuously posted with a magenta and yellow sign(s) bearing the radiation symbol and the words "CAUTION-HIGH RADIATION AREA."

d. <u>Airborne Radioactivity Area.</u> An airborne radioactivity area is any area in which airborne radioactive material is present in concentrations in excess of the amounts specified in Appendix B, Table 1, Column 1 of 10CFR20, or any area where airborne radioactive material is present in concentrations which, if averaged over the number of hours in any week during which individuals are in an area, exceed 25% of the amount specified in 10CFR20, Appendix B, Table 1, Column 1. These areas shall be conspicuously posted with a magenta and yellow sign bearing the radiation symbol and the words "CAUTION-AIRBORNE RADIO-ACTIVITY AREA."

e. <u>Contaminated Area or Item.</u> A contaminated area or item is any area or item where contamination levels exceed those referred to in paragraph 4, they shall be posted with appropriate signs or tags.

f. <u>Temporary Area Identification.</u> Radiation roping or ribbon (yellow and magenta) will be used with warning signs whenever possible for the temporary delineation of radiation, contamination, or airborne radioactivity areas. Where non-colored or different colored rope or barrier are substituted, sufficient signs will be used with the barrier so there will be a clear understanding of the nature of the hazard existing beyond the barrier

APPENDIX II

PROCEDURES

1. <u>General.</u> To conform with the radiation standards as established by this document, contractors and users involved in operations dealing with ionizing radiation sources will comply with the following requirements:

a. A copy of documents and required information listed below will be submitted through the organization RPO to ECOM Safety Office at least two weeks prior to arrival at Fort Monmouth of radioactive materials and/or machines or devices producing ionizing radiation.

(1) Legal documents authorizing the contractor or agency to own, maintain, and use such materials, sources, devices and assemblies. Examples of such documents are USAEC by-Product Material licenses, USAEC Source Material licenses and DA authorizations or permits.

(2) Information concerning radioactive materials and radiation producing machines or devices to include the type, description, and quantity of radioactive materials and the location for storage and use. The detailed description should include the following as applicable:

(a) Manufacturer of the source.

(b) Date of initial source activity determination.

(c) Source identification number.

(d) Cross-sectional sketch showing dimensions.

(e) Source holder material of construction.

(f) Source form (powder, plated, foil, etc.)

(g) Chemical form (metal, oxide, titanate,etc.)

(h) Strength in curies or millicuries as of date of initial source activity determination.

(i) Type of protective cover material or film (if any) over the source.

(j) Date and result of last leak test.

(k) Method of sealing against leakage.

(3) Location and name of responsible individual (or custodian) and licensed organization assigned to supervise handling of radioactive material.

(4) Intended use and operating procedures. Operating procedures will delineate radiological hazard controls in accordance with applicable sections of this regulation. Changes to procedures must be submitted to the ECOM Safety Office.

b. Unattended radioactive material will be secured against unauthorized access and handling at all times.

c. Radiation workers who enter a radiation area must wear a film badge. An exposure record must be maintained for each individual.

d. Protective clothing, where required, must be donned prior to entering the radiation area.

e. Radiation areas will be posted and controlled.

f. Subordinate organization's radiological safety programs for the use of sources of radiation must conform to the minimum standards described herein.

g. All supervisors involved in operations where ionizing radiation is present will, as soon as practicable, notify the ECOM Safety Office, if any of the following incidents occur on Fort Monmouth.

(1) Damage to, or malfunction of equipment or exhaust systems, during operations, in areas where these items are required by approved operating procedures.

(2) Dosimeter readings in excess of 100 mrem in any one day on self-reading dosimeters.

(3) Spilled, or unintentionally released, radioactive material that might result in overexposure of personnel.

(4) Wounds resulting in a break of the skin or other incidents where radioactive material may have entered a person's body

(5) Fire, disaster, or other emergency in areas where radioactive material is being stored or used.

(6) Except RD&E, loss of personnel monitoring device or exposure while not utilizing device.

h. Supervisors of individuals shall ensure that the individuals working in a radiation area will perform their assigned tasks in a manner to minimize their internal and external exposures.

i. Users will clean up any radioactive contamination resulting from their work.

2. Radiation Area Identification and Access Control

a. Posting of Radiation Areas

(1) Storage, radiation, high radiation, airborne radioactivity, and contaminated areas as defined in paragraph 6, APPENDIX I, will be posted with appropriate signs, tags, and labels bearing the standard radiation warning symbol.

(2) Control instructions will be conspicuously posted at the entrances to a restricted area. Persons entering a restricted area will be briefed, as required by area operation plans, concerning any limited work time, contamination control techniques, protective clothing needs, and personnel monitoring devices.

b. Personnel entering a radiation area on a non-routine basis will obtain personnel monitoring device(s) and protective clothing from the responsible organization as required.

3. Radiological Contamination Control

a. Routine and continuous operations will not be conducted in areas where contamination levels exceed the values listed in paragraph 4, APPENDIX I, without approval of ECOM Safety Office, except as conducted by RD&E RPO.

b. At any time allowed contamination levels are exceeded the following action will be taken by the user:

(1) Terminate activity within the area; advise security guards.

(2) Control access to the area until released by the RD&E Radiological Protection Office or the ECOM Safety Office.

4. Waste Disposal. Radioactive wastes include unusable or unwanted radioactive items or material and items contaminated with radioactive materials. Waste material will be disposed of by methods consistent with all applicable regulations (i.e. AR 755-15, 10CFR20) and accepted radiation protection practices.

5. Radiation Exposure Control

a. The amount of exposure to ionizing radiation that a worker is allowed to receive in any period of time is limited. For licensed materials, these limits are set by the licensing authority. For unlicensed sources of radiation, the recommendations of the National Committee on Radiation Protection (NCRP) and the Federal Radiation Council (FRC) will be followed. Exposure guides are specified in APPENDIX I.

b. Exposure Records. Radiation exposure records will be completed and maintained for each individual required to work in a radiation area.

c. Exposure Monitoring. Film badges will be used as the primary device for personnel exposure monitoring.

detection equipment, first-aid supplies, and decontamination apparatus at the assembly area, as required.

(6) Check all personnel involved for possible contamination and segregate personnel who are contaminated.

(7) Decontaminate personnel, equipment, and the emergency area.

(8) Prepare a report of the incident.

b. In the event of emergency, specific actions as prescribed in Chapter 10, TM 3-261 will be followed. Prescribed reports will be forwarded through the ECOM Safety Office, AMSEL-SF-H.

7. Storage. An area designated for the storage of radioactive material shall conform to the following minimum standards:

a. It shall be kept clean.

b. Fire protection devices or equipment shall be readily available.

c. It shall be capable of being secured against unauthorized entry.

d. Appropriate standard radiation sign shall be posted.

e. When the area is left unattended, sources of radiation shall be secured against unauthorized handling and/or individual exposure to penetrating radiation.

f. The names and telephone numbers of responsible individuals shall be posted in a conspicuous location when the area is unattended.

g. Al least one container enclosing the radioactive material should be fire resistant, preferably metallic.

8. SHIPMENTS

a. Incoming

(1) Immediately upon receipt of radioactive material, the activity Supply Officer, before opening the container, will notify the Radiological Protection Officer.

(2) The shipment will be promptly monitored and logged in by a trained monitor.

(3) The radioactive material will then be delivered to the user or stored in a radioisotope storage vault, as circumstances warrant.

b. Outgoing

(1) Radioactive material to be shipped out will be monitored and logged in by the Radiological Protection Officer before and after packaging.

(2) The outgoing shipment will be packaged and labeled to conform with Interstate Commerce Commission regulations and Department of Transportation regulations as well as those of the Surgeon General, AEC, Navy Ships Systems Command, and Army Regulations.

(3) Shipments will be cleared with the Accountable Property Officer.

AMCAD-SE (28 Jul 67) 1st Ind
SUBJECT: Amendment of Byproduct Material License No. 29-1022-6

HQ, U. S. Army Materiel Command, Washington, D. C. 20315, 4 August 1967

TO: Deputy Chief of Staff for Logistics, Department of the Army, ATTN: Chief, PEMA Execution Division, Washington, D. C. 20315

1. This Headquarters has reviewed the inclosed ECOM request for amendment and recommends approval.

2. Two changes are requested:

a. The addition of the two sources listed on the application.

b. Broadening of the R&D program. (Item 7, AEC Form 313.)

3. Additional information furnished by ECOM:

a. Use of the sources requested will be research and development as defined in the 24 May 1967 application.

b. A typographical error appears in the last sentence of the continuation sheet for Item 6b (AEC Form 313). The allowable level of contamination shall not exceed 0.005 microcuries of Sr^{90}.

FOR THE COMMANDER:

1 Incl
wd cy

Fred M. Bishoff
FRED M. BISHOFF
Chief, Safety Division
Administrative Office

DEPARTMENT OF THE ARMY
UNITED STATES ARMY ELECTRONICS COMMAND
FORT MONMOUTH, NEW JERSEY 07703

IN REPLY REFER TO:
AMSEL-XL-S

2 8 JUL 1967

SUBJECT: Amendment of Byproduct Material License # 29-1022-6

TO: Commanding General
U. S. Army Materiel Command
ATTN: AMCAD-SE
Washington, D. C. 20315

In accordance with paragraph 6a of AMCR-385-9, forwarded are 7 copies of the application for amendment of byproduct material license # 29-1022-6.

FOR THE COMMANDER:

1 Incl.
as

S Benedict Levin

S. BENEDICT LEVIN, Director
Institute for Exploratory Research

Form AEC-313
8-64
10 CFR 30

UNITED STATES ATOMIC ENERGY COMMISSION

APPLICATION FOR BYPRODUCT MATERIAL LICENSE

Form approved.
Budget Bureau No. 38-R027

INSTRUCTIONS.—Complete Items 1 through 16 if this is an initial application or an application for renewal of a license. Information contained in previous applications filed with the Commission with respect to Items 8 through 15 may be incorporated by reference provided references are clear and specific. Use supplemental sheets where necessary. Item 16 must be completed on all applications. Mail two copies to: U.S. Atomic Energy Commission, Washington, D.C., 20545, Attention: Isotopes Branch, Division of Materials Licensing. Upon approval of this application, the applicant will receive an AEC Byproduct Material License. An AEC Byproduct Material License is issued in accordance with the general requirements contained in Title 10, Code of Federal Regulations, Part 30, and the Licensee is subject to Title 10, Code of Federal Regulations, Part 20.

1. (a) NAME AND STREET ADDRESS OF APPLICANT. *(Institution, firm, hospital, person, etc. Include ZIP Code.)*

U. S. Army Electronics Command
Fort Monmouth, New Jersey

(b) STREET ADDRESS(ES) AT WHICH BYPRODUCT MATERIAL WILL BE USED. *(If different from 1 (a). Include ZIP Code.)*

The UDM-2 (6 K below) will be used at the
Lakehurst Naval Air Station
Lakehurst, New Jersey
as well as in the Evans Area of U. S. Army Electronics Command

2. DEPARTMENT TO USE BYPRODUCT MATERIAL

NO CHANGE

3. PREVIOUS LICENSE NUMBER(S). *(If this is an application for renewal of a license, please indicate and give number.)*

29-1022-6

4. INDIVIDUAL USER(S). *(Name and title of individual(s) who will use or directly supervise use of byproduct material. Give training and experience in Items 8 and 9.)*

NO CHANGE

5. RADIATION PROTECTION OFFICER *(Name of person designated as radiation protection officer if other than individual user. Attach resume of his training and experience as in Items 8 and 9.)*

NO CHANGE

6. (a) BYPRODUCT MATERIAL. *(Elements and mass number of each.)*	(b) CHEMICAL AND/OR PHYSICAL FORM AND MAXIMUM NUMBER OF MILLICURIES OF EACH CHEMICAL AND/OR PHYSICAL FORM THAT YOU WILL POSSESS AT ANY ONE TIME. *(If sealed source(s), also state name of manufacturer, model number, number of sources and maximum activity per source.)*
J. Americium 241	J. 5 Vacuum sublimed sources. J. 100 microcuries total with no single source to exceed 20 microcuries. J. Vacuum sublimed 100 microcuries Am^{241} source mfg by Radiochemical Center in Amersham, Buckinghamshire, England. Consists of a thin layer of Am^{241} deposited by vacuum sublimation onto a lightly oxidised stainless steel disk of overall diameter 25 mm and thickness 0.5 mm. The diameter of the active area is approximately 7 mm.
K. Strontium 90	K. 4 Sealed sources. K. 120 millicuries total in one UDM-2 Radiac calibrator set. K. The calibrator set consists of two sections: Section 1 is a right cylinder housing 3 ea 25 millicurie Sr^{90}-Y^{90} sources oriented at 120 degrees to each other shielded with tungsten. Section 2 contains a (Cont'd on separate sheet) Inclosure 1)

7. DESCRIBE PURPOSE FOR WHICH BYPRODUCT MATERIAL WILL BE USED. *(If byproduct material is for "human use," supplement A (Form AEC-313a) must be completed in lieu of this item. If byproduct material is in the form of a sealed source, include the make and model number of the storage container and/or device in which the source will be stored and/or used.)*

In addition to research as described in application dated 24 May 1967, authorization for the irradiation of drosophila, meal worms and other small insects and seeds with x-rays, gamma rays and 2 MeV electrons, to determine whether dose-rate saturation of damage in biological systems occurs and to determine its value for specific organisms, is requested. Irradiated organism will be destroyed after the experiments and will be under close control during the experiments.

Incl 14

(Continued on reverse side)

TRAINING AND EXPERIENCE OF EACH INDIVIDUAL NAMED IN ITEM 4 (Use supplemental sheets if necessary)

8. TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (Circle answer)	FORMAL COURSE (Circle answer)
a. Principles and practices of radiation protection	NO CHANGE		Yes No	Yes No
b. Radioactivity measurement standardization and monitoring techniques and instruments			Yes No	Yes No
c. Mathematics and calculations basic to the use and measurement of radioactivity			Yes No	Yes No
d. Biological effects of radiation			Yes No	Yes No

9. EXPERIENCE WITH RADIATION. *(Actual use of radioisotopes or equivalent experience.)*

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION OF EXPERIENCE	TYPE OF USE
		NO CHANGE		

10. RADIATION DETECTION INSTRUMENTS. *(Use supplemental sheets if necessary.)*

TYPE OF INSTRUMENTS (Include make and model number of each)	NUMBER AVAILABLE	RADIATION DETECTED	SENSITIVITY RANGE (mr/hr)	WINDOW THICKNESS (mg/cm²)	USE (Monitoring, surveying, measuring)
		NO CHANGE			

11. METHOD, FREQUENCY, AND STANDARDS USED IN CALIBRATING INSTRUMENTS LISTED ABOVE.

NO CHANGE

12. FILM BADGES, DOSIMETERS, AND BIO-ASSAY PROCEDURES USED. *(For film badges, specify method of calibrating and processing, or name of supplier.)*

NO CHANGE

INFORMATION TO BE SUBMITTED ON ADDITIONAL SHEETS IN DUPLICATE

13. FACILITIES AND EQUIPMENT. Describe laboratory facilities and remote handling equipment, storage containers, shielding, fume hoods, etc. Explanatory sketch of facility is attached. *(Circle answer)* Yes No

NO CHANGE

14. RADIATION PROTECTION PROGRAM. Describe the radiation protection program including control measures. If application covers sealed sources, submit leak testing procedures where applicable, name, training, and experience of person to perform leak tests, and arrangements for performing initial radiation survey, servicing, maintenance and repair of the source.

NO CHANGE

15. WASTE DISPOSAL. If a commercial waste disposal service is employed, specify name of company. Otherwise, submit detailed description of methods which will be used for disposing of radioactive wastes and estimates of the type and amount of activity involved.

NO CHANGE

CERTIFICATE (This item must be completed by applicant)

16. THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATE ON BEHALF OF THE APPLICANT NAMED IN ITEM 1, 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.

Applicant named in item 1

Date June 20 1967 By: Wolfgang J. Ram[illegible]

Basil Mac[illegible]

Chairman, Isotopes Committee

Radiological Protection Officer

Title of certifying official

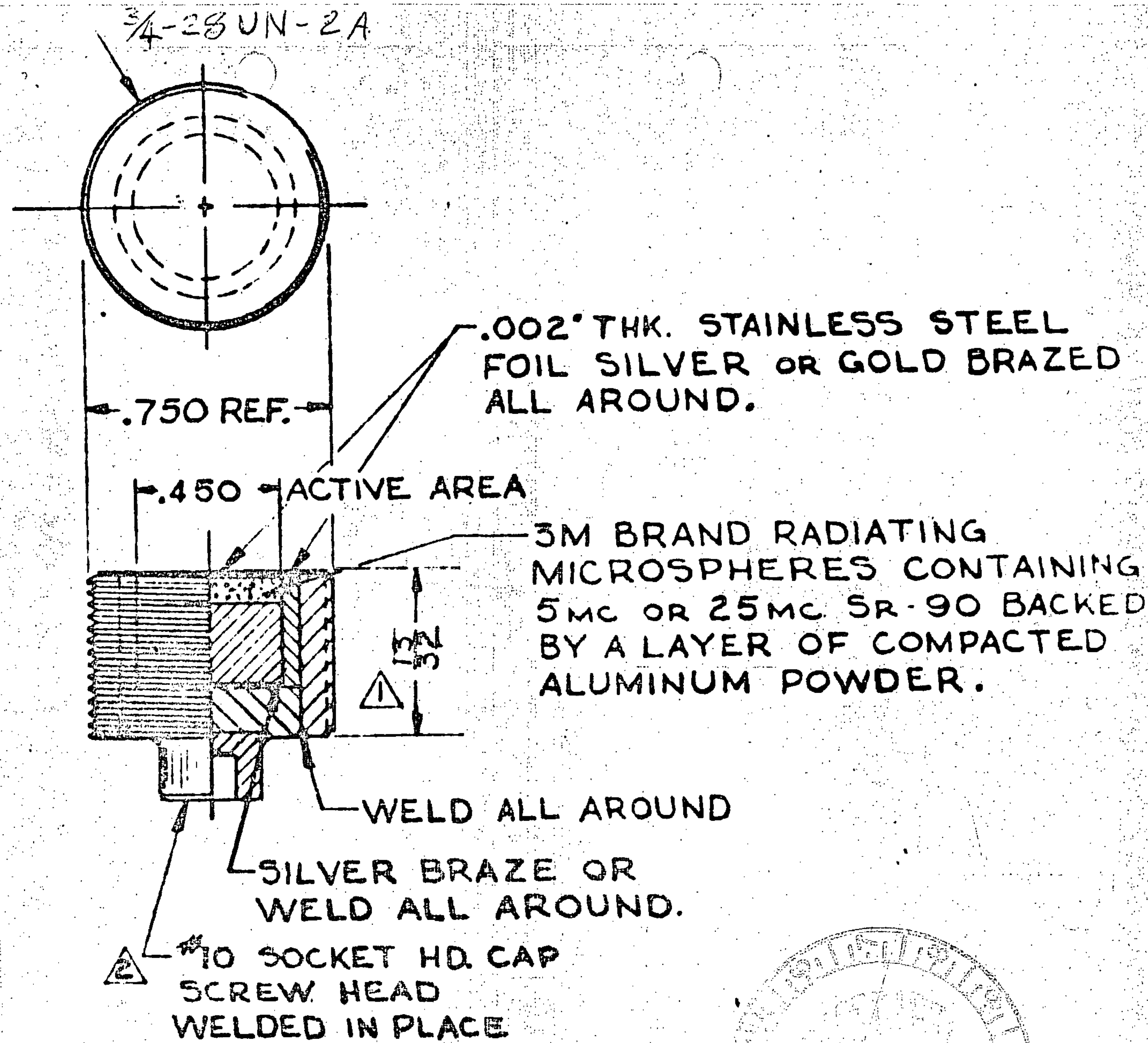
WARNING.—18 U. S. C., Section 1001; Act of June 25, 1948; 62 Stat. 749; makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

☆ U.S. GOVERNMENT PRINTING OFFICE : 1964 O—745-381

Inclosure 1

Form AEC-313 item 6b continued

ratemeter assembly utilizing 25 millicuries Sr^{90} Y^{90} interlocked and shielded with tungsten. This set is being mfg by the Canadian Admiral Corp. Limited, 501 Lakeshore Road, Port Credit, Ontario. Sources are being supplied by the Minnesota Mining and Mfg. Co., St Paul, Minnesota. Drawings of sources are inclosed. All protective devices and precautionary markings have been incorporated in the calibrator in accordance with AEC regulations. Leak tests must all be negative as shown by the absence of bubbles during the conventional bubble test and smear tests must be less than .0005 microcuries of removable Sr^{90}.



MAT'L.
STAINLESS STEEL
TYPE 304

ISSUE	ISSUE DATE AND CHANGE RECORD	REV.	CH.
2	JULY 12, 1966 — 2 WAS SCREWDRIVER SLOT; 1 WAS .500	JDS	JWJ
1	JUNE 3, 1966		

USED ON

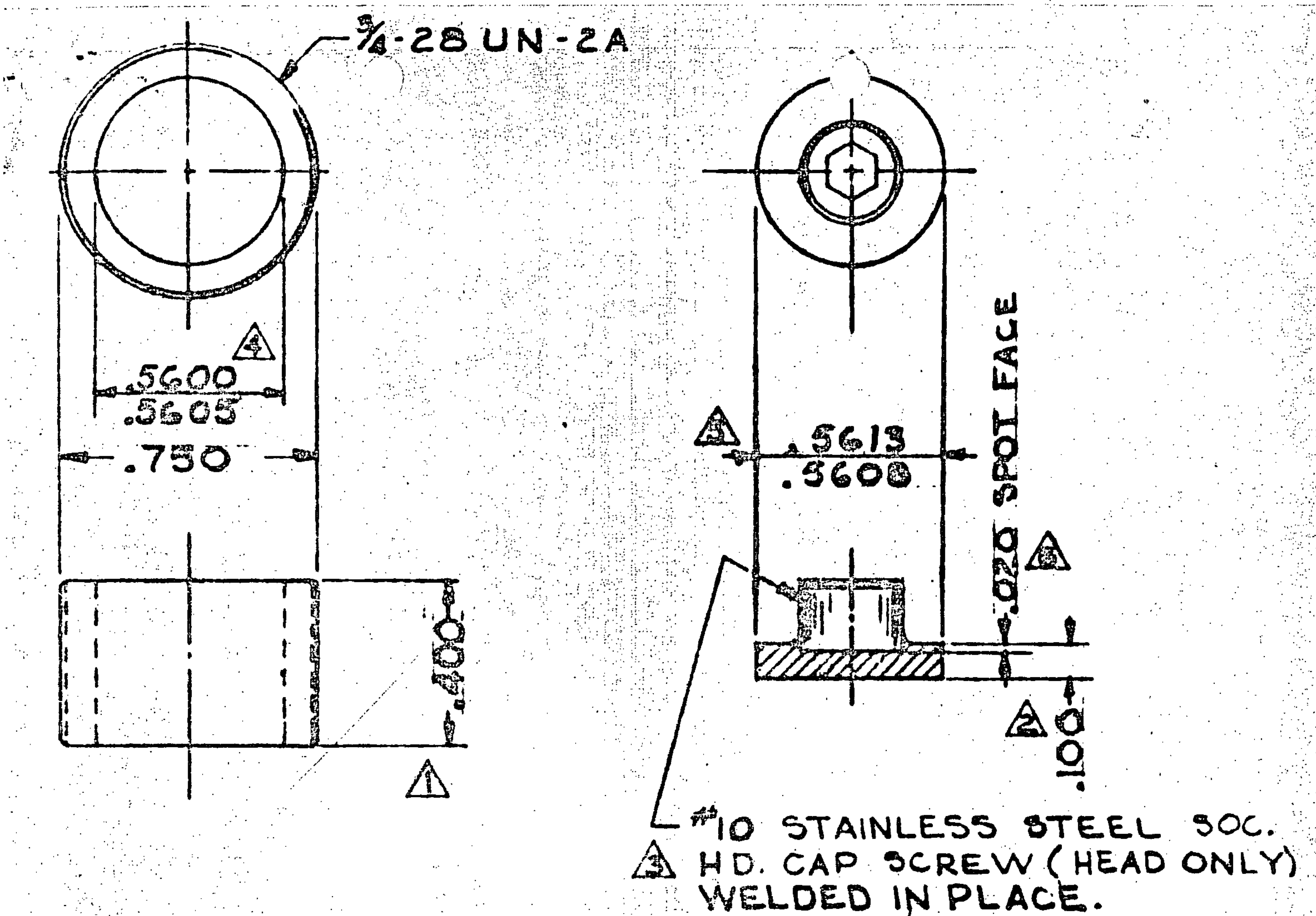
DIVISION NUCLEAR PRODS. PROJ.

SCALE 2" = 1"
DR. J. D. SWENSON
CH. JWJ
APP. TWL

TITLE
Sr-90 BETA SOURCE
3M MODEL # 3F1G

A 1921-474

MINNESOTA MINING & MANUFACTURING CO.
ST. PAUL, MINNESOTA



MAT'L.
STAINLESS STEEL
TYPE 304

3	DEC. 19, 1966 5 ADDED - DELETE SHANK 4 WAS .560 REF. LIGHT PASS 1 WAS .560	JDS	
2	JULY 12, 1966 3 ADDED - WAS SCREWDRIVER SLOT 2 WAS .150 1 WAS .498/.495	JDS	JWJ
1	JUNE 2, 1966		
ISSUE	ISSUE DATE AND CHANGE RECORD	REV.	CH.

USED ON A-1921-474

TOLERANCES EXCEPT AS NOTED MACHINED DIMENSIONS ±.01 .000 ±.005 ANGULAR DIM. ± SHEET UNDER 30" ± DIM. 30" & OVER ± CASTING DIM. ±	MACHINED SURFACE ROUGHNESS EXCEPT AS NOTED 32 SCALE 2" = 1" DR. J.D. SWENSON CH. JWJ APP. TNL

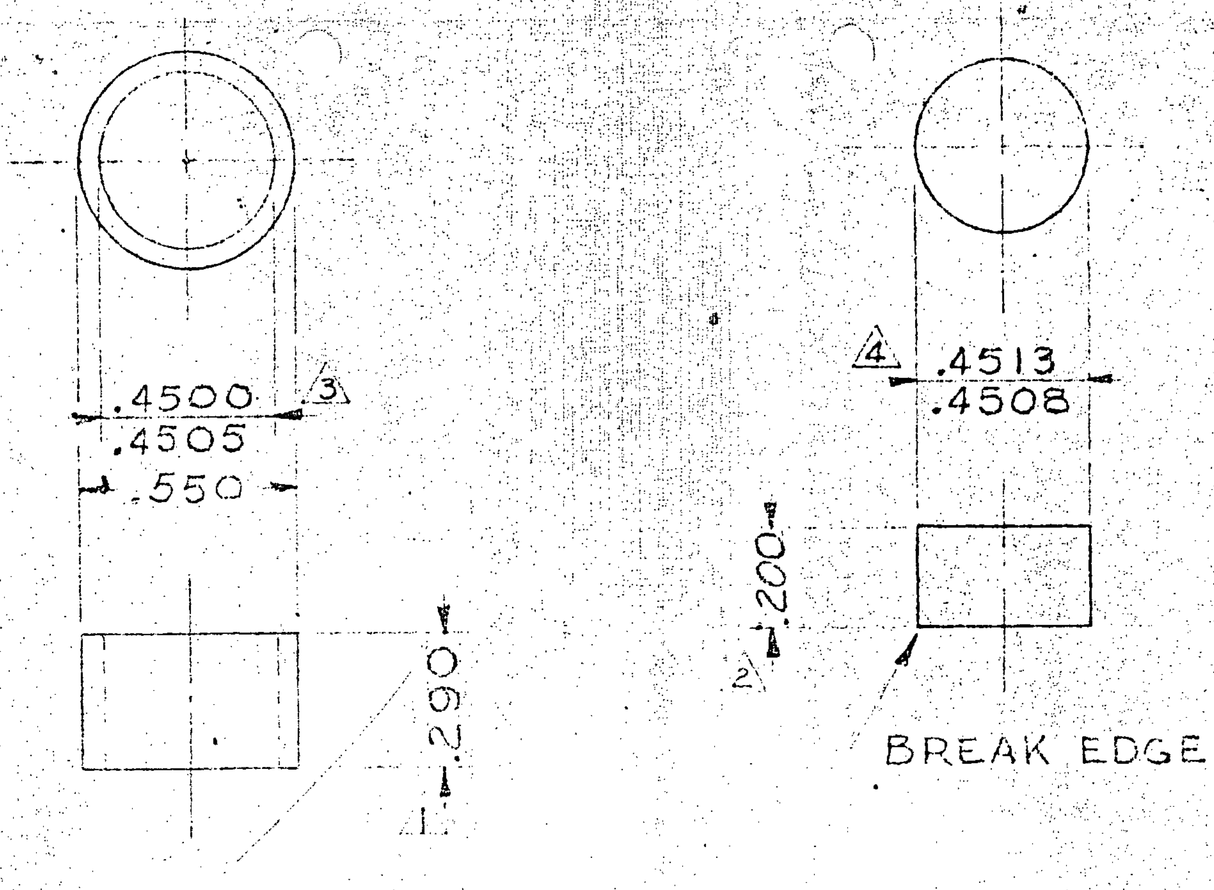
DIVISION NUCLEAR PRODS. PROJ.

TITLE

OUTER CAPSULE & PLUG - 3F1G

A 1921-475

MINNESOTA MINING & MANUFACTURING CO.
ST. PAUL 6, MINNESOTA



MAT'L.
STAINLESS STEEL
TYPE 304

ISSUE	ISSUE DATE AND CHANGE RECORD	REV.	CH.
3	DEC. 19, 1966 4 WAS .450 REF. LIGHT PRESS FIT 3 WAS .450	JDS	
2	JULY 12, 1966 2 WAS .250 1 WAS .340	JDS	JWT
1	JUNE 2, 1966		

USED ON A 1921-474

TOLERANCES EXCEPT AS NOTED
MACHINED DIMENSIONS
.± | .000 ± .003
ANGULAR DIM. ±
...EMENT DIM. UNDER 60° ± | 60° & OVER ±
...TING DIM. ±

MAXIMUM SURFACE ROUGHNESS EXCEPT AS NOTED 63

SCALE 2" = 1"
DR. J. D. SWENSON
CH. JWT
APP. TWL

DIVISION NUCLEAR PRODS PROJ.

TITLE
INNER CAPSULE
& PLUG - 3F1G

MINNESOTA MINING & MANUFACTURING CO.
ST. PAUL 6, MINNESOTA

A 1921-476

AMSEL-XL-S (8 Jun 67) 2nd Ind
SUBJECT: Application for Renewal of Byproduct Material License Number 29-1022-6

HQ, U. S. Army Electronics Command, Fort Monmouth, New Jersey 07703 24 JUL 1967

TO: Commanding General, U. S. Army Materiel Command, ATTN: AMCAD-SE
Washington, D. C. 20315

1. The inclosed application, subject above, is amended to include the omissions mentioned in Indorsement 1.

2. The amended omissions are as follows:

a. ECOM Regulation 385-9 section 4-d-2-c and section 5-B-7 indicates that both the Chairman of the Isotope Committee and the Radiological Protection Officer are to sign as certifying official. AEC Form 313 has only one space for a certifying official. The Radiological Protection Officer therefore signs as the certifying official, and an additional signature block has been added for the Chairman of the Isotope Committee.

b. (1) Survey meters sensitive to alpha, beta and gamma, or beta and gamma are calibrated in a standard gamma flux. (See inclosure 6 of 24 May 1967 renewal application). These instruments are used to locate the source of alpha or beta contamination, not to measure the activity of the source, and relative intensity of alpha to gamma or beta to gamma is sufficient to accomplish this.

(2) The Nuclear Chicago Model 2670 Alpha Survey Meter is calibrated originally at the factory using a Ra D+ E standard. A secondary standard U_3O_8 is incorporated in the instrument and is used to calibrate the model 2670 to $\pm$ 5% every 3 months.

(3) No calibrated survey instruments are available for accurate measuring beta flux.

(4) As indicated in Inclosure 6 of the 24 May 1967 application for renewal, the counting systems which are used to measure the activity of radioactive samples and wipes, in microcuries, are calibrated every 3 months using reproducible geometry and calibration sources purchased commercially from U. S. Nuclear Corp., Tracerlab Inc., Atomic Accessories, or Baird Atomic. A separate source is used for each isotope whose activity is to be measured.

c. (1) Transportation of radioactive sources to and from other areas will be accomplished according to Army Regulation 55-55 dated 30 June 1964. A copy is inclosed.

(2) When sources are used at Nevada Test Site, Pacific Proving Grounds and Fort Huachuca, Arizona, SOP's and safety procedures are under the control of their monitoring personnel and their RPO. ECOM personnel accompanying the sources have the responsibility for complying with all regulations.

96856

AMSEL-XL-S (8 Jun 67) 2nd Ind
SUBJECT: Application for Renewal of Byproduct Material License Number 29-1022-6

Sources used at Lakehurst Naval Air Station, Lakehurst, N. J., Oakhurst Tower Station, Ocean Township, N. J., and Fort Hancock, Highlands, N. J., are within a 30 mile radius of Fort Monmouth, N. J. and are easily monitored and surveyed by our own RPO, who is responsible for checking the compliance of established SOP's, the individual user is responsible to the Isotope Committee.

Sources used at Thule, Greenland, and Yuma Test Station, Yuma, Arizona are accompanied by qualified personnel and operating instructions to cover experiments involving use of these sources. SOP's and monitoring is conducted by these qualified personnel. Tests at these remote locations involving the sources are less than 3 months duration, so that wipe tests before and after the trip is sufficient.

(3) Inventories at these locations are not necessary as only one source is at any one location at a time and is the responsibility of the person using it who keeps it under constant surveillance. A record is made on the inventory card as to location of the source and person responsible for it when at another site. Wipe tests are not necessary as sources are usually returned to ECOM within the wipe test periods. Wipe tests are conducted before the source is shipped and immediately upon its return by personnel of Radiation Facilities Lab at ECOM.

d. Persons requiring the use of radioisotopes are required to fill out a Isotope Handling Qualification form. This completed form is reviewed by the Chairman of the Isotope Committee who reviews it for completeness before submitting it with his recommendations for approval or disapproval to the Isotope Committee. A copy of this form is inclosed.

e. AR 755-15 has been inserted to replace AR 755-380 which has been deleted. ECOM Regulation 385-9 has been amended to refer to AR 755-15 instead of AR 755-380.

3. No letter from the Surgeon General's Office concurring in ECOM's utilization of commercial bioassay services has ever been received by this installation.

However, the use of the bioassay services of Tracerlab, Div of L.F.E. 1601 Trapelo Road, Waltham, Mass. was stated in the application for our last renewal for license 29-1022-6 dated 16 July, 1965, specifically in an answer to a 29 Sept 1965 AEC inquiry dated 21 Oct. 1965 The letter and our answer is inclosed. Since we received the license with no additional inquiries, we assumed all parties in the Chain of Command approved the use of Tracerlab for urine bioassay.

FOR THE COMMANDER:

4 Incl
as

S. BENEDICT LEVIN, Director
Institute for Exploratory Research

96856

DEPARTMENT OF THE ARMY
UNITED STATES ARMY ELECTRONICS COMMAND
FORT MONMOUTH, NEW JERSEY 07703

IN REPLY REFER TO:
AMSEL-XL-S

8 JUN 1967

SUBJECT: Application for Renewal of Byproduct Material License # 29-1022-6

TO: Commanding General
U. S. Army Materiel Command
ATTN: AMCAD-SE
Washington, D. C. 20315

In accordance with paragraph 6a of AMCR-385-9, forwarded are 7 copies of the application for renewal of byproduct material license # 29-1022-6 in its entirety.

FOR THE COMMANDER:

1 Incl.
as

for S. BENEDICT LEVIN, Director
Institute for Exploratory Research

AMCAD-SE (8 Jun 67) 1st Ind
SUBJECT: Application for Renewal of Byproduct Material License Number 29-1022-6

HQ, U. S. Army Materiel Command, Washington, D. C. 20315, 15 June 1967

TO: Commanding General, U. S. Army Electronics Command, ATTN: AMSEL-SL-S, Fort Monmouth, New Jersey 07703

1. The inclosed application, subject above, although among the more complete received by this Headquarters, contains several omissions.

2. The omissions are as follows:

a. The application is not signed. ECOM Regulation 385-9 requires that the chairman of the ECOM Isotopes and Ionizing Radiation Committee sign BML applications as certifying official.

b. Inclosure 6 to Form AEC-313 does not detail the calibration of other than gamma and neutron survey instruments. No sources are listed for the calibration of alpha detecting instruments. Information concerning calibration techniques, calibration frequency, and calibration sources for other than gamma or neutron survey devices is required.

c. Reference Inclosure 1, to Form AEC-313. Additional information is required concerning procedures at the remote locations cited:

(1) How will transportation to and from these sites be accomplished? The information contained in Appendix I to ECOM Regulation 385-9 is not sufficient.

(2) How will compliance with the established SOP's, etc., be accomplished at these sites? At what interval will operations at these sites be surveyed by the RPO to assure compliance with the provisions, statements, and conditions of this application?

(3) How will wipe tests and inventories of radioactive material be maintained at these locations, and by whom?

d. Information is required, in the application, detailing the procedures utilized by the isotopes committee to select qualified users of the radioactive materials. The information must take into consideration the same criteria as required by the AEC on Form AEC-313.

AMCAD-SE (8 Jun 67) 1st Ind
SUBJECT: Application for Renewal of Byproduct Material License Number 29-1022-6

e. AR 755-380 has been superseded by AR 755-15, and AR 755-15 should be referenced in the application in regard to disposal procedures.

3. Request that a copy of the Surgeon General's concurrence in ECOM utilization of commercial bioassay services be furnished this Headquarters for inclusion in the general licensing files.

FOR THE COMMANDER:

Fred M. Bishoff

1 Incl
application

FRED M. BISHOFF
Chief, Safety Division
Administrative Office

Mr. B. MARKOW

Chairman

Ex 6

Mr. Markow was graduated from Lafayette College in [redacted] with a B.S. in Engineering Physics and did graduate work at Rutgers University, and New York University from 1950 to 1953. He also took 30 hours of Nuclear Engineering at Stevens Institute in 1958.

His on-the-job experience in the principles and practices of radiation protection, radioactivity, measurement, standardization and monitoring techniques and instruments, mathematics and calculations basic to the use and measurement of radioactivity, and the biological effects of radiations has been at USASRDA for the past 11 years.

The first 4 years at USASRDA were spent in research and development of radiation detecting instruments, both rate and total dose. Some of the systems he helped to develop were the K Br color changing dosimeter, the IM-93 quartz fiber dosimeter, and the AN/PDR-39 ionization chamber survey meter.

Later he headed the group responsible for evaluation of all radiation detecting equipment to be used by the Army. In this position he set up the procedures for determining calibration and energy dependence of new instruments using the Victoreen R meters as Secondary Standards. He also designed calibration ranges and sources both in the Laboratory and at NTS and PPG of up to 10 Kilo curies.

He participated in the design of equipment for conducting of experiments, evaluating data and the writing of Weapons Test Reports on Operation UPSHOT KNOTHOLE, TEAPOT, REDWING, PLUMBOB AND HARDTACK I.

He has been in charge of radiation facilities and personnel monitoring in USASRDA since 1952.

The last five years have been spent in research of high intensity neutron and gamma detectors.

The following are some of the publications he has to his credit:

1. Capsule for Pneumatically Operated Calibration Facilities Nucleonics May 1954.

2. United Kingdom Dosimeters - T-1290

3. ITR-1414 Initial Radiation Intensity and Neutron Induced Gamma Radiation of N.T.S. Soil.

4. WT-1118 Gamma Dose Rate vs Time and Distance.

5. WT-1311 Gamma Dose Rate vs Time.

6. Effects of Mixed Neutron-Gamma Pulses on Electronic Components. USASRDL Report Sept. 1959.

7. Measurement of High Intensity Gamma Fluxes with Vac-Ion Gauges. USAELRDL TR-2342.

8. POR Smallboy Proj 2.1, 6.4.

1

Supplement to Item 5 of AEC Form 313 "Training and Experience Resume of Dr. Wolfgang J. Ramm."

1. Dr. Wolfgang J. Ramm

2. Position: Research Scientist Title: Principal Research Scientist

3. Educational Background: Ph.D. (Physics) University of Leipzig, Germany.

4. Vocational Experience with Radiation:

A. Research Associate, Kaiser Wilhelm Institute for Physics, Berlin, Germany, 1936 - 1947.

B. Worked in fields of radiation physics and nuclear physics, active in radiation dosimetry from 1937 to present time.

C. Physicist at USAEL from 1948 to present time. Theoretical and experimental work in radiation dosimetry during all this time.

D. Wrote chapter 6 "Scintillation Detectors" in Hine and Brownell "Radiation Dosimetry" published by Academic Press 1956.

E. USAEL Radiological Protection Officer 1957 to 1961 and again in 1963.

5. FORMAL TRAINING IN RADIATION

A. Principles and Practices of Radiation Protection:

1. University of Leipzig, Germany

2. 1926 to 1936

B. Radioactivity Measurement Standardization and Monitoring Techniques and Instruments:

1. University of Leipzig, Germany

2. 1926 to 1936

C. Mathematics and Calculations Basic to the Use and Measurement of Radioactivity:

1. University of Leipzig, Germany

2. 1926 to 1936

D. Biological Effects of Radiation:

1. University of Leipzig, Germany

2. 1926 to 1936

6. ON THE JOB TRAINING

A. Principles and Practices of Radiation Protection:

1. Kaiser Wilhelm Institute , Berlin, Germany, 1936-1937.

2. U.S. Army Electronic Laboratories, 1948 to present.

B. Radioactivity Measurement Standardization and Monitoring Techniques and Instruments:

1. Kaiser Wilhelm Institute, Berlin, Germany, 1936-1937.

2. U.S.Army Electronic Laboratories, 1948 to present.

C. Mathematics and Calculations Basic to the Use and Measurement of Radioactivity:

1. Kaiser Wilhelm Institute, Berlin, Germany, 1936-1937.

2. U. S. Army Electronic Laboratories, 1948 to present.

D. Biological Effects of Radiation:

1. Kaiser Wilhelm Institute, Berlin, Germany, 1936-1937.

2. U. S. Army Electronic Laboratories, 1948 to present.

7. EXPERIENCE WITH RADIATION

ISOTOPE	MAXIMUM AMOUNT	WHERE GAINED	DURATION	TYPE OF USE
Radium	2 curies	Kaiser Wilhelm Ins	1937-47	open, research
1.5 Mev Cockroft-Walton Accelerator bombarded elements	µ curies	Kaiser Wilhelm Ins	1937-47	open, research
2.5 Mev Van De Graaff	µ curies	USAEL	1951-present	open, research
Co^{60}	200 curies	USAEL	1956-present	sealed irradiator
Sr^{90}	1 curie	USAEL	1950-present	open & encapsulated
Cs^{137}	120 curies	USAEL	1958-present	sealed
Mixed fission products	1 curie	USAEL	1956-present	neutron irradiated materials

EXPERIENCE - Dr. Horst H. Kedesdy, Director
Institute for Exploratory Research Division 'E'
USAECOM

EDUCATION: B.S. in Physics, Technical University of Berlin, Germany -

M.S. in Physics, Technical University of Berlin, Germany -

PhD. in Physics, Technical University of Berlin, Germany -

Ex6

1937-1939 Research Assistant, Technical University of Berlin - electron optics and microscopy.

1939-1947 Max Planck Institute, Berlin, Germany - solid state, x-ray and electron diffractions.

1947-1960 U. S. Army Electronics Laboratories, Fort Monmouth, New Jersey - x-ray and electron diffraction semi-conductors, ferromagnetic materials.

1960 to present Director, Institute for Exploratory Research Division 'E' - solid state physics.

EXPERIENCE - Dr. Stanley Kronenberg
Director
Division 'S', Institute for Exploratory Research
USAECOM

Ex 6

Received his education at the University of Vienna and earned his PhD in Physics in [ ] Did his doctorate in theoretical nuclear physics but participated actively during his study in the experimental work performed at the Institute for Radium Research in Vienna. After graduation he was employed by the General Hospital in Vienna to study radioisotopes in connection with medicine. The therapeutic and diagnostic exposures to X-rays, isotope radiation, and corpuscular rays was also part of the job.

Since 1953 he has been employed by the U. S. Army Signal Corps and worked since that time with the nuclear physics group in Fort Monmouth, N. J. Did mainly research in radiation dosimetry, nuclear weapon testing, and basis research in nuclear physics and nucleonics.

Has published numerous papers in the above fields and holds several US patents in this area of interest.

EXPERIENCE - Mr. Richard East

1. Degree in Chemistry, Seton Hall University

2. Experience in Biological and Clinical Chemistry, Serology and Hematology - 2 years.

3. Experience, Health Physics - 2 years

4. Experience in Research and Development and Calibration of radiation sensitive systems - 2 1/2 years.

Designing, fabrication and encapsulation of isotopes for calibration systems.

Encapsulation of radioactive sources up to 200 curies level.

Actively participated in Weapons Tests at Nevada Test Site Operations; "UPSHOT KNOTHOLE, CASTLE, REDWING AND HARDTACK" also "TEAPOT" at Pacific Proving Ground Operations.

EXPERIENCE - Barnard M. Savaiko
Safety Director
USAECOM

Graduated from Columbia University in [redacted] and has a B.S. degree in Industrial Engineering.

Presently employed with USAECOM as Safety Director.

He has had 8 years of safety experience, 4 with U. S. Steel and 4 years at Fort Monmouth, 2 of which he has received on-the-job training experience with radiation safety and measurements.

EXPERIENCE - Captain Ralph B. Carruthers
Chief, Preventive Medicine
Patterson Army Hospital

Ex6

Received M.D. Degree in from the Hahnemann Medical College and Hospital, Philadelphia, Pennsylvania.

Internship spent at Conemaugh Valley Memorial Hospital, Johnstown, Pennsylvania.

Present position is Chief, Preventive Medicine at Patterson Army Hospital, Fort Monmouth.

EXPERIENCE: Giles R. Locke, Capt. MC
Chief, Radiologist
Patterson Army Hospital

Ex6

BA DePauw University, Greencastle, Indiana [.]

MD Western Reserve University, School of Medicine, Cleveland, Ohio [.]

Rotating Internship Milwaukee County General Hospital June 1962-June 1963.

Radiology Residency University of Iowa, Iowa City, Iowa July 1963 to June 1966.

Radium Therapy 2 mos. }
Isotope Training 3 mos. } as part of Radiology Residency.

Isotope training included all basic scans and diagnostic procedures.

EXPERIENCE - Lt. Col James H. Horton
Chief, Logistics Division

ACTIVE DUTY - 31 Years service.

Present duty - Chief, Logistics Division, Fort Monmouth, New Jersey

EXPERIENCE: Louis Leo Kaplan
Electronic Engineer GS-15

Degree - Brooklyn College:

Major - Physics - [ ] Ex4
1 course - Nuclear Physics - 1936

Nuclear Engineering Course - Stevens Institute of Technology at Fort Monmouth - 30 hours - completed 18 September 1958.

Deputy Surety Officer, ECOM - appointed 22 July 1966.

1958-1963 - Army DASA TREE COM representative for Research and Development on Weapons Effects on Electronics.

1939-1942 - Safety Officer, Continental Silver Co. - Industrial Safety.

Local safety representative at various intervals from 1944 to present, including 1958-1966 as Branch Chief of Techniques Branch, Electronic Components Lab. Suggestion award, 1944 (?), on Safety Representative system now in effect at ECOM.

ECOM Laboratory Safety Officer since July 1966. Reports to ECOM Safety Office through the Deputy Director, ESSD, position now held by Louis L. Kaplan.

(a) James F. Ross, 2Lt Cml C

(b) Position title - Radiation Protection Officer

(c) Education background -

Nassau College
Mitchel A.F.B., Garden City
New York 1961-63
Chemistry - Major
Physics - Minor

U. S. Army Chemical Corps
School - Ft McClellan
Alabama 1966

(d) Vocational experience with radiation. -

U. S. Army Chemical School

(e) Formal training in radiation:

1. Principles and practices of radiation protection.

a. U. S. Army Chemical School

b. September - December 1966

2. Radioactivity measurement, standardization, and monitoring techniques and instruments.

a. U. S. Army Chemical School

b. September - December 1966

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

a. U. S. Army Chemical School

b. September - December 1966

4. Biological effects of radiation.

a. U. S. Army Chemical School

b. September - December 1966

96856

(f) On-the-job training in radiation.

1. Principles and practices of radiation protection.

a. U. S. Army Chemical School

b. September - December 1966

2. Radioactivity measurement, standardization, and monitoring techniques and instruments.

a. U. S. Army Chemical School

b. September - December 1966

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

a. U. S. Army Chemical School

b. September - December 1966

(g) Experience with the actual use of radioisotopes.

Max. Activity	Place	Experience	Type of Use
radium 25 mc	Nassau College	Shielding Effects	Monitoring
radium 5mc	U. S. Army Chemical School	Activity & decay Mathematics and Calculations	Calibration of Radiac Sets
radium 2 mc	U. S. Army Chemical School	Activity & decay Mathematics and Calculations	Area Survey

EXPERIENCE - Lynda J. Rockhill
Secretary, Isotopes Committee
USAECOM

1961	Business Curriculum at Neptune High School, Neptune, New Jersey.
1962-1963	Fort Monmouth - Personnel Office.
Feb. 1963 to present	Experience in Personnel monitoring records and Isotope Committee business, also use of monitoring counting equipment and radiation measurement.

Inclosure 3A

Form AEC-313 question 6a and 6b continued

H. Hydrogen 3 — H. U. S. Radium Corporation Model LAB-706 Sealed Light sources H. 500 millicuries contained in 2 sources of 250 millicuries each.

I. Hydrogen 3 — I. Kaman Nuclear Model R Replenishing Cartridges I. 280 curies.

Inclosure 4

Form AEC-313 question 7a

7 (a) Description of Purpose for which Byproduct Material will be used.

The research and development program requiring radioisotopes at USAECOM can be divided into four (4) broad categories.

1. Radiation detection instrument research and development.
2. Radiation effects on electronic parts and components.
3. Radiation power sources.
4. Basic Research

A large group in these Laboratories is concerned with the design and development of radiation detecting instruments, both rate meters and integrating dosimeters. These instruments range from background to such intensities as are found in the fireball of atomic explosions and are sensitive to gammas, betas, alphas, thermal or fast neutrons. It is this program that requires most of the high intensity sealed sources and accelerators. New detectors are also frequently irradiated at reactor facilities which induce radioactivity in the instruments. These instruments must be brought back to USAECOM for evaluation and further testing, and since it would be impossible to predict the exact isotopes that result, a broad license is necessary.

The Electronic Components Laboratory of USAECOM is devoted to research and development of electronic parts and components since it is necessary to know the effects of nuclear radiation on new parts as well as to develop radiation resistant parts, considerable effort is spent irradiating parts and components to various sources of nuclear radiation; both in the laboratory and at other installations. As mentioned above, the nature of induced activity is not known and time spent to determine it would make experiments useless. A broad license is therefore required in this work too.

The work on nuclear batteries and small nuclear power sources could be continued with specific licenses but would be somewhat hampered by delays.

The use of isotopes in basic research is two-fold. Small amounts of radioactive material are needed in experiments requiring high energy ions such as alpha particles and fission fragments while other isotopes are used in experiments involving nuclear decay schemes. Experiments involving high intensity nuclear radiation necessitates their being conducted at outside facilities such as, Godiva, TRIGA, KEWB, and local steady state reactors and accelerators. The problem of bringing activated experimental equipment back to the laboratory again necessitates the possession of a general specific license.

It is not anticipated that possession of elements 3-83 up to 1 curie each would ever reach 80 curies total at any one time since activated apparatus and parts are disposed of as soon as experiments are completed.

Inclosure 5

Form AEC-313 question 10

The following is a list of our Radiation detection instruments:

Radiation Detection Instruments

Type of Instrument	Number Available	Radiation Detected	Sensitivity Range (mr/hr)	Window Thickness (mg/cm^2)	USE
Survey Meters Technical Associates (Juno) Model No 6 S. N. 1339-1343	2 ea	Alpha, Beta, Gamma	0-5 r/hr	.0005 in.	Health Monitoring
Survey Meters Nuclear-Chicago Corp Model - 2610-A-P.15 Sn 955-954	2 ea	Beta, Gamma	0-20 mr/hr	Thin Walled G M Tube D50 (c K 1020)	Health Monitoring
Survey Meters Nuclear-Chicago Corp Model-2612-P16 S.N. 409;1461'1467;184	4 ea	Alpha, Beta, Gamma	.2-20 mr/hr	G M Tube D-35(only) detecto Alpha + Beta, Gamma 1.4 mg/cm^2	Health Monitoring
Radiac Set I M-141/PDR-27J S.N. 4346-E005	2 ea	Beta, Gamma	.5-500 mr/hr	Jan 5980) type Jan 5979) Mil-E-1 G M Tubes	Health Monitoring
Radiac Sets AN/PDR 46 A IM-113/PDR S.N. 36;14;47	3 ea	Beta-Gamma	0-20 mr/hr	Beta Window G M Tube	Area Monitoring
Tritium Monitor Atomic Accessories Model TSM-91-C	1 ea	.018 Mev Beta	0-30000 $\mu c/m^3$ in 4 decade scales	Air conductivity 0 Window thickness	Alarm and continuous Area Monitoring
Radiac Set AN/PDR-39 S.N. 1020,329	2 ea	Gamma	0-50,000 mr/hr	Thick walled Ion chamber	Area Monitoring
Quartz Fibre Dosimeters	8 ea	Gamma	200 mr	N A	Health Monitoring

Radiation Detection Instruments

Type of Instrument	Number Available	Radiation Detected	Sensitivity Range (mr/hr)	Window Thickness (mg/cm^2)	USE
Radiac Meter I M 108/PD S.N. 9547	1 ea	Gamma	1-500 r/hr	Thick walled Ion chamber	To determine radioactive contamination levels in field
Radiac Meter 1M-9B/10 Radiac Meter 1M-147/80	5 ea	Gamma	50 r	N A	Health Monitoring
Bendix # 862	15 ea	Gamma	200 mr	N A	Health Monitoring
Bendix # 609	9 ea	Thermal neutron	2 x daily tolerance	N A	Health Monitoring
Chirpees Personal Radiation Monitor, Atomic Accessories Model PRM-253	10 ea	Gamma	1 chirp/.1 mr	Ion chamber	Health Monitoring
Nuclear Chicago Alpha Survey Meter Model 2670 S.N. 106	1 ea	Alpha	0-150,000 cpm 7 scales (0-1875 alpha/cm^2/sec)	Proportional counter	Area Monitoring
Nuclear Chicago Neutron Survey meter Model 2671	1 ea	Fast & Thermal Neutron	0-25,000 n/cm^2/sec 7 scales	BF_3 Proportional counter with removeable moderator	Area Monitoring

Radiation Detection Instruments

Type of Instrument	Number Available	Radiation Detected	Sensitivity Range (mr/hr)	Window Thickness (mg/cm^2)	USE
Mighty Mite Air Sampler Model MS-343 + Sample Counting System	3 ea	Alpha, Beta, Gamma	Down to Background	0 or 2 mg/cm^2	Health Monitoring

In addition to above monitoring instruments the following laboratory measuring equipment is available?

10 Scalers, with four (4) counting pigs, with G M tubes and scintillating extras with photomultipliers.

2 Single channel pulse height analyzers.

1 Auto sweep pulse height analyzer.

1 RIDL Model 34 multichannel analyzer - 2 June 63

1 "Long Counter" for neutron detector.

A stock of Gold, Cobalt, foils and sulphur pellets for neutron dosimetry.

5 sets Victoreen R meters for secondary standards.

1 NBS Secondary Standard Chamber with Keithly Model 610 for current measuring - 8 June 63.

2 Nuclear Chicago's 2612 for Lab use.

3 AN/PDR-39's for Lab use.

Inclosure 6

Form AEC-313 question 11

Gamma instruments are calibrated every 3 months using Co^{60} or Cs^{137} sources. The calibration of the sources is checked at least once a year using Victoreen R-meters. The R-meters are inturn calibrated by NBS annually and certified to ± 3%. The source intensities are corrected each month for decay.

Counting systems are calibrated with U. S. Nuclear Corp. standard sources accurate to ± 2%.

An NBS calibrated Ra-Be source (± 3%) is used to calibrate the neutron detectors.

Inclosure 7

Form AEC-313 question 12

Lexington Signal Depot Film Badge Service is used for personnel monitoring on a monthly basis for gamma, and on a monthly basis for neutrons.

Quartz fiber dosimeters are used whenever personnel work in a radiation area and are checked during and at the end of each day spent in the radiation area.

In addition, personnel working in a high radiation area use Atomic Accessories Personal Radiation Monitors (chirpees).

For personnel working with Tritium, Strontium 90 or involving any other possible ingestion hazard an Atomic Accessories "Mighty-Mite" personal air sampler is used, and checked daily or more often if required.

For personnel working with Tritium or Strontium 90 involving a possible ingestion hazard, an assay of a urine sample is made as soon as practicable after the experiment (5 days). This assaying procedure is conducted by Tracerlab, Div of L. F. E., 1601 Trapelo Road, Walthan, Mass. Any assay results greater than 15 microcuries per liter is relayed to us by telephone or telegram. The results of other analysis are sent by mail. An assay of 15 microcuries of Tritium per liter of urine or greater is investigated.

Inclosure 8

Form AEC-313 question 13

The following facilities and containers are described.

I. Building [401] - Isotopes and Accelerator Shields.

II. Building [T-383] - Isotope Storage Vault.

III. Building [S-45]

IV. Underground Vault - [3500] curie Cobalt 60 irradiator - separate license # 29-1022-7.

V. Area 'G' Range

VI. [Oakhurst Station]

VII. Nevada Test Site

VIII Other Field Ranges - [PPG, Lakehurst Air Station, Fort Huachuca.]

IX. Source Containers

1. AN/UDM-1

2. AN/UDM-1A

3. SC-200

4. SC-3

5. Drawing # LAB 706 - Light Source Container

X. Fort Hancock Facility - Kaman Neutron Generator.

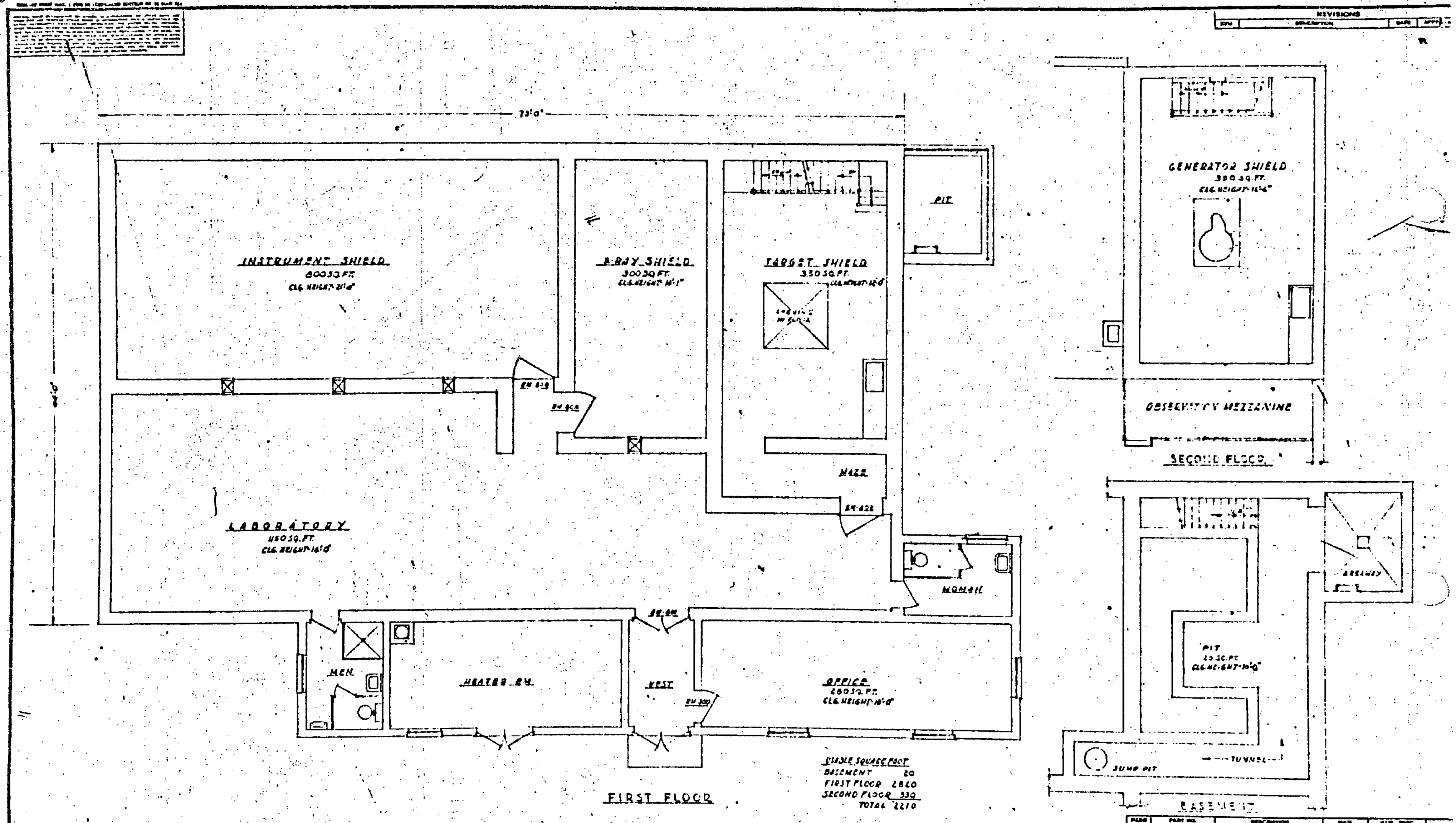
A remotely controlled carriage and a "closed system" television is used inside the X-Ray Shield and controlled from the console in the Laboratory. With all the facilities "on" the intensity in the Laboratory is 0.2 mr/hr everywhere except at the X-ray console where it is 0.25 mr/hr.

Drawing ES-D-118031 also shows the Van de Graaff Shield and added office space. The 2 Mev Van de Graaff Generator made by High Voltang Engineering is located on the second floor, while the target assembly is on the main floor. The Target Shield is entered through a Maze with a lead covered door at the Maze entrance. This generator can be used to accelerate either positive ions or electrons thus producing X-rays, and electrons, of 2 Mev energy or neutrons using 2 Mev protons or deuterons with various targets. The control console is on the face of the Maze in the Laboratory. A safety interlock on the door to the Maze makes it impossible to operate the generator with the door open.

The console for an Atomic Accessories Neutron Generator Model GN 312 using Phillips Neutron Generator Tube 18600 is located next to the X-ray console in the Laboratory area. The generator tube is located in the tunnel of the basement (ES-D-118031). Interlocks are located at the entrance from the Pit to the basement at the Van de Graaff Maze entrance and at the X-ray Shield entrance . The Neutron Generator cannot be operated unless these doors are closed. The Phillips tube 18600 contains a 9.5 curie tritiated target but is a hermetically sealed vacuum tube (not pumped).

Fast neutron intensity, when the Neutron Generator is operating at maximum output, is less than 2 millirem at the console and background in all unrestricted areas around Building 401.

The gamma intensity is less than .05 mr/hr with all facilities is use. The alpha, beta and neutron level is at background in the Laboratory and Office.



LIST OF MATERIAL

APPLICATION

AUTHENTICATION

RADIOLOGICAL SHIELD BUILDING - 11840: FLOOR PLANS

SCALE 1/4"

ES-D-118031

WHEN REFERRING TO THIS DRAWING STATE DRAWING NO. APPLICABLE REVISION SYMBOL IF ANY AND DATE

II. MATERIAL STORAGE VAULT BLDG [T-383]

Drawing ES-D-90768 shows the Radioactive Materials storage Vault. This building is used to store radioactive materials. Waste is also stored here until it is disposed of.

III. BUILDING [S-45]

Drawing [S-45] shows the Decontamination Room and Processing Room located in Building [S-45.] The Processing Room is provided with remote handling equipment (sufficient to handle up to one curie) glove box, and ventilated hood (100 linear feet per minute across opening when half open). Army combat gas masks are available for use as respirators when required. Also available is closed oxygen system. Cover-alls, surgical caps and gloves and booties are available in various sizes. All work surfaces are stainless steel designed to contain spills.

The Decontamination Room contains a shower, knee operated sink, absorbant paper with waterproof backing, and chemical agents for decontamination. Sewage is stored in an underground tank and the controls for dilution before permitting it to enter regular sewage are located in the Processing Room.

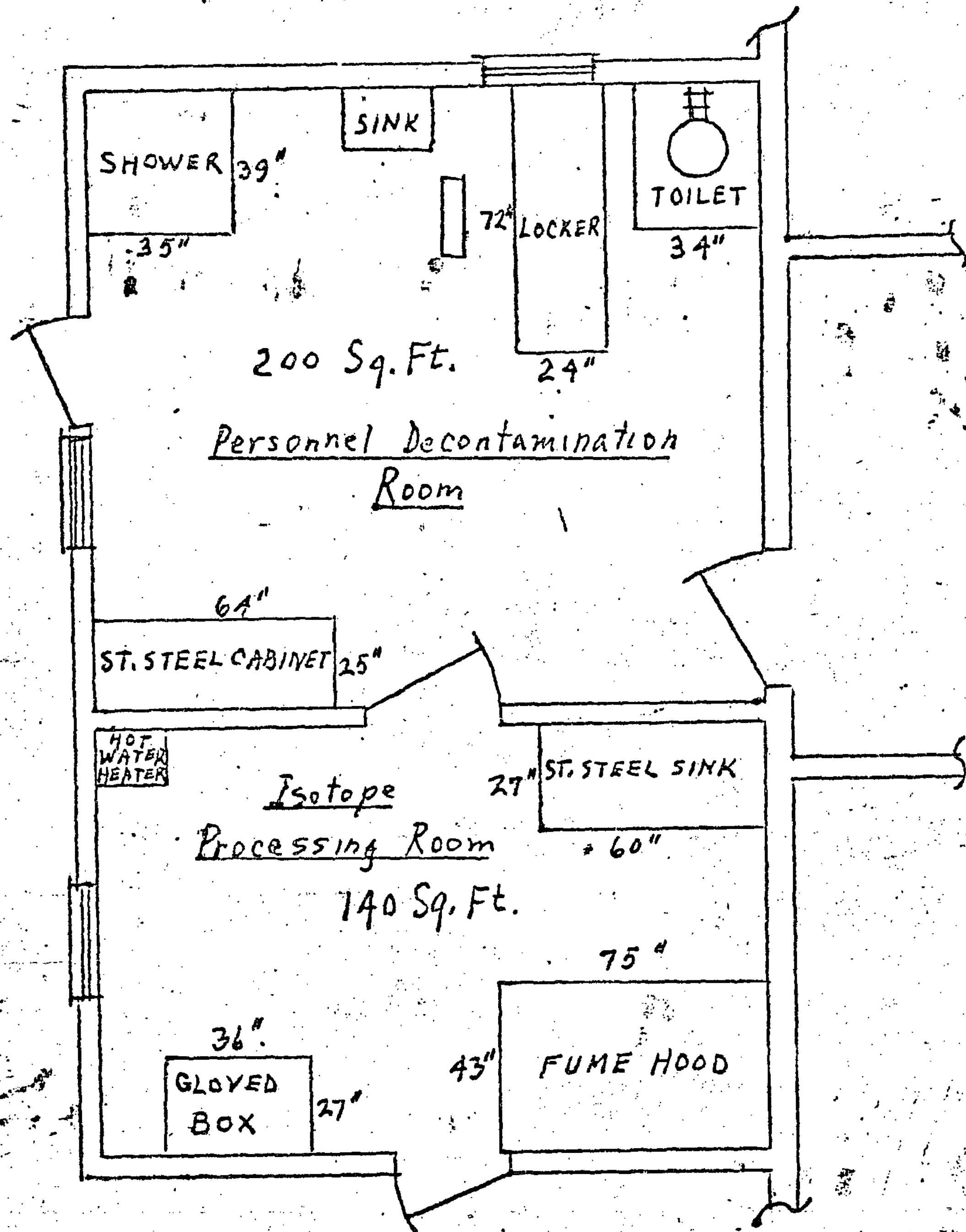
Lead bricks are available for shielding radioactive materials while under hood, in glove box, or on other work surfaces or for temporary storage while awaiting use.

IV. UNDERGROUND VAULT

The [3500 curie] Cobalt 60 irradiator facility is under separate License # 29-1022-7 which expires November 30, 1968.

V. AREA 'G' RANGE

Area 'G' Irradiation Range is shown in Drawing "Area G - Evans." This range is used for experiments which require a minimum of scattering and for vertically collinated beams of gamma radiation. A fence inclosing a 150 ft. circle has radiation warning signs around its periphery. The radiation intensity is never allowed to measure more than 2 mr/hr at the fence and is kept less than .24 mr/hr when irradiation is not going on. Warning lights are located on the platform in the center of the enclosed area and on the gates. Pneumatic controls and compressor are located at the gate.



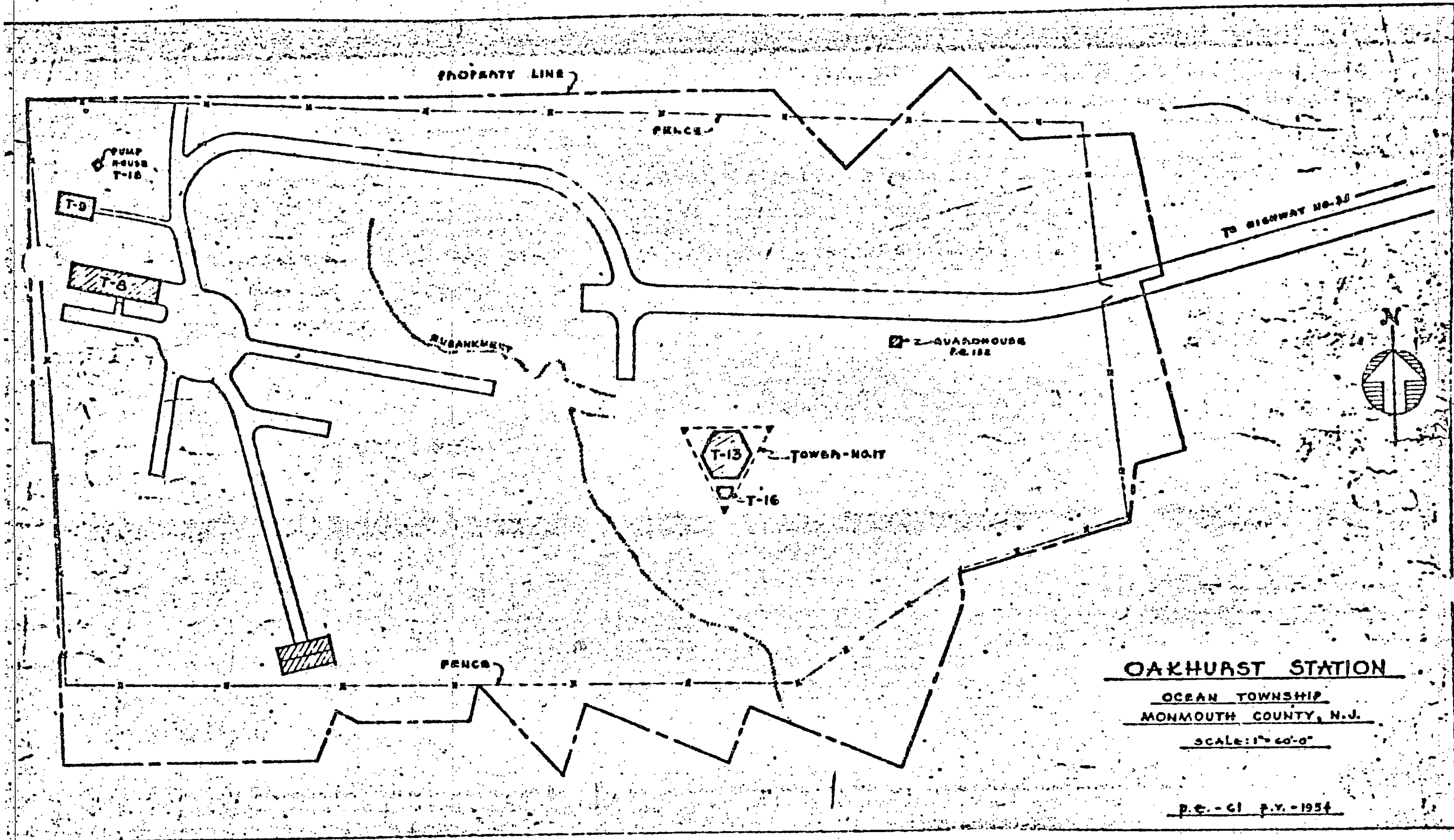
Part of Building
S-45

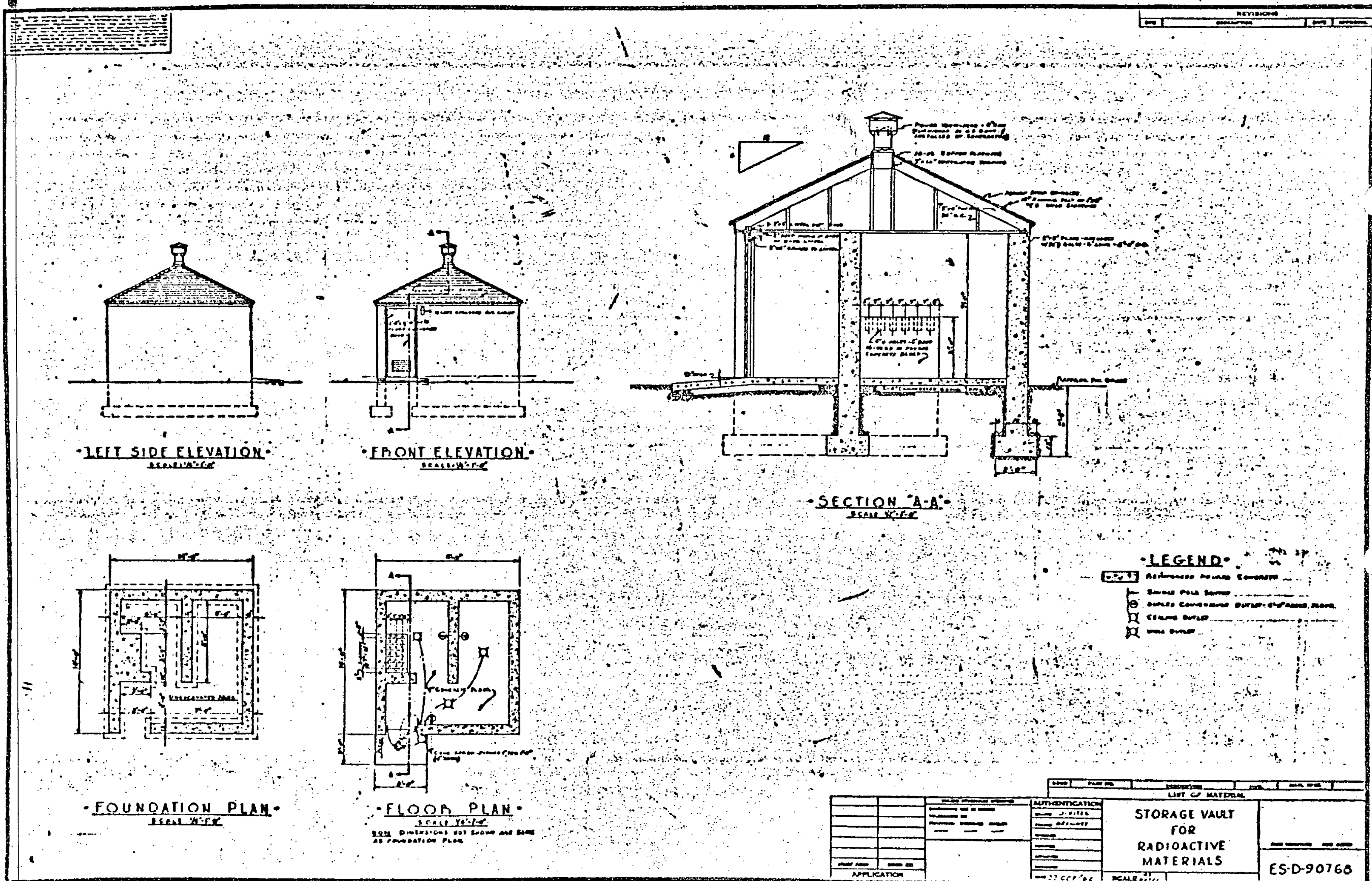
7/11/63

VI. OAKHURST STATION

The "Oakhurst Station" Drawing shows the location of the 115 curie Co^{60} sources and the roped off area with warning signs.

The source remains in the SC-200 container and only the "shipping plug" is removed when in use. This gives a pencil like beam which is aimed about 40° from the horizontal at the tower. The source is located at the bottom of 1" diameter hole 12" deep. The container is supported in its tilted position by a frame constructed of steel I beams capable of supporting 6000 lbs. The intensity at the rope is less than 2 mr/hr.


PROPERTY LINE
FENCE
PUMP HOUSE T-18
T-9
T-8
EMBANKMENT
TO HIGHWAY NO. 35
GUARDHOUSE P.C. 132
N
T-13
TOWER-HOIT
T-16
FENCE
OAKHURST STATION
OCEAN TOWNSHIP
MONMOUTH COUNTY, N.J.
SCALE: 1" = 60'-0"


LEFT SIDE ELEVATION
FRONT ELEVATION
SECTION "A-A"
FOUNDATION PLAN
FLOOR PLAN
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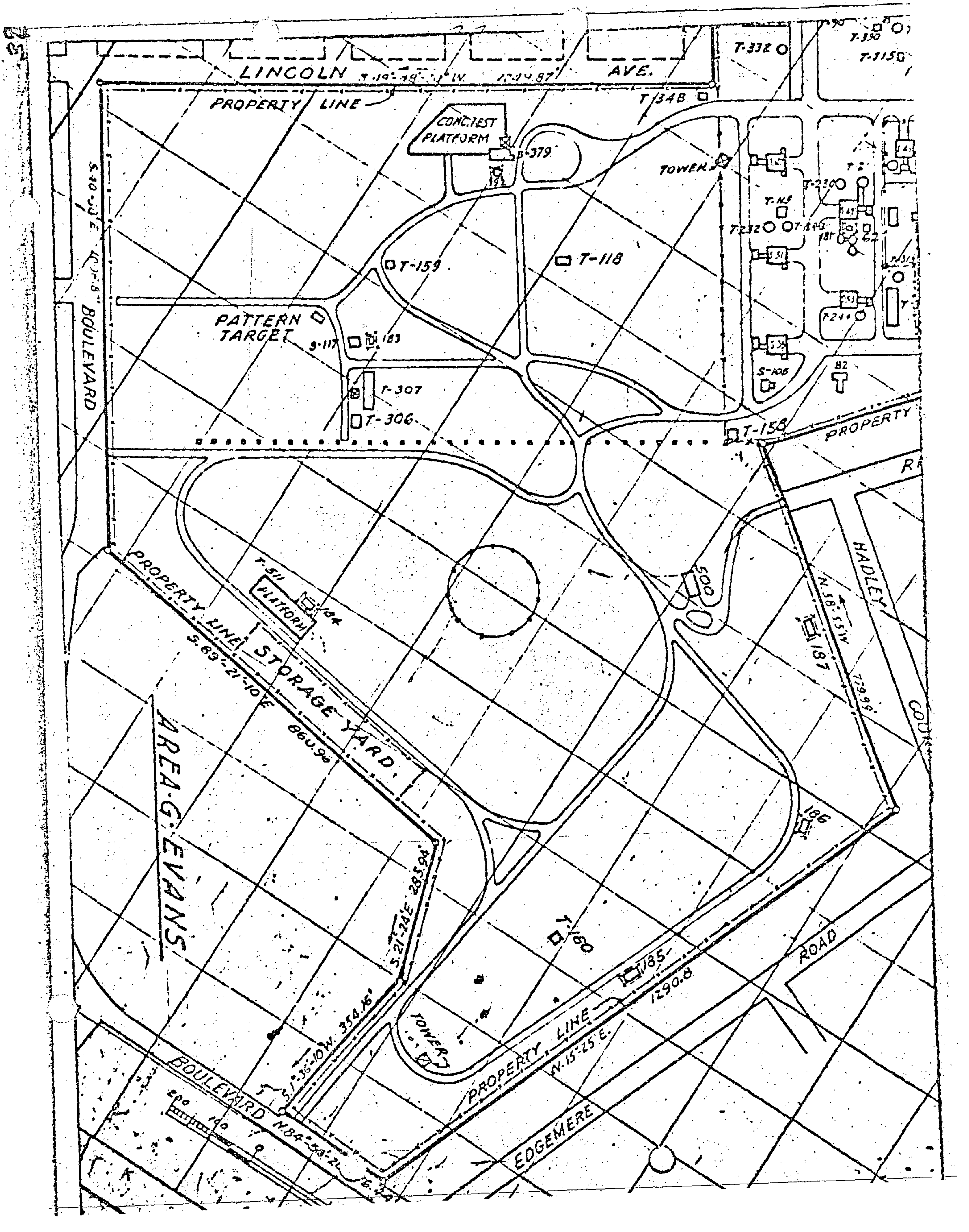
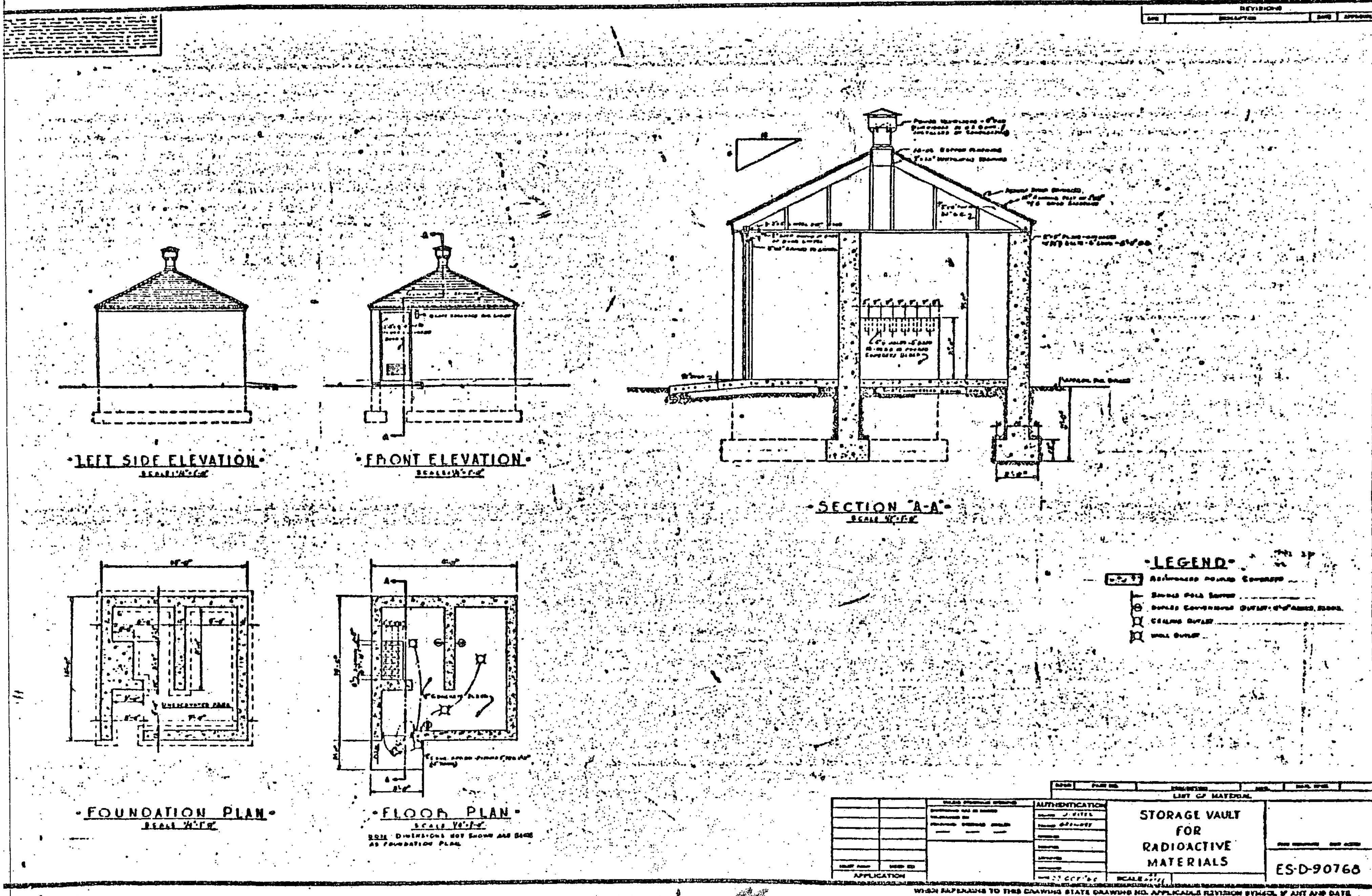
STORAGE VAULT
FOR
RADIOACTIVE
MATERIALS
ES-D-90768
APPLICATION
AUTHENTICATION
REVISIONS
LIST OF MATERIAL



LINCOLN
AVE.
PROPERTY LINE
CONC. TEST PLATFORM
B-379
TOWER
T-332
T-348
T-230
T-232
T-159
T-118
PATTERN TARGET
183
T-307
T-306
T-158
PROPERTY
BOULEVARD
T-511
PLATFORM
184
500
187
N. 58° 55' W.
HADLEY
PROPERTY LINE
S. 69°-21'-10" E.
STORAGE YARD
AREA G EVANS
186
S. 21°-24' E
T-60
185
ROAD
TOWER
PROPERTY LINE
N. 15°-25' E.
1290.8
BOULEVARD
EDGEMERE


REVISIONS
LEFT SIDE ELEVATION
FRONT ELEVATION
SECTION "A-A"
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FLOOR PLAN
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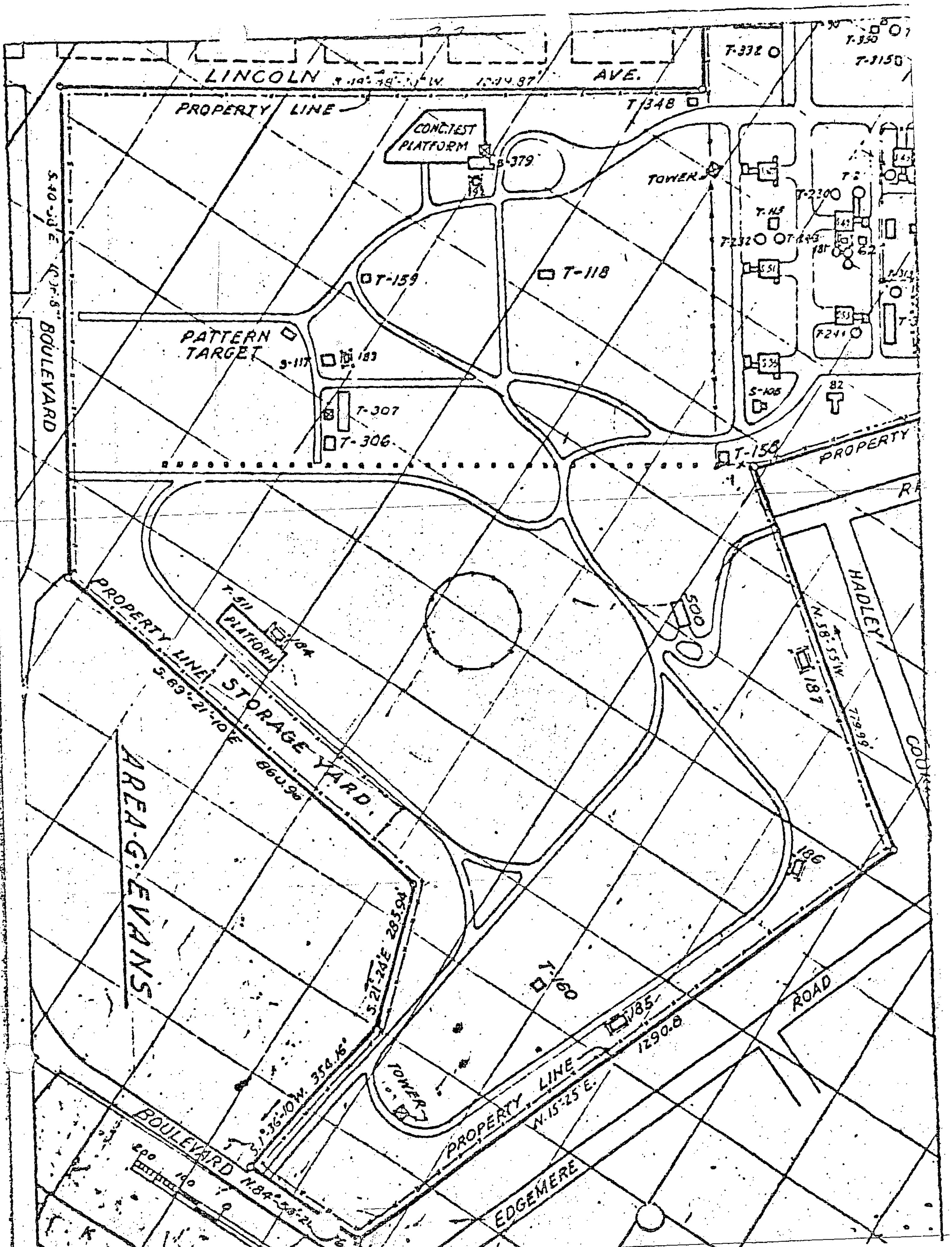
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PLATFORM
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STORAGE YARD
AREA G EVANS
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HADLEY
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S.21°-24'E 283.94
T-160
185
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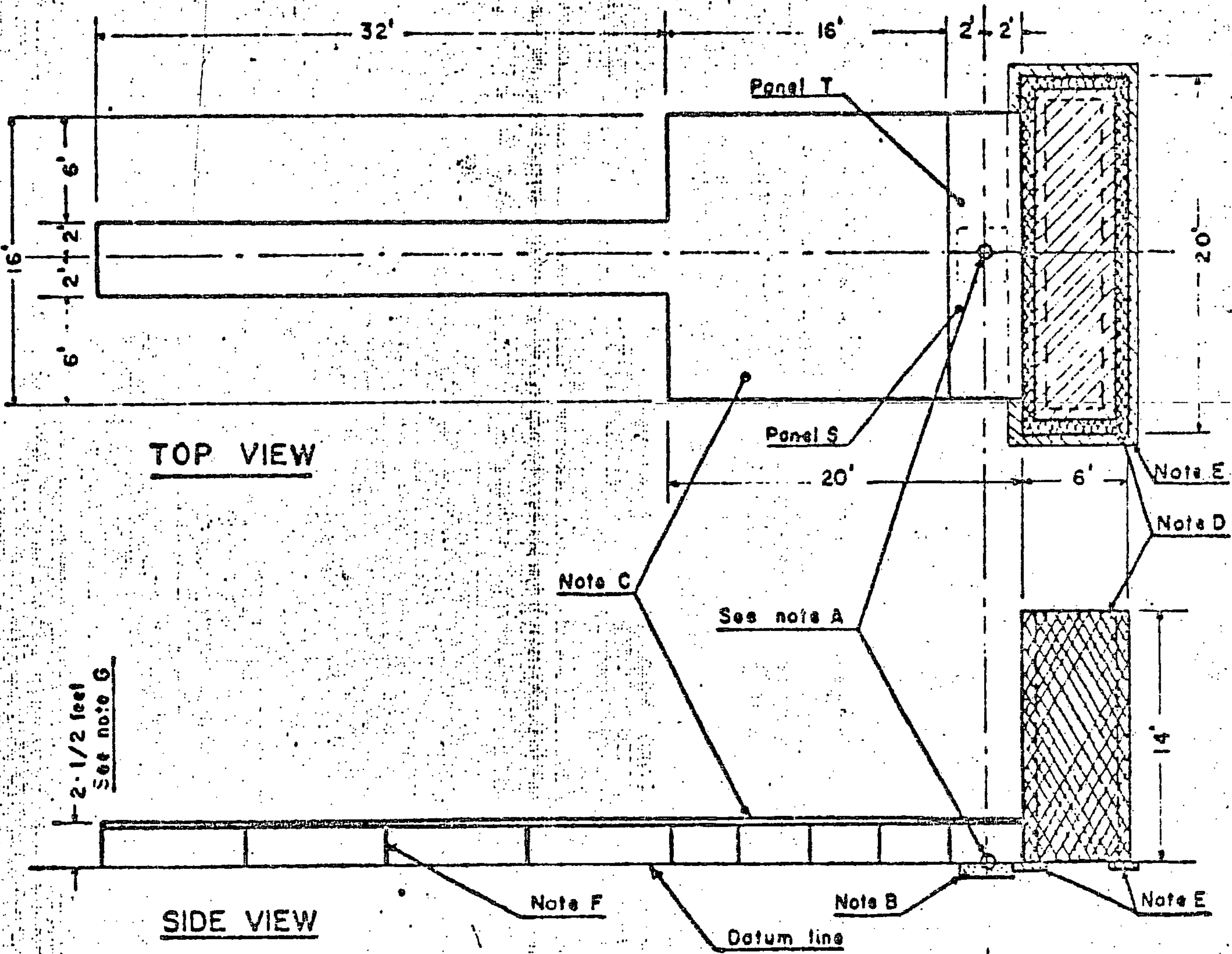
PROPERTY LINE
N.15°-25'E.
1290.8
ROAD
354.16
BOULEVARD
EDGEMERE
200
100
0



CALIBRATION PLATFORM & SHIELDING WALL

NOTES:

A- Working point, this DATUM POINT is located on the top surface and at the center of the concrete footing described in note B.

B- Reinforced concrete footing capable of supporting a load of 2 Ton, the surface shoud be smooth and level, minimum of 3 feet square surface area.

C- Platform surface of 3/4 IN. plywood, Panels S & T not to be permanently attached.

D- Shielding wall, constructed of concrete or cinder block, the space inclosed to be filled with soil available in the area, tie-rods as required

E- Footing as required for support of the wall.

F- Framework and bracing need only be sufficent to allow personnel to work on the platform and to keep the surface level.

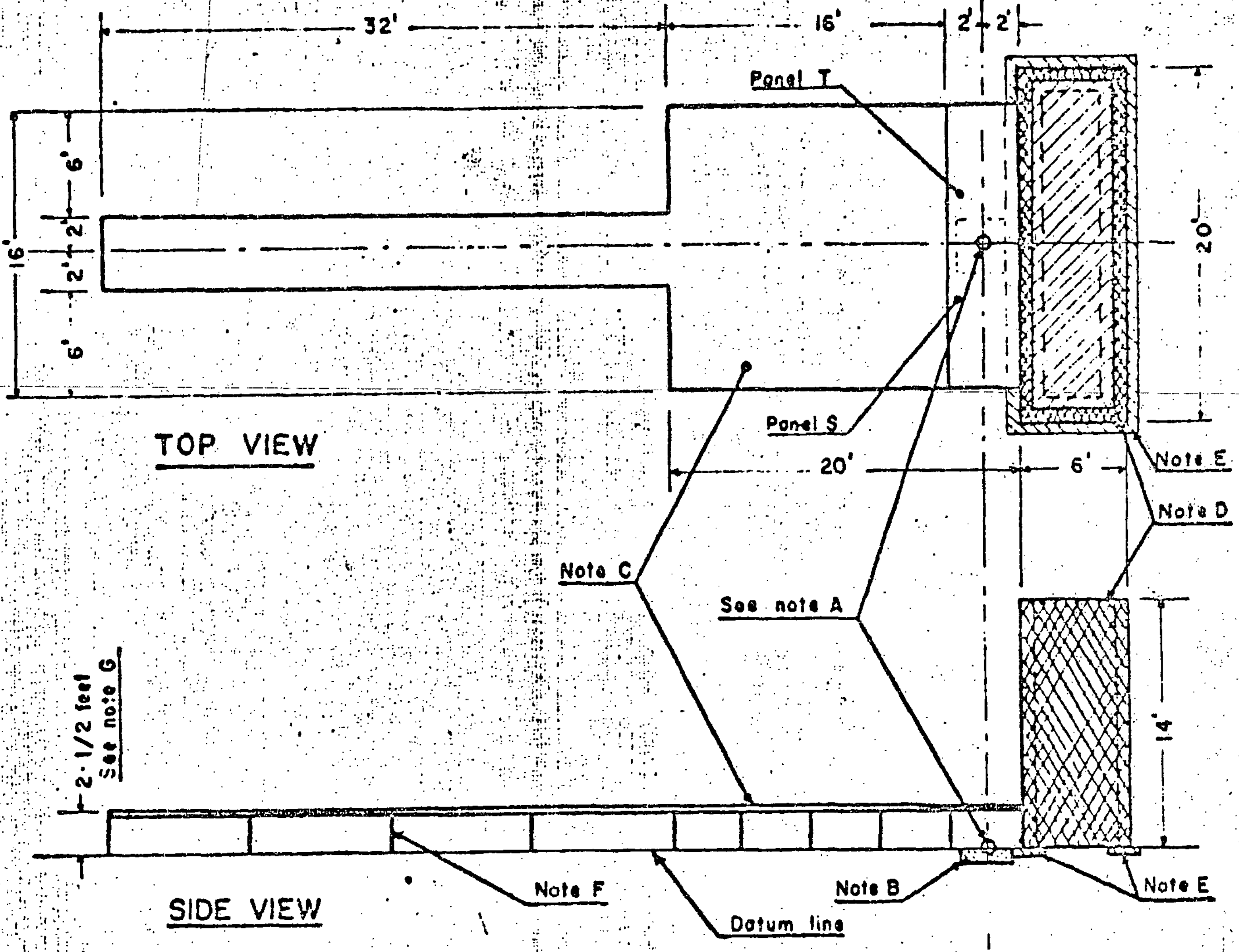
G The top surface of the platform should be level and 2-1/2 feet above the datum point. Tolerance on this dimension is 1/8 INCH.

VII. NEVADA TEST SITE RANGE

The Drawing labeled "Calibration Platform and Shielding Wall" shows the calibration range at the Nevada Test Site. The range is located in a small valley with access limited to the road leading straight back from the wall (away from the source). Control trailer was located against the shielding wall. Warning lights were located on top of the wall and at valley entrance.

VIII. OTHER FIELD RANGES

At the Pacific Proving Grounds, Lakehurst Naval Air Station, and Fort Huachuca the SC-200 is used with a collinating shield (see source containers). Access to the beam end of the collinater is controlled and limited to areas below 2 mr/hr intensity. Fences are used for the sides of the beam and berms or open sea for the end of the beam.



CALIBRATION PLATFORM & SHIELDING WALL

NOTES:

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E- Footing as required for support of the wall.

F- Framework and bracing need only be sufficent to allow personnel to work on the platform and to keep the surface level.

G The top surface of the platform should be level and 2-1/2 feet above the datum point. Tolerance on this dimension is 1/8 INCH.

IX. SOURCE CONTAINERS

A variety of small lead source containers are available for storing and moving small sources.

In addition, the following large special containers are used:

1. The Radiac Calibrator Set AN/UDM-1 #21 is designed for 7 curies Co^{60}. It is manually operated and is collinated when in use. It was designed for the Department of the Navy, Bureau of Ships, and calibrated by NBS, March 16, 1953. Operating procedure is described in the NBS manual that comes with it.

2. The Radiac Calibrator Set AN/UDM-1A #120 is designed for 120 curies Cs^{137}. It is also manually operated and is collinated. It was designed for the Navy and was calibrated by NBS on Feb. 26, 1959. The Technical Manual that describes the system and gives the operating procedure is Navships 93204.

3. The USAELRDL Source Container SC-200 was designed for 200 curies Co^{60}. It is shown in inclosed drawings that include the description of its operation. This container was designed for 4π operation; however with a lead collinater shown in Drawing Col-200 it can be used as a collinated source. The basic lead container is a square lead pig with a 3" diameter x 12" deep well which can be easily decontaminated without loss of the entire container. The well plug which houses the source is made of monel and can be discarded and replaced if necessary. The use of monel proved satisfactory even under the corrosive conditions found at the Pacific Proving Grounds. The drawings also show the secondary capsule of monel. The primary encapulation was done at Chalk River, AECL, Drawing CP-60. The drawing of the Head Assembly shows the head including the micro-switch used to close the warning lights relay. When source is being shipped the

"rise tube" is replaced with a shipping plug and a cover bolted and locked in place. The Source Container can sustain a fall of 3 ft. in any direction without danger of losing or exposing the capsule. Compressed air is used to "raise" the source and to "lower" it. A copy of the operating procedure is inclosed. When the SC-200 is used with the 3.5 kilo curie source it will not be removed from the Underground Radiological Vault. The storage plug had to be lead filled and the outer Capsule is also different for the 3.5 kilocurie Co^{60} source. Details are included in application for License # 29-1022-7.

4. The Source Container SC-3 was designed for a 3 curie Co^{60} source. Drawing SC-3 (a) shows the container in operating conditions (b) shows it ready for shipping. The operation is similar to the SC-200. The capsule used is the one reported in Nucleonics May 1954, a drawing is inclosed. Also included is a copy of the operating procedure.

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#2

OPERATING PROCEDURE FOR [200 CURIE] Co^{60} SOURCE IN CONTAINER SC-200 WITHOUT COLLINATER

1. WARNING

This source shall not be operated without Collinator COL-200 except at NTS and in the Underground Radiological Vault at USAELRDL.

2. Two operators must be present during operation of this source.

3. Each operator must:

a. Wear a film badge

b. Wear 2 quartz fiber dosimeters (0-200 mr and 0-5 r) and check the reading after each entry into the high radiation area.

c. Have in operation and keep in sight a survey meter (Radiac Set AN/PDR-39 or equal) during the entire period when the source is being used.

d. NEVER enter the high radiation area without a survey meter to check the radiation intensity as he goes.

4. The following safety precautions are required for the operation of this source:

a. Radiation Warning signs must be displayed at, and access prevented into, area above 2 mr/hr. (Either fence or natural barriers may be used).

b. The warning signs will show whom to contact in EMERGENCY and where he may be reached.

c. A blinking red warning light must be "ON" during irradiation period.

d. When not in use, controls of source will be locked. Possession of the key or combination will be limited to the authorized operators.

5. Setting up (at NTS or Underground Radiological Vault)

a. Two operators with dosimeters, survey meters and wrist badges are required.

b. Shipping cover is removed from SC-200 and shipping plug removed.

WARNING

Keep clear of source well.

Intensity at the mouth of well is 3000 r/hr.

c. Screw in 4 size rise tube, head and connect air lines.

d. Check Warning light system.

e. Inspect high intensity radiation area. Make sure no one will be in this area while source is up.

f. Check air supply and pressure.

g. Raise source (about 20 psi on "UP" hose).

h. Drop source (about 5 psi on "DOWN" hose).

i. Warning

The scattered radiation is considerable and operators must not leave the Control point behind the barrier without their survey meters at any time.

j. Warning sign at road block forbids entrance beyond that point without survey meter.

6. Operation (at NTS)

a. Entrance beyond road block must be entered only with survey in operation even when warning lights are "OFF"

b. Inspect high intensity area to make sure no one will be in this area when source is "UP"

c. Check Warning light system.

d. Check Air supply and pressure.

e. Check intensity at Control point of raising and lowering source.

f. Set up equipment to be irradiated.

WARNING

Take survey meter with you and check it often to make sure source is "DOWN".

g. One operator should stay at the controls otherwise they must be locked during setting up of equipment for irradiation.

h. Lock up controls when operators leave.

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OPERATING PROCEDURE FOR [200 CURIE] Co^{60} SOURCE IN CONTAINER SC-200 WITH COLLIMATOR COL-200

1. WARNING

This source shall not be operated without Collimator COL-200 except at NTS and in the Underground Radiological Vault at USAELRDL.

2. Two operators must be present during operation of this source.

3. Each operator must:

a. Wear a film badge

b. Wear 2 quartz fiber dosimeters (0-200 mr and 0-5 r) and check the reading after each entry into the high radiation area.

c. Have in operation and keep in sight a survey meter (Radiac Set AN/PDR-39 or equal) during the entire period when the source is being used.

d. NEVER enter the high radiation area without a survey meter to check the radiation intensity as he goes.

4. The following safety precautions are required for the operation of this source:

a. Radiation Warning signs must be displayed at, and access prevented into, area above 2 mr/hr. (Either fence or natural barriers may be used).

b. The warning signs will show whom to contact in EMERGENCY and where he may be reached.

c. A blinking red warning light must be "ON" during irradiation period.

d. When not in use, controls of source will be locked. Possession of the key or combination will be limited to the authorized operators.

#2

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5. Setting Up (with Collinator COL-200_

a. Two operators with dosimeters, survey meters and wrist badges are required.

b. The shipping cover is removed from the top of the container SC-200 and Collinator COL-200 put in place on top of the container.

c. The plug should then be removed from the top of the Collinator and the shipping plug removed from the SC-200.

WARNING

Keep clear of the source well.

Intensity at the mouth of the well is 3000 r/hr.

d. Screw in collinator-size, rise tube, head, and connect air lines at source (Hoses enter from the front, not the top at source) and control point.

e. Replace Collinator plug

f. Check Warning Light System.

g. Inspect high intensity radiation area. Make certain no one will be in this area while source is up.

h. Check air supply and pressure.

i. Raise source (about 20 psi on "UP"hose).

j. Drop source (about 5 psi on "DOWN" hose).

k. Raise source and determine the location of the 2 mr/hr isodose line.

WARNING

The scattered radiation is considerable from this source. Line of sight is not necessary to reach high intensity.

l. Locate fence at 2 mr/hr line

6. Operation (with Collimator COL-200)

a. Inspect high intensity area (within fence) to make sure no one is within fence.

b. Check warning light system.

c. Check air supply and pressure.

d. Check operation of survey meter and intensity at operating point by raising source then lowering quickly.

e. Set up equipment to be irradiated.

WARNING

Take survey meter with you and check it often to make sure source is down.

f. One operator should stay at the controls other wise they must be locked while setting up equipment for irradiation.

g. Lock up controls when operators leave.

OPERATING PROCEDURE FOR [3 CURIE] Co^{60} SOURCE IN CONTAINER SC-3

1. Operator of this equipment must

   a. Wear a film badge.

   b. Wear a quartz fiber dosimeter in the 0-200 mr range (Radiac meter IM9A or equal) and check it at least every hour.

   c. Carry a working survey meter (Radiac Set AN/PDR-39 or equal) whenever entering possible high intensity area and have it "ON" and within view for the entire period of operation of the source.

2. This source shall not be operated unless the following safety precautions are taken:

   a. Radiation Warning signs must be displayed at, and access limited into, area above 2 mr/hr (fence or natural barrier).

   b. Warning signs shall show whom to call in EMERGENCY and WHERE.

   c. A blinking red warning light visible from all directions must be "ON" during operation of the source.

   d. When not in use, source will be locked; possession of key or combination will be limited to authorized operator.

3. Setting up of Calibration range:

   a. Operator must comply with 1.

   b. Locate SC-3 in the center of a 300 ft. diameter roped off area.

   c. Install warning lights and signs.

   d. Locate control point 150 from the SC-3 container i.e. (compressed air supply and valve system).

   e. Check warning light system.

   f. Replace shipping plug with "rise tube"

WARNING

Keep clear of the hole containing capsule.

g. Attach 2 - 150 ft. air hoses with clamps at the container end and at the control points.

h. Raise source with about 3 psi of air on the "UP" hose.

i. Intensity at Control Point should be less than 2 mr/hr.

j. If barrier is used between SC-3 and Control Point (CP), walk in from CP location to barrier and ascertain radiation below 2 mr/hr along the way.

k. Mark off 2 mr/hr isodose line.

l. Apply 3 psi to the "DOWN" air hose. Survey meter should indicate source has dropped into SC-3 container.

m. CP may now be moved closer to SC-3 container and fence located at the 2 mr/hr line.

4. Operation:

a. Inspect fenced in area to make sure no one is within the fence.

b. Turn on warning lights.

c. Raise source with 3 psi on "UP" hose.

d. Survey meter should show when source is "UP".

e. Drop source with 3 psi on "DOWN" hose. Survey meter should go to zero.

f. Locate instruments to be irradiated at the proper distance.

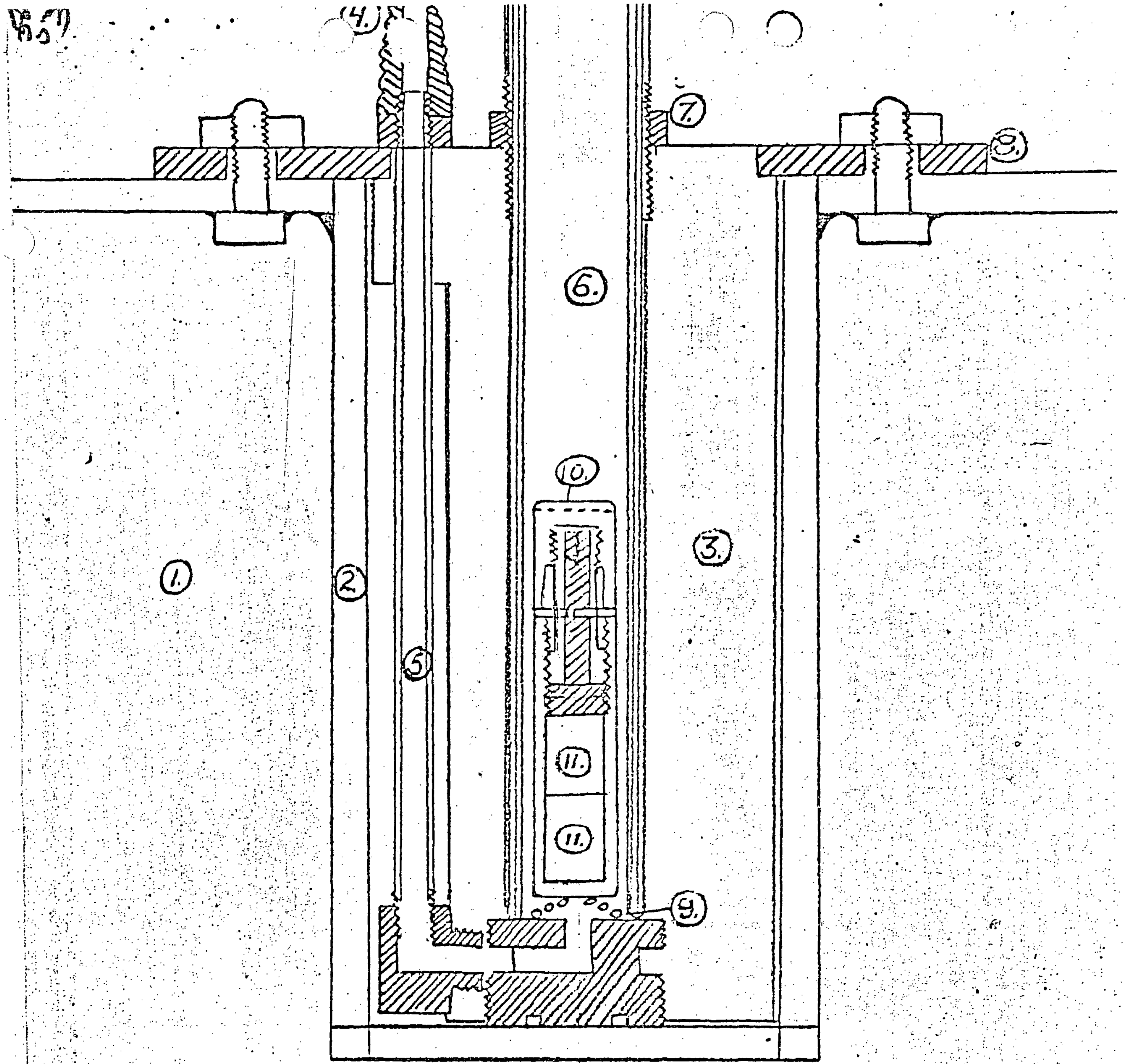
WARNING

Take survey meter with you. Check often to make sure source is "DOWN".

g. Proceed with irradiation.

5. If container can not be locked up when not in operation the "Rise Tube" must be removed after each operation, shipping plug replaced and SC-3 Container locked as for shipment.

95-57



1. LEAD CONTAINER
2. MONEL PLUG WELL
3. MONEL PLUG
4. "UP" HOSE CONNECTOR
5. "UP" AIR PIPE
6. RISE TUBE
7. RISE TUBE LOCKNUT
8. PLUG HOLD DOWN PLATE
9. BUMPER SPRING
10. CAPSULE ASSEMBLEY
11. 100 CURIE COBALT 60 CYLINDER

1 1/4 Copies

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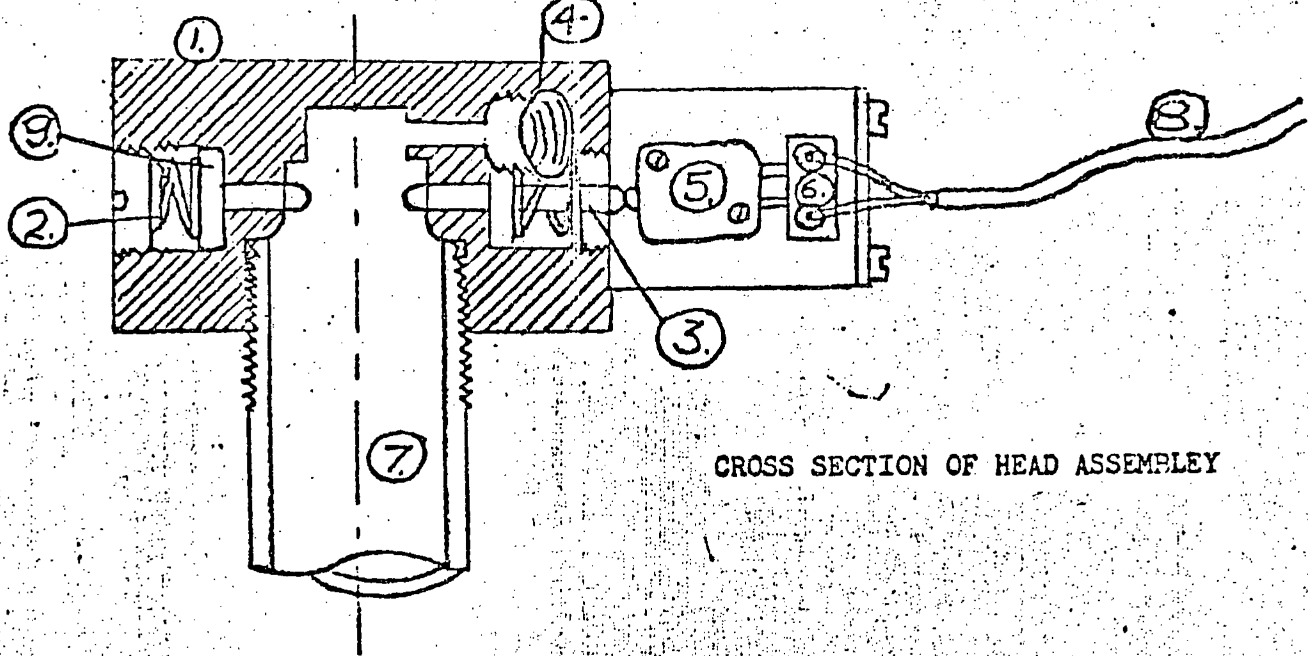
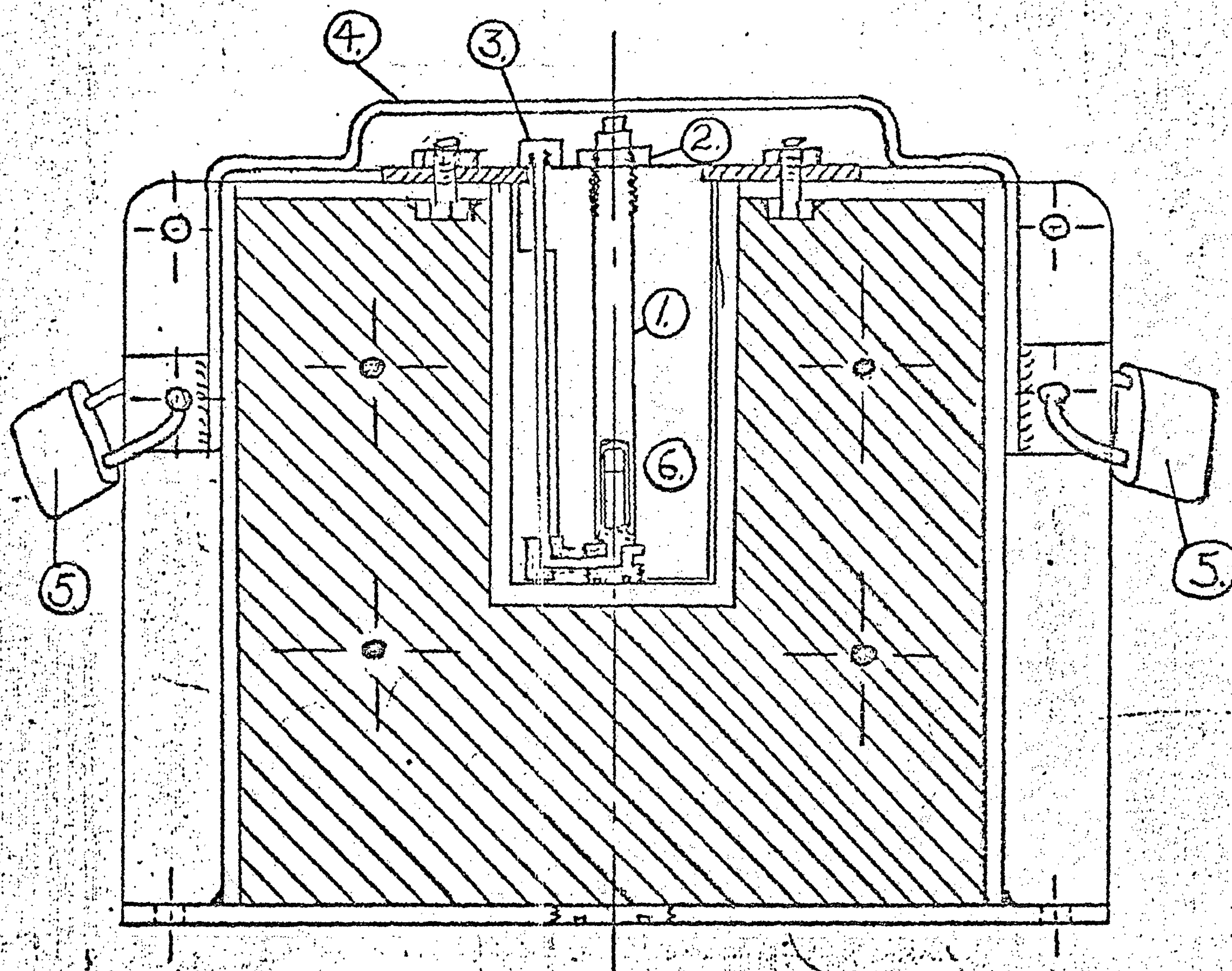


CROSS SECTION OF HEAD ASSEMBLEY

1. STAINLESS STEEL HEAD
2. SPRING (3 EACH)
3. EXTENSION PIN
4. "DOWN" AIR INLET
5. MICRO SWITCH
6. ELECTRIC PLUG
7. RISE TUBE
8. WIRE TO RED WARNING LIGHTS WHEN CAPSULE IS "UP"
9. PIN (2 EACH)

11 copies

LEAD CONTAINER READY FOR SHIPPING



1. STAINLESS STEEL SHIPPING ROD
2. SHIPPING ROD LOCKNUT
3. CAPNUT FOR "UP" AIR PIPE
4. AISI ¼" TYPE 316 STAINLESS STEEL SHIPPING COVER
5. PADLOCKS
6. MONEL PLUG

OPERATION

1. REGULATED AIR PRESSURE IS FORCRD INTO "UP" HOSE CONNECTOR(FIGURE4 SHEET# 2)

2. AIR GOES THRU AIR PIPE (FIGURE 5 SHEET # 2) AND THRU MONEL ELBOW AND BOTTOM PLUG.

3. THIS FORCES STAINLESS STEEL CAPSULE (FIGURE 10 SHEET # 2) UP THE RISE TUBE (FIGURE 6 SHEET # 2).

4. CAPSULE IS SEATED IN THE HEAD (SHEET # 3)

5. 3 SPRING LOADED PINS (FIGURES 3 AND 9 SHEET# 3) RETAIN THE CAPSULE IN THE HEAD (SHEET #3) WHEN THE AIR PRESSURE IS SHUT OFF.

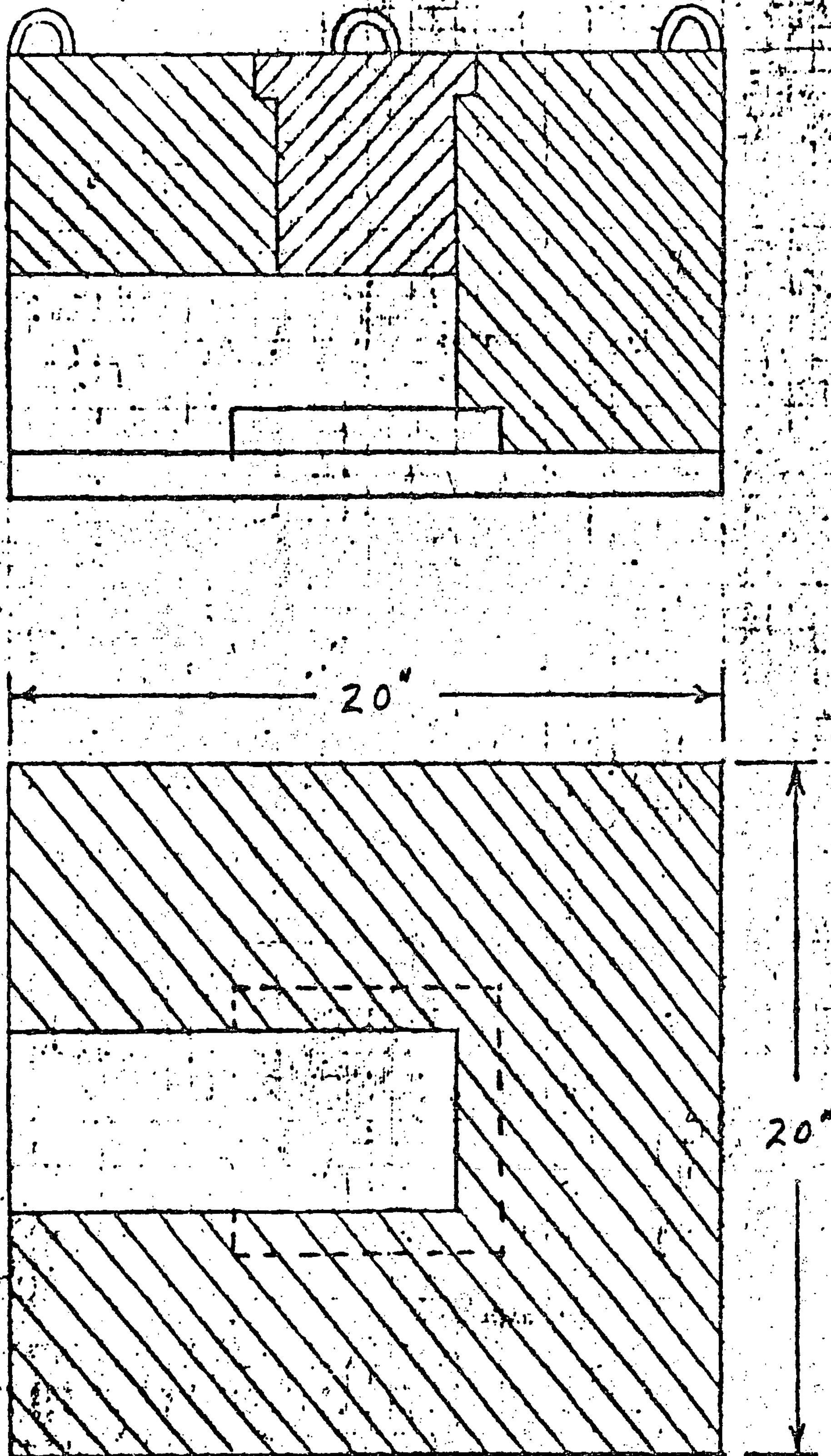
6. EXTENSION PIN (FIGURE 3 SHEET 3) ACTIVATES A MICRO-SWITCH WHICH CONTROLS RED WARNING LIGHTS.

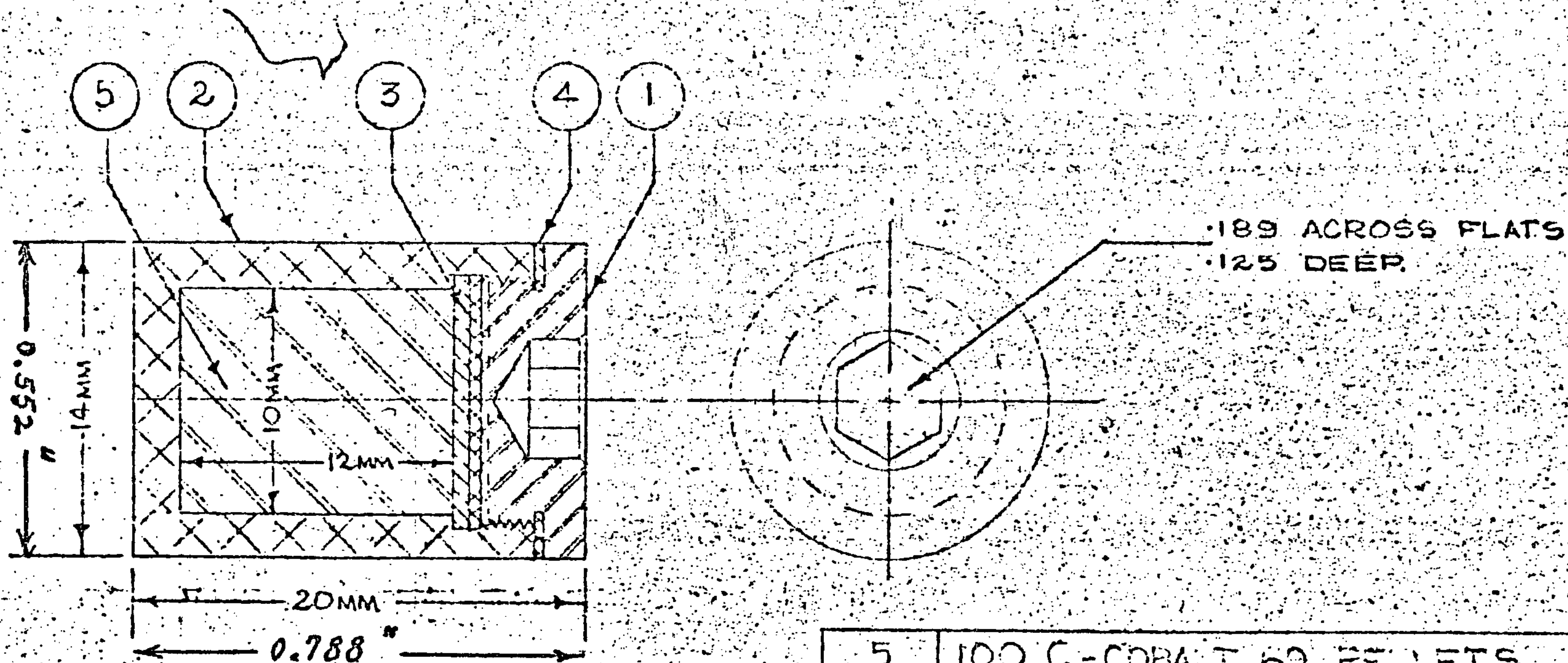
7. WHEN THE CAPSULE IS TO BE RETURNED TO THE LEAD CONTAINER (SHEET# 1) REGULATED AIR IS FORCED INTO THE "DOWN" AIR INLET (FIGURE 4 SHEET #3), THIS OVERCOMES THE TENSION OF THE SPRING LOADED PINS (FIGURES 3 AND 9 SHEET #3) AND FALLS DOWN THE RISE TUBE (FIGURE 7 SHEET# 3).

8. TO PREVENT THE CAPSULE FROM EXCESSIVE POUNDING AT THE BOTTOM OF THE RISE TUBE (FIGURE 6 SHEET #2), THE MICRO-SWITCH THAT CONTROLS THE WARNING LIGHTS ALSO SHUTS OFF THE "DOWN" AIR AND CLOSES ALL SOLENOIDS. THE AIR IN THE RISE TUBE BENEATH THE CAPSULE IS COMPRESSED BY THE FALL OF THE CAPSULE AND ACTS AS AN AIR CUSHION. THE CAPSULE FINALLY COMES TO REST ON A SPRING AT THE BOTTOM OF THE RISE TUBE (FIGURE 6 SHEET #2)

9. THE LEAD CONTAINER (SHEET #1) IS ALSO USED FOR TRANSPORTING THE SOURCE (SHEET # 4) BY REPLACING THE RISE TUBE (FIGURE 6 SHEET # 2) WITH A SOLID PLUG (FIGURE 1 SHEET #4) AND ADDING A COVER PLATE (FIGURE 4 SHEET #4) TO THE LEAD CONTAINER AND PADLOCKING IT.(FIGURE 5 SHEET #4)

S/ DA COLLIMATOR COLS 200





ITEM	DESCRIPTION
5	100 C - COBALT 60 PELLETS
4	LEAD WASHER
3	MONEL DUST CAP — SOLDER SEAL
2	BODY — MONEL
1	CAP — STAINLESS MAGNETIC STEEL

CODE	REVISION	DATE	APP.	BY

STANDARD TOLERANCES UNLESS OTHERWISE SPEC.

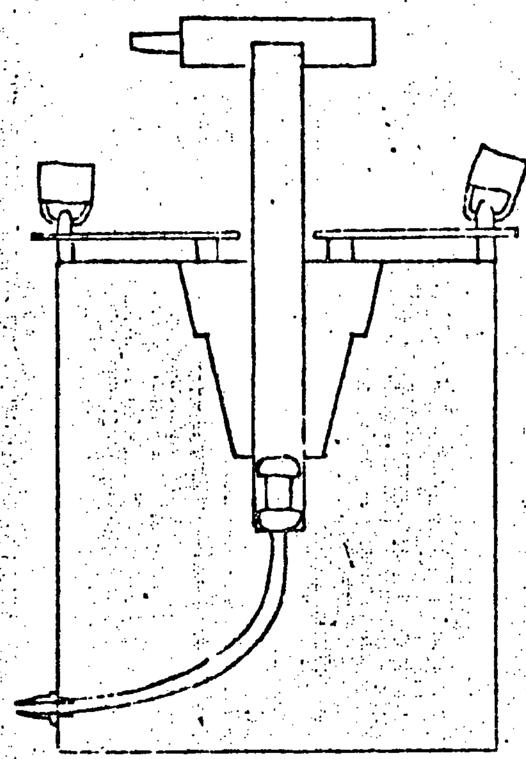
Inches:	Fractional	Decimal
0-6	± 1/64	± .005
OVER 6-24	± 1/32	± .010
OVER 24	± 1/16	± .015

SURFACE FINISH SYMBOLS USED ARE THOSE DESIGNATED IN A.S.A. B46.1-1947

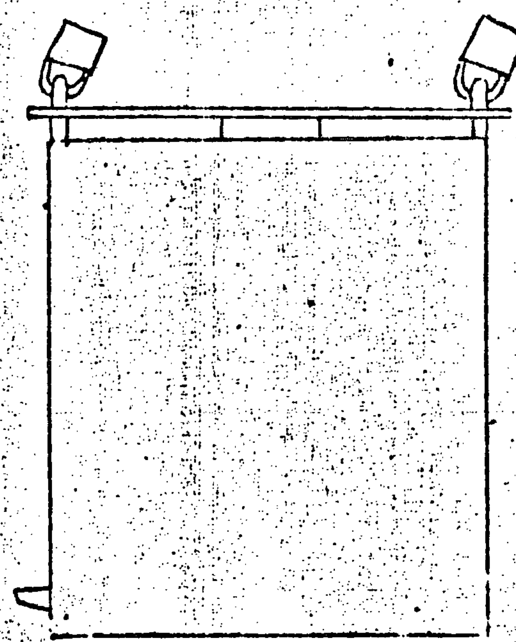
ATOMIC ENERGY OF CANADA LIMITED
Commercial Products Division
OTTAWA CANADA

MAT'L AS LISTED
ASS'Y DWG.
FINISH 32 OUTSIDE SURFACE
DATE 27 FEB - 56
DRAWN D.V.R. | CHK'D | ENG. [signature] | APPROV. | NO. REQ'D
TITLE COBALT 60 CAPSULE FOR P & S 6566
SCALE 5 X FULL
DWG. No. CP-60

K. & E. CO., MONTREAL

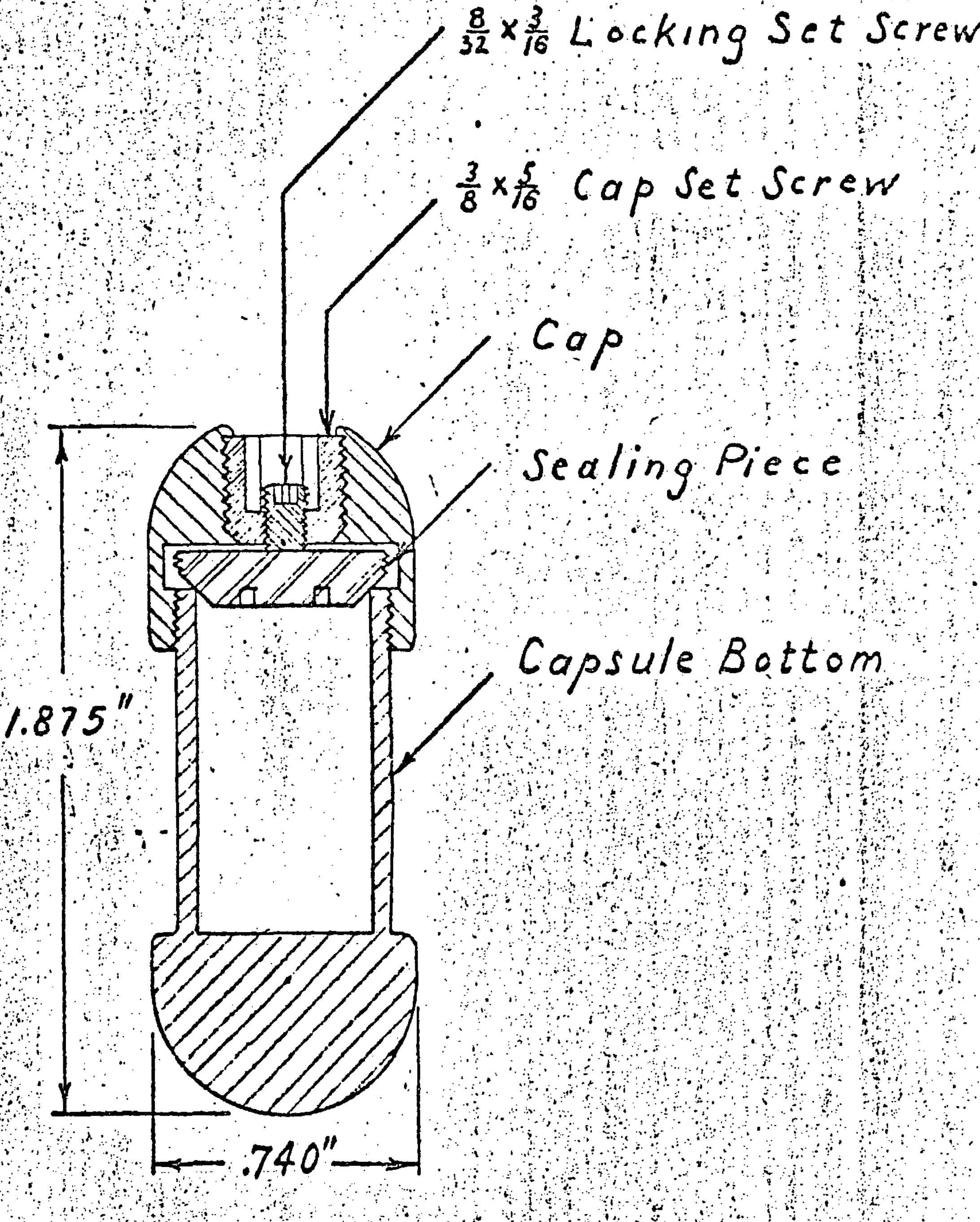


A



B

Fig. 1



Isotope Capsule

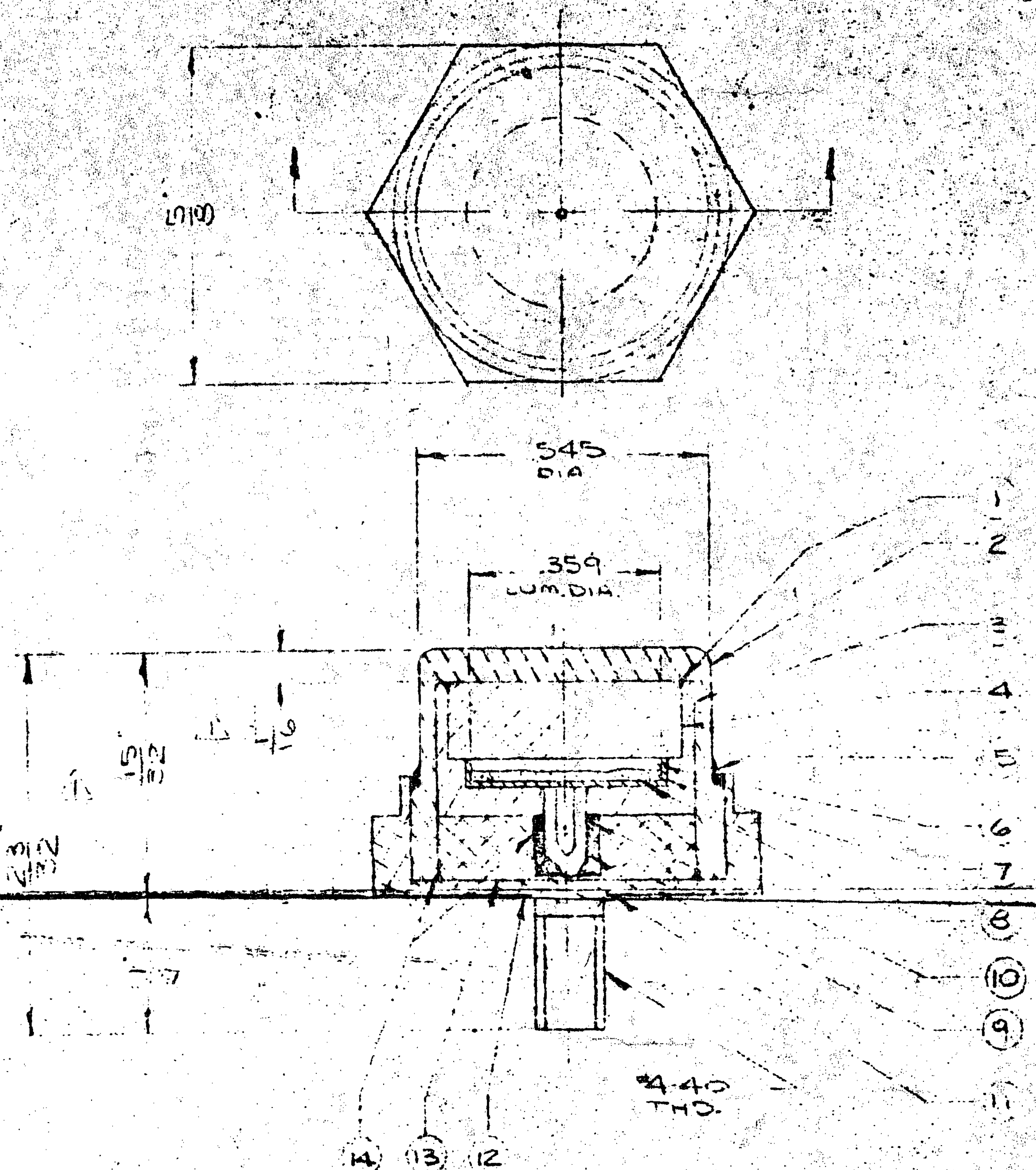
ISOLITE STANDARD LIGHT SOURCE CONTAINER

This is a drawing of the source container of the U. S. Radium Isolite Standard Light Source. (Drawing # LAB 706

This source container and source was manufactured by the U. S. Radium Corp. under AEC license # 37-30-2.

6A

DWG. NO. LAB 706	BY	APP'D	DATE	REVISIONS
REV. ⚠	FB	J	2-8-61	REV. FRONT WINDOW



LEGEND:

1. GLASS-METAL SOLDER SEAL
2. OUTER HOUSING - PLEXIGLAS
3. INNER HOUSING - C.R.S. (CAD. PLATED)
4. CERIUM GLASS WINDOW
5. CONTINUOUS EPOXY RESIN SEAL
6. ACTIVE GAS
7. ALUMINUM CUP
8. PHOSPHOR BED
9. Cu FILLING TUBE - CRIMP & SOLDER DIP
10. SILVER SOLDER - 1145°F
11. HOUSING ALUMINUM - GOLD ANODIZE
12. LABEL DATA
13. BACKPLATE - ALUMINUM
14. CONTINUOUS EPOXY RESIN SEALS

LABEL DATA:

1. CAUTION RADIOACTIVE MATERIAL
2. RADIATION SYMBOL
3. ISOTOPE SYMBOL & CONTENT
4. SEALING DATE

SAFE OPERATING TEMP. 180°F (MAX.)

USRC CODE I-922

USRC LABEL CODE - Q

LAB DEPT.		UNITED STATES RADIUM CORPORATION	
MATERIAL	TOLERANCES		
SPEC. AS NOTED	FRACTIONS ± 1/64" ANGLES ±	D'W'N BY FB	TITLE LIGHT SOURCE TRITIUM GAS
	DECIMALS UNLESS OTHERWISE NOTED ± .005	CK'D BY J	
THICKNESS	DECIMAL DIMENSIONS TO 5" ±	APPR'D BY	
	DECIMAL DIMENSIONS 5" TO 10" ±	DATE 1/25/61	
FINISH	DECIMAL DIMENSIONS 10" AND UP ±	SCALE 4X	

ECOM NEUTRON FACILITY AT FORT HANCOCK

Fort Hancock is located at the end of Sandy Hook approximately 15 miles from Fort Monmouth. Drawing labeled "Fort Hancock Neutron Shield" (Figure I) shows the area surrounding Bldg. 539 which houses the Kaman Nuclear Corp. Neutron Generator Model A-1001.

Figure II shows the lay-out of the shielding that was added and the ventilating system. Four more inches of block (than shown in Figure II) were added between control room and generator room making a total of 64 inches of concrete block and poured concrete.

Figure IV shows the overhead shielding and the ventilating duct elevation.

The following measurements were made on the ventilating system:

Outlet duct velocity	1950 ft/min
Outlet duct air movement	950 CFM
Inlet duct velocity	1440 ft/min
Inlet duct air movement	576 CFM

The above measurements show that the air in the neutron generator room is changed every 2 minutes. The direction of air flow in the control room is toward the maze and generator room (374 CFM).

An Atomic Accessories Tritium Monitor and Alarm Model TSM-91 is used to determine if the tritium level is above 5×10^{-6} microcuries per milliliter in the generator room.

A remote wind velocity and direction indicator is located in the control room and target replenishing, target change or total system pump down in not performed unless the wind velocity is over 5 miles per hour and the direction from which it is blowing is 180° to 225° (out to sea).

There is a 6 foot fence around the entire building with signs on each side with the standard radioactive symbols and colors and the words "Caution Radiation Area."

Figure III shows the electrical circuits for heat, lights and safety interlocks and warning lights. The gate to the maze is interlocked so that generator is shut off if gate is opened. Whenever generator is "ON" red warning lights are turned on in the locations indicated on the drawing. When the generator is first turned "ON" a warning bell rings for 10 seconds before the accelerating voltage can be run up.

The vacuum system is also interlocked and the ion pump is shut off before there is any possibility of tritium being released to the atmosphere.

The 14 Mev neutron intensity in the control room was computed as follows:

$$\varphi = \frac{\varphi_0}{4\pi r^2} \exp(-\mu x)$$

φ_0 = 4π output of source = 2×10^{11} n/sec

r = minimum distance from source to operator = 427 cm

μ = absorption coefficient for concrete block = .153 inches^{-1} (AERE-R-3920)

x = thickness of shield = 64 inches

$$\varphi = \frac{2 \times 10^{11}}{4\pi (427)^2} \exp(-.153 \times 64) = 4.37 \text{ n/cm}^2\text{/sec}$$

Since 10 n/cm^2/sec of 14 Mev neutrons is equal to 100 millirem for a 40 hour week, the rate in the control room is below tolerance.

The computation of the dilution of tritium as a result of turbulent diffusion is based on the work by O. G. Sutton in Micrometeorology, published by Mc Graw-Hill.

The distances, from the foot of the stack, of the point of maximum concentration at ground level is given as:

$$x = \left(\frac{h^2}{C_z^2}\right)^{\frac{1}{2-n}}$$

and the maximum concentration is given as:

$$X = \frac{2Q}{e\pi \bar{u} h^2} \left(\frac{C_z}{C_y}\right).$$

Q = source strength released at the stack mouth = 1 curie/sec

$\bar{u}$ = wind velocity = 224 cm/sec (5mph)

h = stack height = 975 cm (32 ft)

x = horizontal distance from stack in cm

X = concentration in curies/cm^3

C_y = diffusion coefficient based on wind profile and height of stack = .326 cm$^{1/8}$

C_z = diffusion coefficient = .126 cm$^{1/8}$

n = constant = 1/4

$$x = \left(\frac{975}{.126}\right)^{8/7} = 2.7 \times 10^4 \text{ cm} = 887 \text{ ft}$$

It should be noted that the distance from the stack, of the maximum concentration at ground level, is independent of the magnitude of the wind velocity. Only its direction is important. From Figure I, we see that the ocean is 350 feet from the stack due North and 550 feet in the Northeast direction. Therefore, the maximum concentration of the stack effluents will be located over the ocean.

When the wind is 5 miles per hour and 1 curie/sec is released at the stack mouth, the concentration at 887 feet is:

$$X = \frac{2}{2.72 \times 3.14 \times 224 \times (975)^2} \left(\frac{.126}{.326}\right)$$
$$= 4.26 \times 10^{-4} \ \mu\text{c/ml}$$

The concentration is directly proportional to the curies/sec released at the stack mouth and inversely proportional to the wind. These are the only parameters that can be varied in our fixed installation.

The following total quantities of tritium are released under the circumstances indicated.

a. Target change (with isolation valve closed) = 1.8 x 10^{-6} curies.

b. Replenishing cartridge change (with isolation valve closed) = 1.8×10^{-6} curies.

c. Evacuation of entire accelerator (ion pump off) = 3.5×10^{-5} curies.

d. Breakage during replenishing = 2.07×10^{-4} curies.

e. Breakage at other time - no tritium released.

f. Evacuation of entire accelerator (ion pump on using Kaman Sorption pump) = no tritium released.

Under conditions a, b, and c above, the tritium would be released over approximately 5 minutes (while the cold trap warms up).

The maximum activity released during the shortest time would be d, or 2.07×10^{-4} curies would be released in about 1 sec.

Since the concentration at 887 feet is proportional to rate of release of tritium in curies/sec, the actual concentration would be

$$X = 4.26 \times 10^{-4} \times 2.07 \times 10^{-4} \ \mu c/ml$$
$$= 8.81 \times 10^{-8} \ \mu c/ml$$

The above amount is below the $2 \times 10^{-7} \mu c/ml$ permissable in unrestricted areas (CFR 10-20).

The estimate of the maximum concentration is conservative since:

a. The stack mouth is really higher than 32 feet above maximum high tide.

b. Additional height should be added since effluents are emitted upward at a velocity of 1950 ft/min.

c. Wind velocity will usually be greater than 5 miles per hour which is the minimum allowable.

The concentration on the land between the water's edge and the stack will be less than the above since it is at least 337 feet closer to the stack than the location of the maximum concentration.

e. Scintillation detector systems using plastic scintillating materi

f. An Ortecs Model 505 Neutron Spectrometer, using 2 model NSB 14A fast neutron sandwich spectrometers, combined with a RIDL 400 channel analyser. This system can be used with other surface barrier solid state detectors to detect neutrons or associated charged particles.

Targets and spare replenishing cartridges will be stored in the Isotope Storage Vault, Bldg. T-383 in the Evans Area. They will be stored in the Fort Hancock Facility only for short periods during target or replenisher cartridge changes. While they are stored at the Fort Hancock Facility, they will be kept in the generator room on a shelf near the ventilating duct. The ventilating blower will run continuously (24 hours a day) while they are there. The generator room is evacuated once every 2 minutes by the ventillating system, as previously mentioned. The estimated storage time at the Fort Hancock Facility should not exceed 2 or 3 days.

The Isotope Storage Vault, Bldg. T-383, the permanent storage location, is described in Inclosure 8, part II. The blower shown in drawing ESD-90768 of the above reference is turned "ON" when the door is opened and evacuates the vault approximately 2 1/2 times a minute.

The Target Replenishing Cartridge or Tritium Reservoir Assembly is shown in the Kaman Nuclear drawing 101262 inclosed. It will be stored in its shipping container shown in the Kaman Nuclear drawing 101305 except for dimensions or in air tight glass jars properly labeled.

Copies of the following instructions are inclosed at the end of this description.

a. Monitoring and Survey Instructions.

b. Operating Procedures for Kaman Neutron Generator.

c. Procedure for Replacement of Target.

A set of operating procedures is displayed prominently in the control room. Included with these are procedures for replenishing the target, changing the target, changing the replenishing cartridge and evacuating the accelerator assembly.

The Neutron Generator located at Fort Hancock, New Jersey will be installed permanently for the next few years, however, we eventually plan to install it in the Evans Area. When the design of the Evans installation is completed and the funding for its completion has been allocated, an application for amendment authorizing this move of the generator will be sent through channels.

Surveys for determining the extent of tritium contamination will be conducted prior to each day of operation of the neutron generator using an Atomic Accessories Tritium Monitor Model TSM-91. In addition, after operations or repairs which are known to release tritium, wipe tests will be made of the generator surfaces and surrounding areas and the contamination level determined in microcuries. During such operations or repairs, surfaces will be monitored with a thin window Geiger counter to check the contamination level and prevent spread of any contamination. Details of the survey and monitoring procedures are given in the "Monitoring and Survey Instructions" that follow.

A Nuclear-Chicago Neutron Survey Meter Model 267 will be in the Control Room and "ON" during all operations of the generator. In addition, the following instruments may be present at the installation as required:

a. A Texas-Nuclear Lithium Iodide Dosimeter and Survey Meter Model 9145

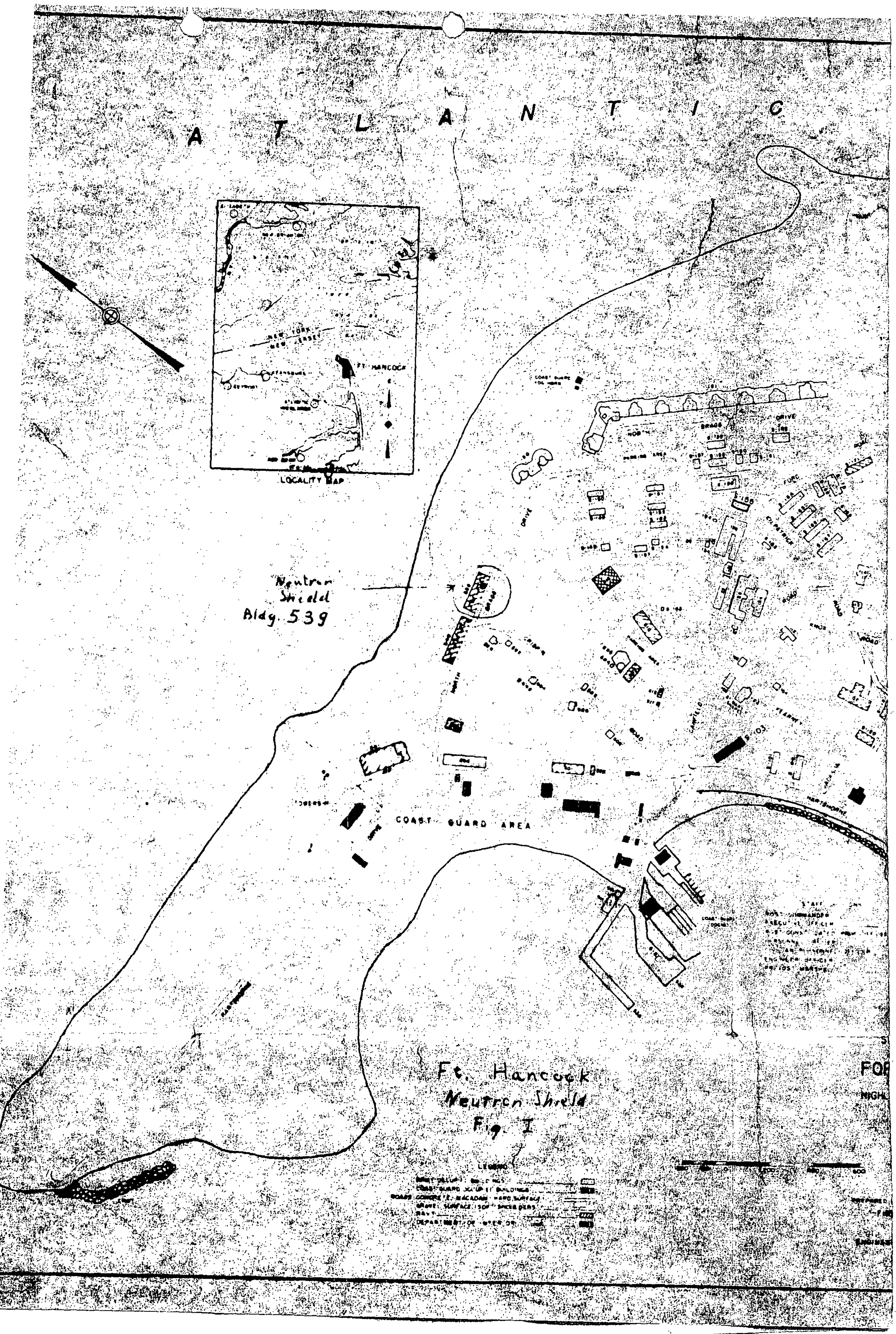
b. Sulphur pellets for threshold measurements.

c. Gold foils with and without cadmium jackets for thermal neutron measurements whenever moderators are used with the generator.

d. Photographic film for track measurements.

d. Procedure for Replacement of Target Replenisher Cartridge.

e. Procedure for Evacuating the Entire Accelerator Assembly (Incl Ion Pump).



Ft. Hancock
Neutron Shield
Fig. I


O C E A N.
OF
COCK
JERSEY
LAWSON LANE
2000 FEET

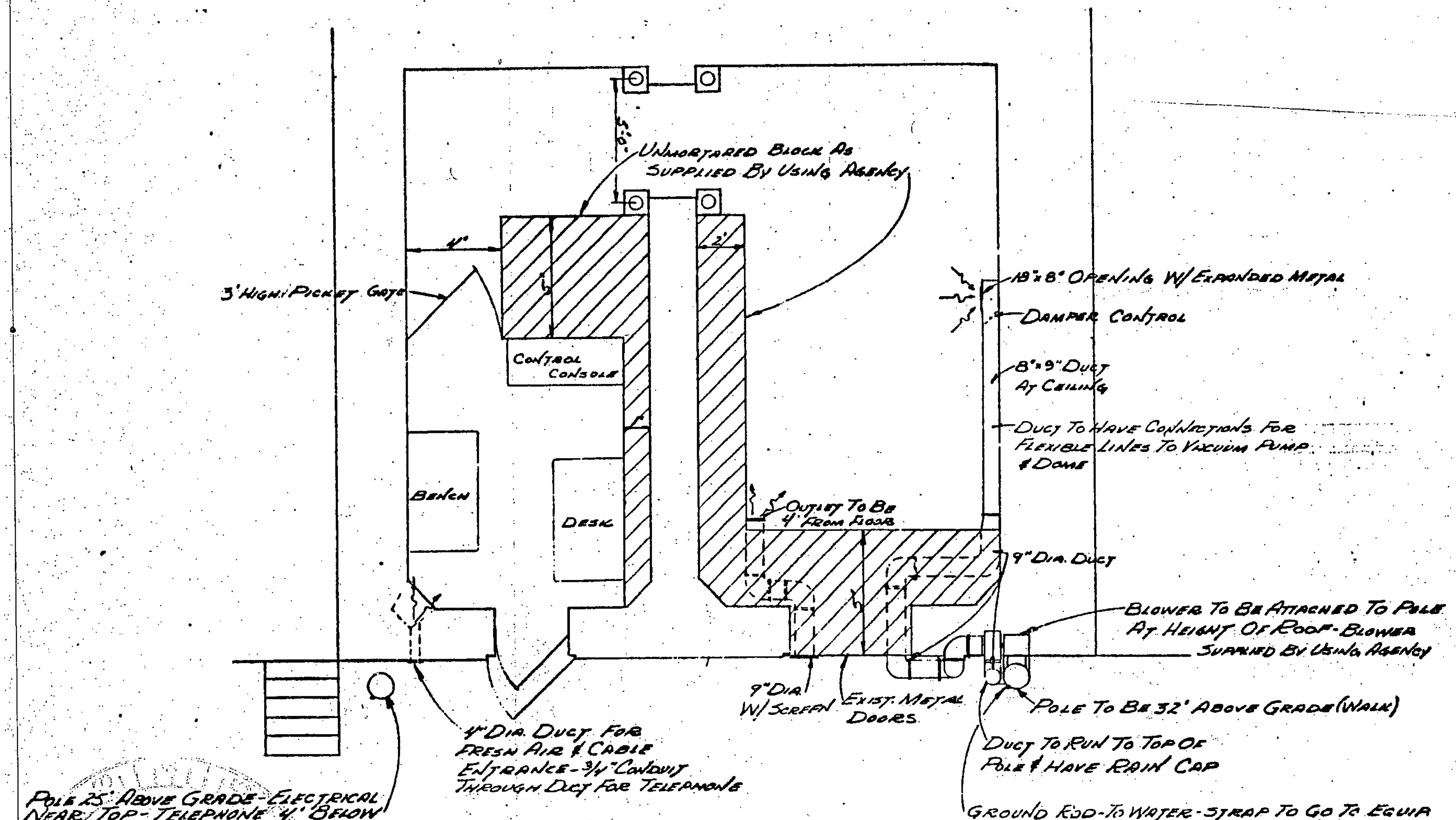


Fig II BLOCK & VENTILATION PLAN

SCALE 1/4" = 1'-0"

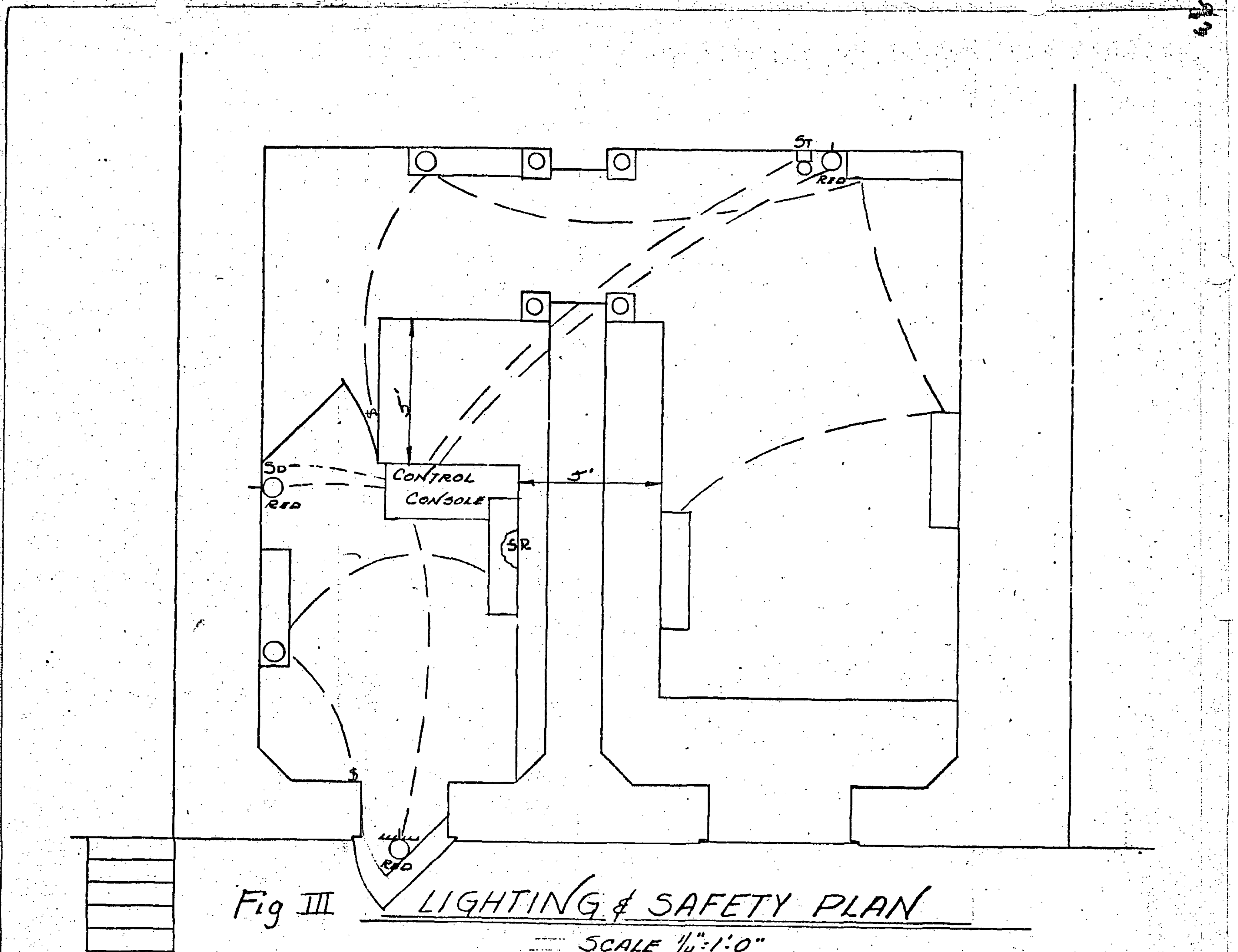


Fig III LIGHTING & SAFETY PLAN

SCALE 1/4" = 1'-0"

PLAN

SCALE 1/4"=1'-0"

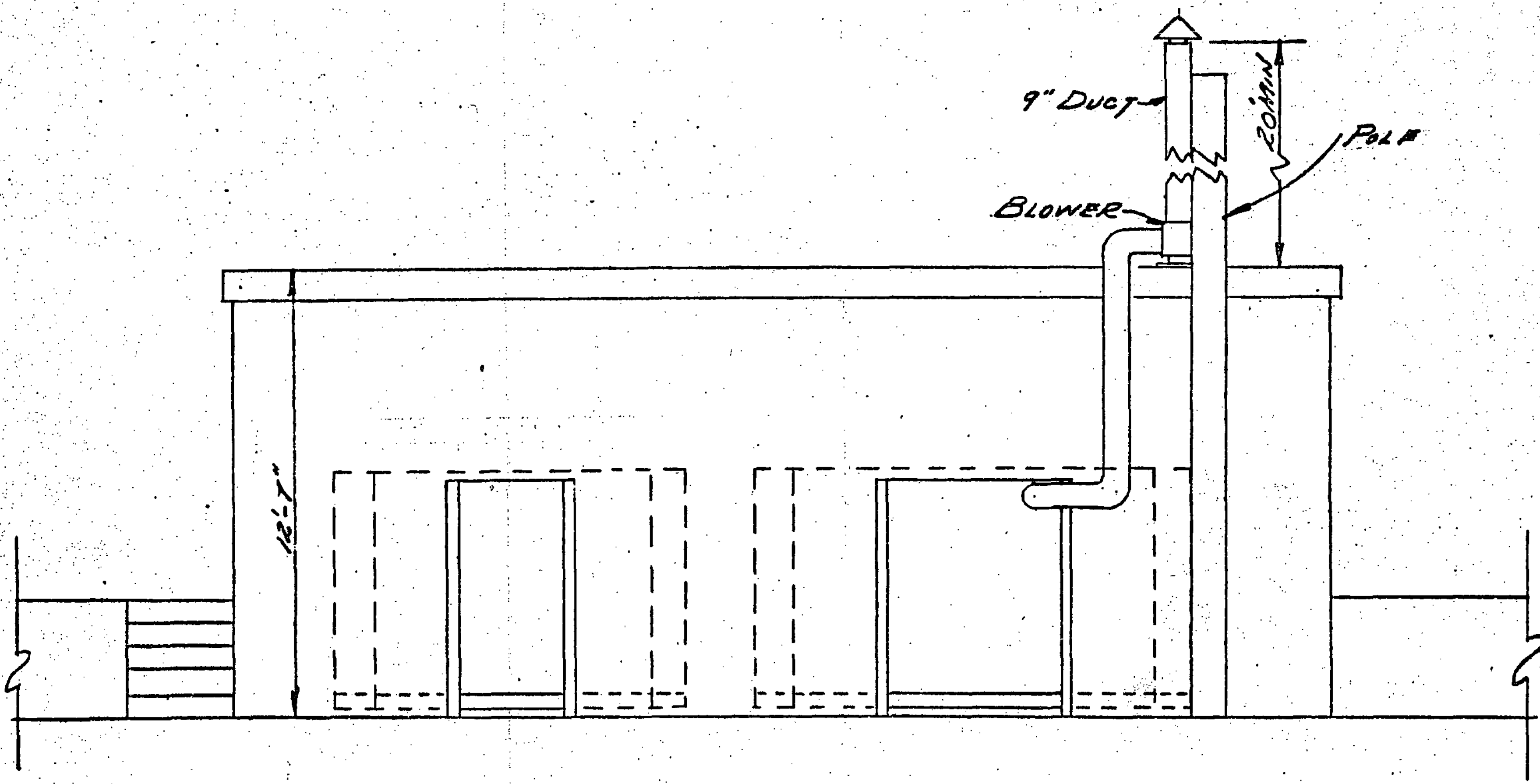


Fig IV ELEVATION

SCALE 1/4"=1'-0"

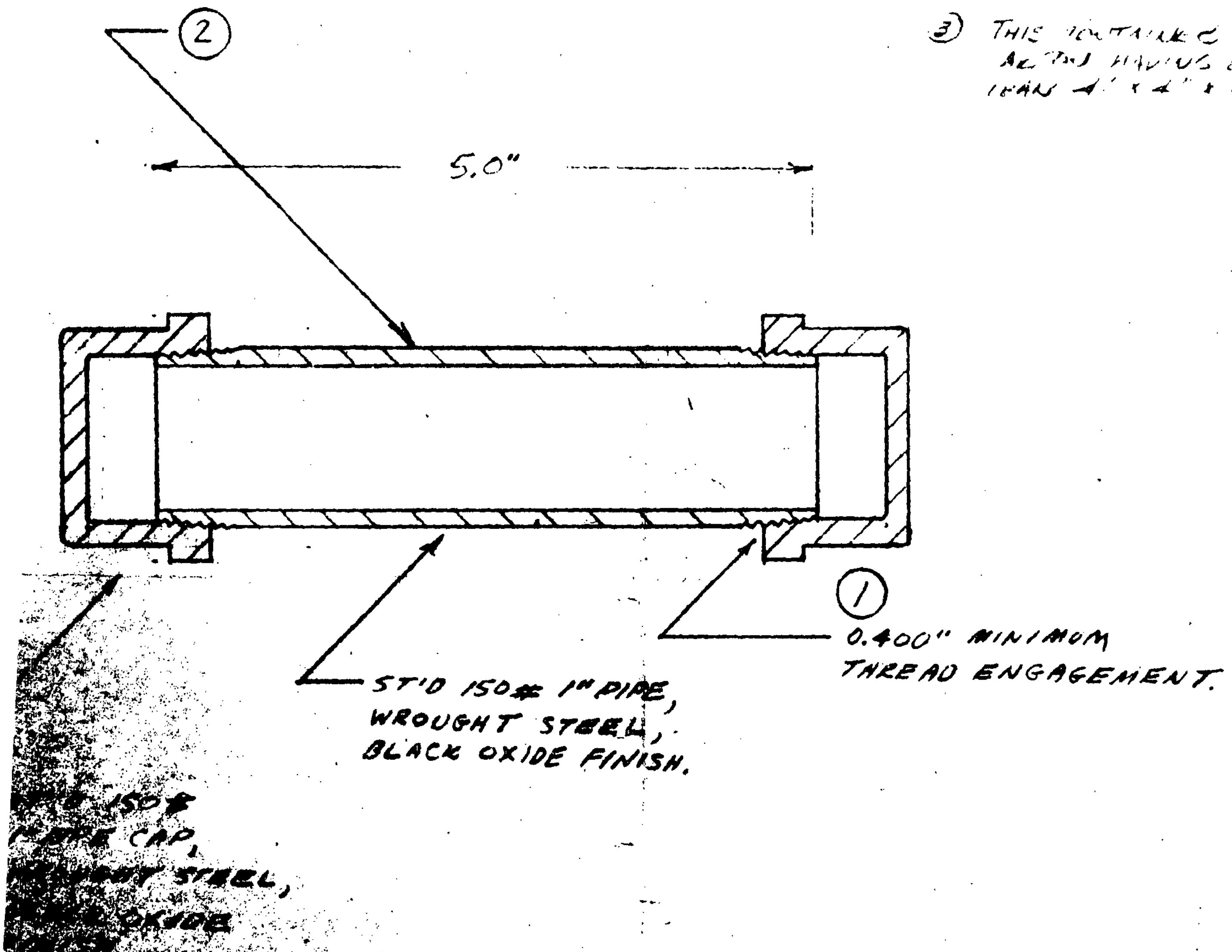
NOTES

REV. NO.	DATE
B	[illegible]

(1) SEAL ALL OF ENG[illegible]
WITH SODIUM SIL[illegible]
BOTH ENDS

(2) AFFIX AEC-ICC A[illegible]
RADIOACTIVE MATERI[illegible]
LISTING ISOTOPE TY[illegible]
CURIES

3) THIS [illegible] TO BE
[illegible]
[illegible] 4" x 4" x 6"



REV. NO.	DATE	DESCRIPTION	BY	APPROVED
B	[illegible]	ADDED NOTE 5	[illegible]	

SEAL ALL OF ENGAGED THREAD
WITH SODIUM SILICATE, USP.
BOTH ENDS

FFIX AEC-ICC APPROVED
ADIOACTIVE MATERIALS LABEL,
STING ISOTOPE TYPE & ACTIVITY IN
IRIES

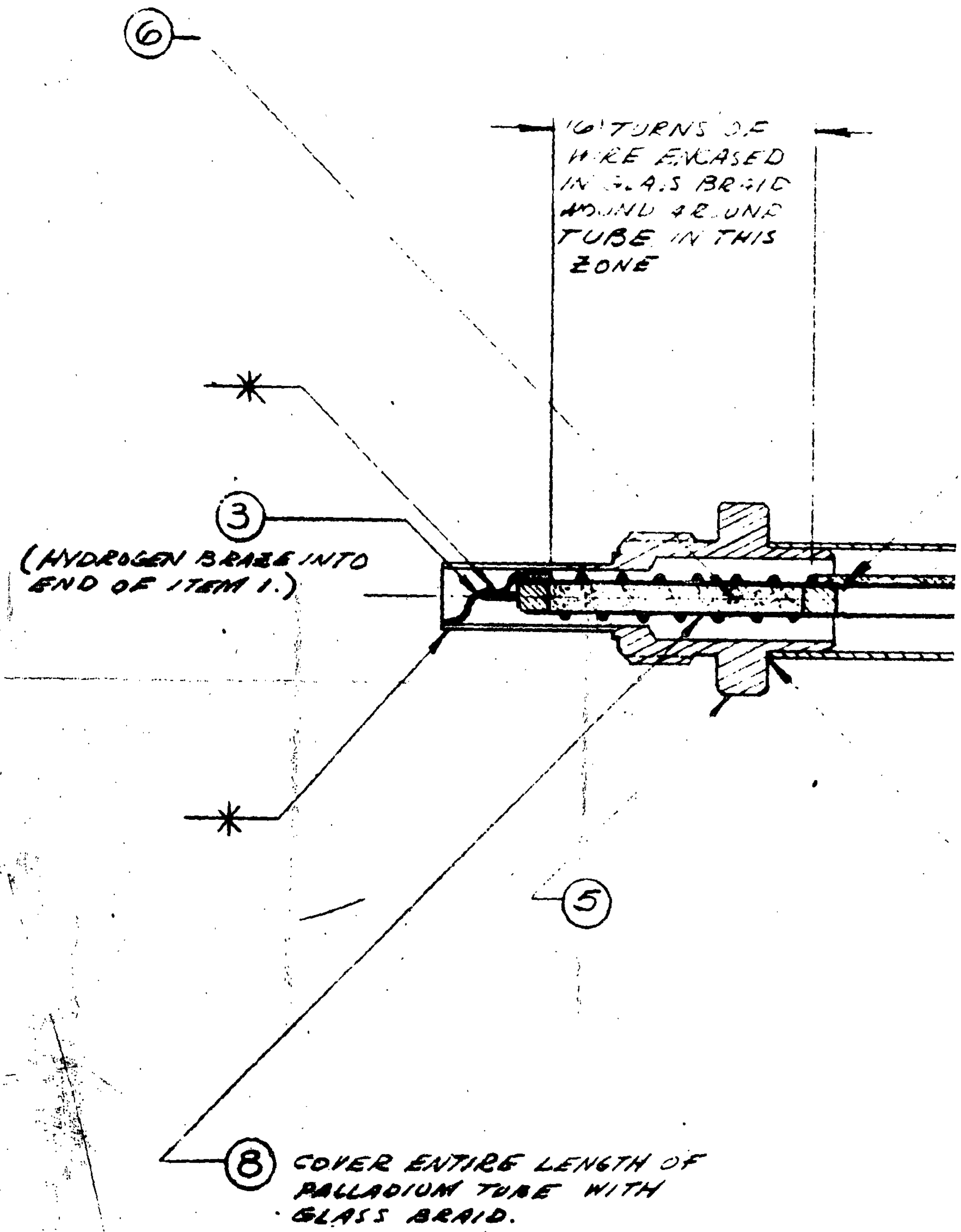
IS CONTAINER TO BE SHIPPED IN OUTER
ER HAVING DIMENSIONS GREATER
AN 4" x 4" x 6"

NIMUM
NGAGEMENT.

[illegible]

1. FRENCHTOWN
FRENC

2. ALL HYDROGEN, &
WESTERN GOLD
BELMONT, CA



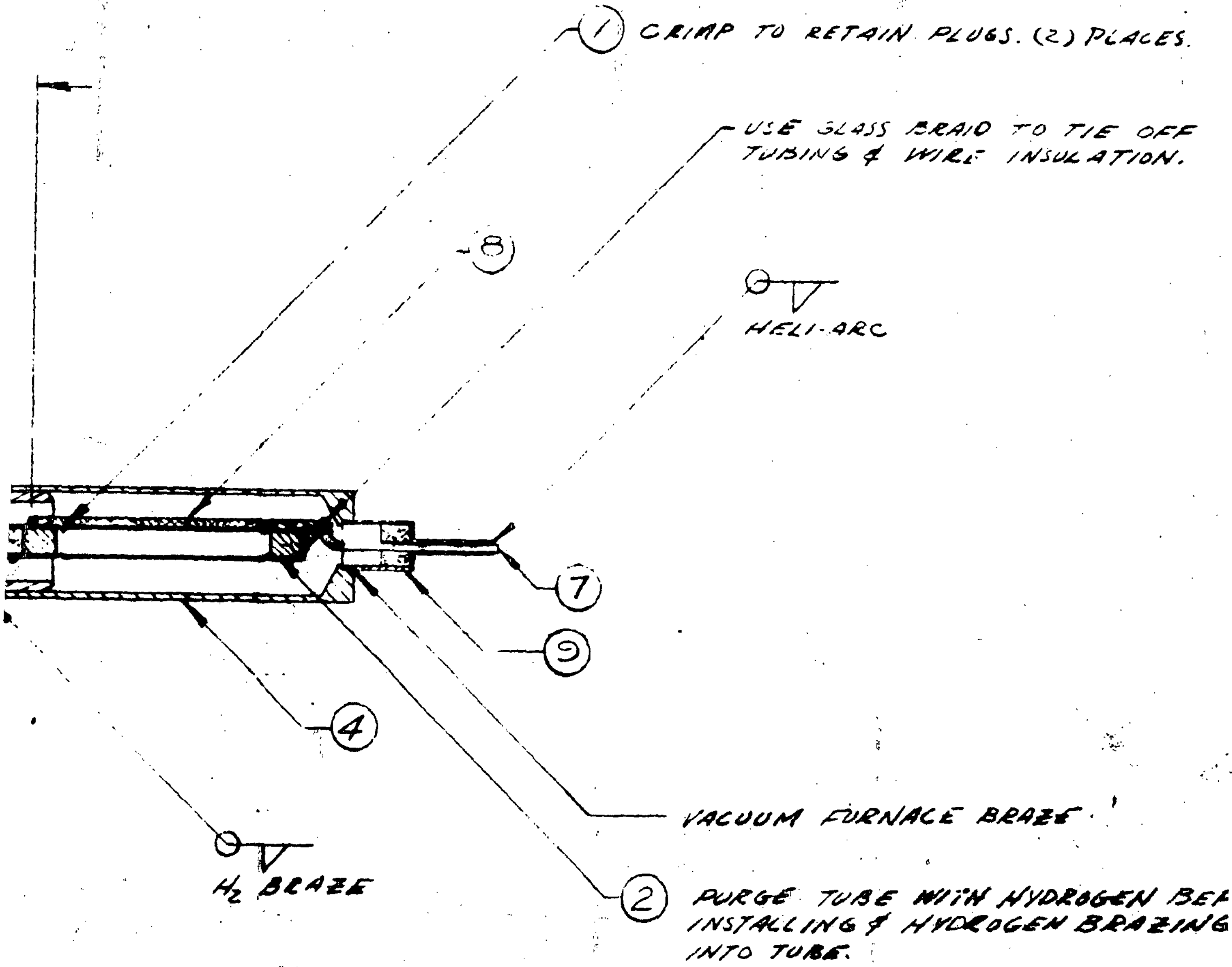
NOTES

...YTOWN PORCELAIN CO.
FRENCHTOWN N.J.

...ROGEN, & VACUUM FURNACE BRAZE - "CUSIL" AG-CU ALLOY.

...RN GOLD & PLATINUM CO.
...ONT, CALIF.

REV. NO.	DATE	DESCRIPTION
A	[illegible]	ORIG. [illegible]
B	2-13-64	ADDED (9) TO LENGTH... VACUUM FURNACE BR... HYDROGEN BRAZE.



ITEM	QTY		PART NO.	DESCRIPTION
9		1		MINITURE...
8		AR		GLASS...
7		AR		22 GAGE...
6				TITANIU...
5		1	101261	BODY
4		1	101260	BARRE...
3		1	101259	ELEME...
2		2	101258	PLUG -...
1		1	101257	[illegible]

MATERIAL -

FINISH -

- UNLESS OTHERWISE SPECIFIED -
BREAK SHARP EDGES
TWO PLACE DECIMALS ±.010
THREE PLACE DECIMALS ±.005
ANGLES ±1/2°

A [illegible] ORIG. [illegible]

B 2-13-64 ADDED (.93) TO LENGTH OF ITEM 5, VACUUM FURNACE BRAZE WAS HYDROGEN BRAZE. FHK

FHK

BRAZE - "CUSIL" AG-CU ALLOY.

(1) CRIMP TO RETAIN PLUGS. (2) PLACES.

USE GLASS BRAID TO TIE OFF TUBING & WIRE INSULATION.

(8)

HELI-ARC

(7)

(9)

VACUUM FURNACE BRAZE

(2) PURGE TUBE WITH HYDROGEN BEFORE INSTALLING & HYDROGEN BRAZING PLUG INTO TUBE.

9		1		MINITURE FEED THRU (FE-5083)	1
8		AR		GLASS BRAID INSULATION ([illegible] I.D.)	
7		AR		22 GAGE NICHROME WIRE	
6				TITANIUM TRITIDE	
5		1	101261	BODY - (ACTIVITY ≈ 1 c/[illegible])	
4		1	101260	BARREL -	
3		1	101259	ELEMENT CAP -	
2		2	101258	PLUG -	
1		1	[illegible]	[illegible]	
ITEM	UNIT	[illegible]	PART NO.	[illegible]	

RIAL -

H -

- UNLESS OTHERWISE SPECIFIED -

[illegible]

6 101262

MONITORING AND SURVEY INSTRUCTIONS

A. Procedure Before Each Operation of the Generator:

1. The blower should be turned "ON" immediately after entering the facility. The Atomic Accessories Tritium Monitor (TSM-91) should then be turned "ON" (in the Control Room) and the level checked.

CAUTION

If the level is greater than 5×10^{-6} µc/ml, leave the area immediately (to a place where the level is below 5×10^{-6} µc/ml) and investigate the cause of the high tritium level.

2. The Atomic Accessories Tritium Monitor should then be taken into the generator room and a survey made of the joints on the accelerator.

CAUTION

If the level is greater than 5×10^{-6} µc/ml, leave the area immediately (to a place where the level is below 5×10^{-6} µc/ml) and investigate the cause of the high tritium level.

3. If the level in the generator room is below the maximum permissible concentration (MPC) in a restricted area (5×10^{-6} µc/ml) move the tritium monitor back to the Control Room and leave it in the "ON" position during the operation of the generator.

4. The Nuclear-Chicago Neutron Survey Meter Model 267 should then be turned "ON" and left "ON" during the operation of the generator.

CAUTION

The neutron level in the Control Room should not be allowed to exceed 10 neutrons/cm^2/sec.

5. Before starting the generator, the ion pump current should be checked as in "Operating Procedure". If the current is above 100 microamperes, a leak is indicated.

CAUTION

If the ion pump current indicates a leak, the machine should be taken out of operation and arrangements made to have it repaired. The person in charge of the facility and the Radiological Protection Officer should be notified.

B. Procedure After Any of the Following Operations or Events:

a. Target change.

b. Replenishing cartridge change.

c. Breakage at any time.

d. Evacuation of the entire system.

e. Leakage of the vacuum system at any time.

1. During any of the above operations or during repairs, the Nuclear-Chicago Model 2612 thin window GM counter will be used to check surfaces to detect and prevent any tritium contamination.

2. At the completion of any of the above operations or repairs resulting from leakage, breakage, or malfunction, a Wipe Test will be made of all the exposed or accessible areas on and around the neutron generator. The results of the Wipe Tests will be recorded in the Wipe Test and Assay Log Book in microcuries of tritium.

CAUTION

If there is any wipable contamination on any exposed or accessible surfaces in the neutron facility, it must be decontaminated until subsequent Wipe Tests indicate no wipable contamination.

The generator will not be used until it is decontaminated.

3. On the day following the completion of the above operations or repairs, Procedure A. will be followed <u>before</u> the ventilating blower in turned "ON". The hose of the tritium monitor (TSM-91) will be placed as close to the ceiling as possible, where maximum accumulation is likely to occur.

CAUTION

If the level is greater than 5×10^{-6} µc/ml, leave the area immediately (to a place where the level is below 5×10^{-6} µc/ml) and investigate the cause of the higher tritium level.

OPERATING PROCEDURES FOR KAMAN NEUTRON GENERATOR

A. Preoperational Checkout

Before energizing the equipment it is essential to ascertain that all conditions are proper for operation. The following checks should be made each time the neutron generator is started up from a shutdown condition:

1. Check that ion pump current reading is less than 100 us.

a. Place "Pump Range" switch in "KV" position. Voltage reading should be between 5 and 6.

b. Move "Pump Range" switch counterclockwise through current positions until an observable meter reading is obtained. If accelerator has not been operated for several hours reading should be less than 100 µa. A higher reading indicates a leak in the system.

2. Check that deuterium leak pressure is between 25 and 30 psi.

3. Check that SF_6 pressure in dome is between 30 and 33 psi.

4. Check that all personnel who will be in the restricted area wear gamma and neutron film badges, 0-200 millirem fast neutron and gamma quartz fiber dosimeters and an Atomic Accessories "Chirpie" (Model PRM-253).

5. Check that the liquid Freon tank is one-half to two-thirds full.

6. Make certain that target valve is full counterclockwise.

7. Insure that all radiation monitors are located and operating properly.

8. Insure that barriers are in place and that potentially hazardous areas are cleared of personnel.

9. Be sure that the target flap is out of the beam path.

CAUTION

Do not enter the room housing the neutron generator when accelerator voltage is in excess of 90 KV, because of x-ray hazard.

B. Start Up

1. Turn "Main Power" key switch on.

2. Turn "Cooling On-Off" switch on.

3. Check that "Dome Pressure OK," and "Ion Pump Pressure OK" lights are on and steady.

4. Rotate "Source,""Accelerator" and "Extractor Voltage Adjust" variacs to zero.

5. Push "Start" button.

6. Turn "Leak Selector" switch to the "D_2" position.

7. Place "Pump Range" selector switch at "2ma".

8. Place "Leak Vernier" switch in "Raise" position until an increase in ion pump current is observed. Place the "Pump Range" switch to "20ma".

9. The leak responds slowly because of its thermal mass. Increase "Leak Vernier" setting in steps of two minor divisions, waiting approximately 30 seconds between steps, until an ion pump current of approximately 5 ma is obtained.

C. Operation

CAUTION

Before initiating the generation of neutrons, be certain that all area warning lights are on, that neither "Neutrons" button is lit, that monitors are in place and operable, and that no personnel are in restricted areas.

1. Place "Warning and Interlock" switch in position to apply power to warning lights and interlocks. Light should illuminate.

NOTE

If dome pressure, cooling, ion pump pressure or overvoltage interlocks are interrupted, the generator high voltage will be shut off. When interlocks are again closed the voltage adjustments outlined in the following steps (2 through 11) must be repeated.

If the "Warning" and door interlock switches are open, no power will be available to the Neutron switches.

2. Depress "Neutrons Manual" switch to "On" position.

3. Advance "Source Voltage Adjust" variac to approximately 45.

4. Place "Beam and Target Current" selector switch in "Target 0-1.5 ma" position.

5. Turn "Extractor Voltage Adjust" variac to 90.

6. Advance "Accelerator Voltage Adjust" to approximately 40.

   a. "Accelerator Voltage Meter" should read about 60 KV.

   b. "Extractor Voltage Meter" should read about 45 KV.

7. Adjust "Source Voltage Adjust" variac between 30 and 80 for maximum target current reading.

8. Adjust ion pump current by varying leak vernier to obtain maximum target current.

9. Advance "Accelerator Voltage Adjust" variac to obtain desired accelerator voltage.

10. Reoptimize target current by adjusting "Source Voltage Adjust" variac and "Leak Voltage" buttons. (The best target current obtainable should be 0.9 to 1.3 ma at a corresponding accelerator voltage of approximately 180 KV. As accelerator voltage is reduced, the beam current will be reduced correspondingly.)

11. Adjust "Extractor Voltage Adjust" for maximum target current. This adjustment gives approximately the smallest beam diameter on the target. Then rotate "Extractor Voltage Adjust" slightly clockwise until a decrease of approximately 5% in target current is observed. This assures that the beam is spread over the target, giving best target economy for a given neutron yield. Note the "Extractor Voltage Adjust" setting for future start up.

NOTE

The optimum position of the "Source Voltage Adjust" may occur either in the region of 40 to 50 or 65 to 75. Both regions should be checked to determine optimum target current. A few seconds wait after each adjustment will permit the leak to respond to changes in the leak current. The ion pump pressure and the optimization of the "Source Voltage Adjust" interact. After reoptimizing pump pressure, the "Source Voltage Adjust" should be rechecked for maximum beam current.

12. On units equipped with the optional target flap, this flap must be moved manually to the open (raised) position before initiating the production of neutrons.

CAUTION

(1) Do not enter the room housing the neutron generator when accelerator voltage is in excess of 90 KV, because of the x-ray hazard.

(2) Deflect the ion beam before approaching the accelerator to raise the target flap.

13. Generate neutrons for the required priod of time by either of the following methods:

a. Manual Control

Turn "Neutron Manual"switch on and permit beam to strike target for desired period of time. To stop generation of neutrons, turn switch off. Light will extinguish. Decrease setting on "Accelerator Voltage Adjust".

b. Automatic Control

Turn "Irradiation Time" timer to the desired setting and place "Neutron Automatic" switch in "On" position. When time has elapsed, decrease setting on "Accelerator Voltage Adjust" to 0.

14. The beam sorter, when switched to the "On" position while in the normal mode, will deflect the ion beam from the target, stopping the production of neutrons. The beam sorter is equipped with a Wein velocity filter. This filter consists of

crossed electric and magnetic fields which can be adjusted to focus the atomic ion beam on the target. In this case, the switch is turned to the "On" position to stop the production of neutrons.

D. Shut Down

1. Turn "Accelerator Voltage Adjust" to 0.
2. Turn "Source Voltage Adjust " to 0.
3. Turn "Extractor Voltage Adjust" to 0.
4. Turn "Warning and Interlock" switch off.
5. Turn cooling off.
6. Turn "Main Power" switch off.
7. Leave "Leak Vernier" in its last operating position.

NOTE

Do not turn ion pump off.

E. Operation of Special Features

1. Beam Sorter

a. Energizing

1. Energize accelerator as for normal operation.

2. When target current has reached 0, place "Beam Sorter On-Off" switch in "On" position.

3. Advance "Sorter Voltage Adjust" for maximum target current.

4. Readjust the "Extractor Voltage Adjust" as in No. 11. Record the sum of the "Beam Sorter Voltage", Plate A and B. (Add the Plate A and Plate B readings.)

5. Advance the "Sorter Voltage Adjust" so that the sum of the Plate A and the Plate B, "Beam Sorter Voltage" is equal to 1.4 times the previously recorded sum.

De-energizing

1. Place "Beam and Target Current" selector switch in "o-1.5 ma" position.

2. Reduce "Sorter Voltage Adjust" to 0.

3. Turn "Beam Sorter On-Off" switch off.

4. Accelerator is now operating in full beam.

2. Target Replenishing

NOTE

A target replenishing cartridge is available as optional equipment on the Model A-1001 neutron generator. The following procedures apply only to units so equipped.

1. Turn "Main Power" key switch on.

2. Turn "Cooling On-Off" switch on.

3. Check that "Dome Pressure OK" light is on.

4. Turn "Start" switch on.

5. Decrease "Leak Vernier" meter reading to 0.

6. Turn "Leak Selector" switch to "H^3" position.

7. Raise leak vernier meter reading to increase pressure of tritium in accelerator. Do not allow "Leak Vernier" meter indication to increase more than two divisions between each setting. Approximately 30 seconds is required between settings to permit the leak temperature to stabilize.

NOTE

Once an operating point has been established, the same setting may be used as a starting point whenever tritium replenishing is required.

8. Turn on "Warning and Interlock" switch.

9. Turn on the "Neutron Manual" switch.

10. Adjust controls as for neutron generation for a total accelerating voltage of 70 to 80 KV.

11. Thirty minutes of regeneration will usually bring a target that is 50% depleted back to 80 to 85% of initial activity.

CAUTION

If breakage of the vacuum system occurs during replenishing, gaseous tritium may be released to the atmosphere. Therefore:

a. A tritium monitor must be in operation with the intake near the cartridge.

b. Ventilating system must be on.

c. Wind velocity must be greater than 5 miles per hour and from the direction of 180° to 225°.

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PROCEDURE FOR REPLACEMENT OF TARGET

CAUTION

It is possible for gaseous tritium to be released to the atmosphere during the process of changing targets. Prior to performing this operation, associated personnel must be thoroughly familiar with AEC Regulation 10 CFR 20. Appendix B of the AEC regulation lists the allowable concentration limit of tritium in air as of December 22, 1965, to be 2×10^{-7} microcuries per milliliter for unrestricted areas. A tritium monitor must be operated during any target changing procedures or maintenance procedures on the neutron generator proper to insure that appropriate action will be taken should the tritium concentration exceed the allowable limit.

Loss of tritium from the ion pump must be avoided by the correct sequencing of isolation valve closure and ion pump operation (detailed in rough pumping operation).

Target replacement should be undertaken only when the wind is greater than 5 miles per hour and blowing from the sector 180° to 225°.

A. Equipment

The following equipment should be available before proceeding with target replacement:

1. Disposable gloves (polyethylene or equivalent nonpermeable material).

2. A gaseous tritium monitor with sufficient sensitivity to detect levels of concentration prescribed in AEC Regulation 10 CFR 20. Atomic Accessories Model TSM-91-c.

3. Safety glasses.

4. A cylinder of dry gaseous nitrogen fitted with a 0-30 psi regulator and hose coupling for attachment to accelerator roughing valve.

5. A 3 inch square (or larger) polyethylene bag.

6. A new 1.500 inch diameter tritiated titanium target with a 0.010 inch thick oxygen-free copper backing. The activity should be approximately 4 curies per square inch.

7. A clean 1.500 inch OD x 0.070 inch section diameter Viton "A" "O" ring (size # 2-28).

8. A covered container for radioactive waste.

9. A screwdriver to fit standard ASME flathead 8-32 screws.

10. A mechanical roughing pump or sorption pump.

11. A Nuclear Chicago 2612, thin window geiger counter.

12. Liquid nitrogen for roughing pump cold trap.

B. Procedure

1. Turn off all power except that to the ion pump. (See Shut Down Procedure). Operation of the ion pump during target replacement avoids the removal of outgassed tritium from the ion pump by the roughing operation when the system is restored to vacuum.

2. Put on gloves and glasses.

3. Place tritium monitor so its air inlet is near work area. Energize monitor and allow it to reach stable operating conditions.

4. Close target isolation valve.

5. Rotate knob on nitrogen regulator completely counterclockwise to reduce output pressure to 0 (zero).

6. Gradually open main cylinder valve on nitrogen tank. (There should be no flow of gas at this time if regulator is operating properly.)

7. Restrict output hose of nitrogen cylinder with thumb or by kinking hose, and slowly open regulator knob to obtain a reading of 1-2 psi.

8. Attach hose to accelerator roughing valve, purging air from hose and inlet of roughing valve.

9. Open roughing valve and leave it open until audible flow of gas ceases, then close roughing valve.

10. Detach nitrogen hose from roughing valve and close regulator valve.

11. Disconnect the coolant outlet line from the target cap. This outlet line is located at the upper end of the target cooling cap when the accelerator is in a horizontal position.

12. Hold target cooling cap in place, and remove four flathead screws holding cap in place.

13. Slowly remove cap by pulling it straight forward, away from accelerator.

NOTE

Be ready to catch the used target should it become dislodged from target cooling cap. The 2 psi in the drift tube should dislodge target and cap.

14. If target does not come free, gently remove target and "O" ring intact, being careful not to separate "O" ring and target.

CAUTION

Monitor tritium concentration carefully to assure adequate warning of excessive gaseous tritium.

15. Place used target and "O" ring in polyethylene envelope and dispose of package as quickly as possible in and AEC approved container. (AEC Regulation 10 CFR 20).

16. Remove new target and "O" ring from their protective envelopes.

17. Install target in target cooling cap with the silvered side visible.

18. Place "O" ring on top of target and position target cooling cap on end of drift tube.

NOTE

Be careful to keep the target cap slightly tilted so that "O" ring and target do not become dislodged. When positioned, rotate the cap slightly to seat "O" ring.

19. Hold cap in place and insert two of the screws, tightening them finger tight to hold cap.

20. Install the two remaining screws and tighten all four screws until cap is felt to seat so that "O" ring is compressed against its mechanical stop.

21. Reconnect coolant lines to target cap.

22. Rough pump target end of tube, connecting pump to accelerator roughing valve and pump vent to ventilating manifold.

NOTE

The pressure within that portion of the generator tube between the target and the target isolation valve must be reduced to the vacuum required for normal operation. The system is evacuated by a mechanical pump which should be attached at the accelerator roughing valve. The mechanical pump must be vented to the exhaust manifold and up the stack so that the limits specified in AEC Regulation 10 CFR 20 are not exceeded.

a. Slowly open accelerator roughing valve and leave it open at least 15 minutes.

b. Close roughing valve, then carefully open the target isolation valve while observing ion pump current on the "20 ma" scale. The current should at no time rise above 10 ma. (If current is above 10 ma, there is a leak in the system, probably at the target, or the pump is not operating properly. If a leak is suspected, proceed as outlined in Step 23 below).

c. Continue opening target isolation valve, keeping the ion pump current below 10 ma. When valve is completely retracted, ion pump pressure should decrease. (If it does not, a leak is indicated).

d. When ion pump current is less than 1 ma, shut off and disconnect the roughing pump.

23. If, at Step 22b, the ion pump current rise indicates a leak in the system, it is necessary to disassemble the target, again following Steps 4 through 14 above. Then:

a. Inspect "O" ring and seat for cleanliness, and, if required, clean them thoroughly using a lint-free saturated with clean methyl alcohol cloth.

b. Reassemble the target cooling cap and target assembly. A reliable seal is easily obtained if the assembly is put together in a clean and careful manner.

c. After a seal is obtained and the coolant line reconnected, gradually open target isolation valve, noting that ion pump current will rise and then begin to fall again. Proceed from Step 22c above.

24. Carefully remove gloves by grasping the outside of one glove with the other gloved hand. Then with bare hand reach inside second glove and remove it.

CAUTION

Do not touch the outside of gloves with bare hands at any time.

25. Thoroughly wash hands, being careful to clean under and around fingernails and in crevices, knuckles and wrists.

26. Survey hands using a thin-window Geiger counter. If there is any indication above background, rescrub hands until indication drops to background level.

27. When target replacement has been completed, a urine sample should be obtained from each person who took part in the replacement and sent to Tracerlab for Bioassay.

PROCEDURE FOR REPLACEMENT OF TARGET REPLENISHING CARTRIDGE

CAUTION

The same potential hazards from gaseous tritium that exist with target replacement also apply to replacement of the target replenishing cartridge.

Loss of tritium from the ion pump must be avoided by the correct sequencing of isolation valve closure and ion pump operation (detailed in rough pumping operation).

Replenishing Cartridge should be undertaken only when the wind is greater than 5 miles per hour and blowing from the sector 180° to 225°.

A. Equipment

The following equipment should be available before proceeding with replacement of the target replenishing cartridge:

1. A gaseous tritium monitor with sufficient sensitivity to detect levels of concentration prescribed in AEC Regulation 10 CFR 20, Atomic Accessories Model-91-c.

2. Disposable gloves (polyethylene or equivalent non-permeable material).

3. Safety glasses.

4. A cylinder of dry gaseous nitrogen fitted with 0 - 30 psi regulator and hose coupling for attachment to cartridge manifold roughing stem.

5. A covered container for radioactive waste.

6. A target replenishing cartridge.

7. A cartridge copper seal washer (furnished with each cartridge).

8. A roughing pump capable of attaining blank-off vacuum of less than 20 microns.

9. A Nuclear Chicago 2612, thin window geiger counter.

10. Liquid nitrogen for cold trap on roughing pump.

B. Procedure

1. Put on gloves and safety glasses.

2. Place tritium monitor so that its air inlet is near work area. Energize monitor and allow it to reach stable operating conditions.

3. To gain access to the cartridge manifold assembly, remove the pressure dome in the following manner:

a. Vent the dome pressure by attaching a 2 - 3 inch length of 1/4 inch polyethylene tubing to the pressure inlet fitting.

b. After the audible flow of gas has ceased, TWO men, working together, should remove the outer pressure dome. One man should hold the dome to prevent its moving while the other loosens the dome-retaining ring.

c. Slide the dome off, moving it straight along the axis of the accelerator. Be very careful not to allow the dome to fall, as this could break the glass in the accelerator.

d. Remove the screws holding the inner corona dome in position, then carefully slide off the dome.

4. Close the cartridge isolation valve.

5. Rotate knob on nitrogen regulator completely counterclockwise to reduce output pressure to zero.

6. Gradually open main cylinder valve on nitrogen tank. (There should be no flow of gas at this time if regulator is operating properly.).

7. Restrict output hose of nitrogen cylinder with thumb or by kinking hose, and slowly open regulator knob to obtain a reading of 1 - 2 psi.

8. Attach hose to cartridge manifold roughing stem, purging air from hose and valve inlet.

9. Open manifold roughing valve, and leave it open until audible flow of gas ceases, then close valve.

10. Detach nitrogen hose from roughing valve and close regulator valve.

11. Disconnect the electrical lead to the cartridge.

12. Remove depleted cartridge by unscrewing retaining nut on cartridge manifold. Do not rotate cartridge. Handle cartridge only by its exposed barrel, being very careful not to touch any part of the cartridge exposed to vacuum portion of the system.

13. Discard the depleted cartridge and the copper seal washer in cover waste container.

14. Using a new copper washer, install fresh cartridge.

15. Reconnect the cartridge lead.

16. Rough pump cartridge assembly, attaching the mechanical pump to the cartridge assembly roughing valve and the pump vent to the ventilating system manifold.

17. Close the cartridge roughing valve.

18. Observing the ion pump current, carefully open the cartridge isolation valve, maintaining the pump current at less than 10 ma during the opening.

19. Replace pressure dome, and re-pressurize to between 30 and 33 psi.

20. Remove gloves and clean hands as follows:

a. Carefully remove gloves by grasping the outside of one glove with the other gloved hand. Then with bare hand reach inside the second glove and remove it.

CAUTION

Do not touch the outside of gloves with bare hands at any time.

b. Thoroughly wash hands, being careful to clean under and around fingernails and in crevices, knuckles and wrists.

c. Survey hands using a thin-window Geiger counter. If there is any indication above background, rescrub hands until indication drops to background.

21. When cartridge replacement has been completed, a urine sample should be obtained from each person who took part in the replacement and sent to Tracerlab for Bioassay.

PROCEDURE FOR EVACUATING THE ENTIRE ACCELERATOR ASSEMBLY (INCLUDING ION PUMP)

CAUTION

It is possible for gaseous tritium to be released to the atmosphere during the process of evacuating the accelerator assembly. Prior to performing this operation, associated personnel must be thoroughly familiar with AEC Regulation 10 CFR 20. Appendix B of the AEC regulation lists the allowable concentration limit of tritium in air as of December 22, 1965, to be 2×10^{-7} microcuries per milliliter for unrestricted areas. A tritium monitor must be operated during accelerator assembly evacuating procedures or maintenance procedures on the neutron generator proper to insure that appropriate action will be taken should the tritium concentration exceed the allowable limit.

Target replacement should be undertaken only when the wind is greater than 5 miles per hour and blowing from the sector 180° to 225°.

A. Equipment

The following equipment should be available before proceeding.

1. Disposable gloves (polyethylene or equivalent nonpermeable material).
2. A gaseous tritium monitor with sufficient sensitivity to detect levels of concentration prescribed in AEC Regulation 10 CFR 20. Atomic Accessories Model TSM-91-c.
3. Safety glasses.
4. Liquid nitrogen.
5. A 3 inch square (or larger) polyethylene bag.
6. A covered container for radioactive waste.
7. A Nuclear Chicago 2612, thin window geiger counter.
8. A mechanical pump with cold trap and vacuum guage.
9. Kaman Sorption pump and vacuum guage.

B. Procedure

1. Turn off all power including ion pump.

2. Open outside stack lid.

3. Turn ventilating blower on and check if it is functioning properly.

4. Check if wind is in proper direction and over 5 miles per hour.

5. Put on gloves and glasses.

6. Place tritium monitor so its air inlet is near work area. Energize monitor and allow it to reach stable operating conditions.

7. Attach mechanical pump hose to accelerator roughing valve and attach pump vent to the exhaust manifold.

8. Start mechanical roughing pump and put liquid nitrogen in cold trap.

9. Open roughing valve and leave it open for about 45 minutes, accelerator assembly should be evacuated to 5 microns of mercury.

CAUTION

Monitor tritium concentration carefully to assure adequate warning of excessive gaseous tritium.

Monitor the wind direction and velocity to assure effluents, if any, are being dispersed in the right direction.

10. Close roughing valve.

11. Start ion pump. The ion pump current should increase to 300 - 400 ma before it starts decreasing. If after 10 minutes the current does not decrease, shut off ion pump and proceed with 13 below.

12. If ion pump current decreases, wait until it is less than 1 ma then move ion pump switch to "Protection."

13. Continue mechanical roughing pump until cold trap has warmed up to room temperature.

14. Shut off and disconnect mechanical roughing pump.

NOTE

If ion pump did not start to pump (11 above) proceed as follows:

15. Connect the completely enclosed, sealable Kaman Sorption pump to the roughing valve.

16. Fill sorption pump with liquid nitrogen.

17. Open check valve on sorption pump.

18. Open roughing valve on accelerator and allow the accelerator to be evacuated to about 5 microns of mercury.

19. Start ion pump. The ion pump current should go to a maximum of about 300 - 400 ma. Continue pumping with the sorption pump 15 minutes, pressure will go up to about 100 microns.

20. Shut off ion pump and allow sorption pump to evacuate the accelerator to 5 microns.

21. Repeat 19 and 20 until ion pump starts to pump. This will be indicated when the ion pump current drops rapidly from 300 - 400 ma to about 50 ma.

22. Shut off roughing valve, after ion pump starts pumping.

23. When ion pump current is less than 1 ma move ion pump switch to "Protection."

24. Close check valve on sorption pump and remove coupling hose from roughing valve.

25. Install protective cap over sorption pump assembly with safety wires in place.

26. After operations requiring Kaman Sorption pump, pump should be packed in accordance with AEC and FCC regulations for shipping radioactive materials and returned to Kaman Nuclear.

Inclosure 9

Form AEC-313 question 14

The Radiation Protection Program at the USAECOM laboratories is outlined in Memo Nr. 385-9 "Prevention and Control of Radiation Hazards," a copy of which is inclosed. In addition the following wipe test procedure is used.

Wipe Test Procedure:

Sealed radioactive sources are monitored for external contamination and/or leakage at intervals not exceeding 6 months, except alpha sources which are tested at intervals not exceeding 3 months. Each sealed source container must have a tag showing date of leak test, who performed it and result.

Each sealed source is wipe tested on all outside surfaces as well as the exposed surface of the capsule and capsule well.

Swipes are closely scanned with a thin window GM Tube Survey Meter. If reading is above background an accurate measurement is made using a counting system.

If result is greater than that permissable in Memorandum Nr. 385-9, it is immediately decontaminated to permissable levels or properly sealed and stored, pending disposal.

The Survey instrument used is a Nuclear-Chicago 2612 with 1.4 mg/cm^2 window or equivalent. Assay Counting system used is a Tracerlab TCC-1/1B83 2.6 mg/cm^2 and Nuclear Chicago Scaler Model 186 with a background count of 26 counts per minute.

Personnel authorized to make wipe tests are:

Mr. Charles Olsen

Mr. R. G. Rast

Mr. Basil Markow

Mr. Joseph Crotchfelt

Mr. Charles Pullen

Mr. Markow's and Mr. Rast's experience are included in inclosure 3 as members of the Isotope Committee. Mr. Olsen's, Mr. Crotchfelt's and Mr. Pullen's experience are as follows:

EXPERIENCE - Mr. Charles N. Olsen

Mr. Olsen spent 5 years with the Weapons Effects Section in the Surveillance Department of these Laboratories.

He participated in Operations Redwing, Buster Jangle, Plumbob, Hardtack and took part in radiation measurements, monitoring and recovery of instruments from fall-out areas often requiring full Radex.

He attended the Radiation Monitor School at the Nevada Test Site and was certified a RadSafe Monitor on several operations.

Since 1960 Mr. Olsen has been with the Radiation Facilities Group and has had experience in monitoring, calibration of radiation detection instruments, wipe testing and when necessary decontaminating.

EXPERIENCE - Mr. Joseph Crotchfelt

Mr. Crotchfelt has been working in the field of radiation measurement, handling and decontamination since 1956.

He originally received instruction on the principles and practices of radiation protection, radioactivity measurement and monitoring techniques and instruments, calculations basic to the use and measurement of radiation at the Pacific Proving Ground in 1956. Since then he has had additional instruction and experience on-the-job in these laboratories in radiation measurement, instrument calibration, wipe testing, and decontamination.

His experience in PPG and NTS include recovery, radiation measurement, decontamination and instrument calibration.

EXPERIENCE - Mr. Charles F. Pullen

1. Degree in Physics B.S. Monmouth College 1960.

2. Actively participated in Weapons Tests at Nevada Test Site. Operations: Upshot Knothole, Buster Jangle, Plumbob, Smallboy. Radiation measurements, monitoring and recovery of test equipment from fall-out areas.

3. He has worked on the design, fabrication and encapsulation of isotopes for calibration systems to the 200 curie level.

4. He participated in the research, design and development of radiation detection instruments, AN/PRD-39 ionization chamber survey meter, IM-71/pd, IM-70 and IM-108 radiacmeters.

5. He designed and fabricated an airplane landing device involving the use of a rotating radioactive source producing a vertical columated beam.

6. He has taken a course in Basic Radiological Health given by the Department of Health, Education and Welfare, Public Health Services.

7. He has had experience in monitoring, calibrating of radiation detection instruments, wipe testing and surveying.

Reference of ECOM Regulation 385-9 to AR 755-380 should be deleted and AR 755-15 should be inserted.

DISPOSITION FORM

(AR 340-15)

REFERENCE OR OFFICE SYMBOL	SUBJECT
AMSEL-RD-GX	Pen and Ink Change

TO: Ch, Admin Ofc
Bldg 2525

FROM: R&D Safety Ofc

DATE: 3 Jul 67

CMT: /JW/51250

1. DA has renumbered AR 755-380, "Disposal of Unwanted Radioactive Material," to AR 755-15, same title. Within our ECOMR 385-9, there is reference to this AR.

2. In order to comply with Atomic Energy Commission and DCSLog regulations, the following pen and ink changes within ECOMR 385-9 are requested:

a. Para 10, References, section (g): Change to read "AR 755-15, 'Disposal of Unwanted Radioactive Material.'"

b. Appendix I, para 5, Disposal, sections A and B, change AR 755-380 to read "AR 755-15."

James Ross
JAMES ROSS
2/Lt CmlC
Rad Prot Off

REPLACES DD FORM 96, EXISTING SUPPLIES OF WHICH WILL BE

103

HEADQUARTERS
UNITED STATES ARMY ELECTRONICS COMMAND
FORT MONMOUTH NEW JERSEY 07703

ECOM REGULATION
NUMBER 385-9

15 November 1966

SAFETY

PREVENTION AND CONTROL OF RADIATION HAZARDS

1. PURPOSE. This regulation prescribes procedures for the safe handling of radioisotopes and other sources of ionizing radiation, and for the prevention and control of ionizing radiation hazards, throughout all U. S. Army Electronics Command (ECOM) activities located at Fort Monmouth.

2. SCOPE. This regulation applies to all ECOM elements in the Fort Monmouth area that procure, produce, possess, use, or transfer radioactive materials and sources of ionizing radiation which require an Atomic Energy Commission (AEC) license or Deputy Chief of Staff for Logistics approval in accordance with AR 700-52 and AMCR 385-9, or which constitute a potential radiation hazard.

3. DEFINITIONS. Definitions and terms used herein are those appearing in the Code of Federal Regulations (CFR), title 10, chapter I, "Atomic Energy."

4. ECOM ISOTOPES AND IONIZING RADIATION COMMITTEE. This committee, hereafter referred to herein as the Isotopes Committee, has been established to advise the Commanding General, ECOM, on all matters pertaining to the use, procurement, and safe handling of radioisotopes and other ionizing radiation sources.

a. Membership. The Isotopes Committee consists of:

Director, Division S, Institute for Exploratory Research

Supervisor of Radiation Facilities, ECOM

Safety Director, ECOM

Radiological Protection Officer, ECOM

Executive Officer, Research and Development (R&D) Directorate

Chief, Logistics Division, R&D Directorate

Chief, Preventive Medicine

Representatives of user organizations as determined by the committee

The Chairman of the committee will forward a resumé of the background and experience of all members of the committee, and any changes to the background or membership, through the Safety Director, U. S. Army Materiel Command (AMC), to the AEC.

b. Responsibilities

(1) The responsibilities of the Isotopes Committee are:

(a) Provide advice and instructions on radiological hazards.

(b) Review applications for licenses to use, process, handle, or transfer radioactive materials or ionizing radiation producing machines.

(c) Evaluate, from safety standpoint, existing and proposed use of radioactive materials.

(d) Recommend supplementary rules and regulations pertaining to operating procedures in which radiological contamination and ionizing radiation offer potential hazards.

(2) When an infraction of the regulations or any practice involving a radiological hazard comes to the attention of any member of the committee, he will immediately report it to the Chairman, who will cause an investigation to be made without delay. The results of the investigation will be evaluated by the committee and appropriate recommendations will be made through the Chairman to the Commanding General, ECOM, with the least practicable delay. When the seriousness of the infraction warrants, the recommendation may be to institute disciplinary action.

c. Meetings. The Isotopes Committee will meet quarterly on special request of the Chairman, or as directed by the Commanding General, ECOM.

d. Chairman

(1) The Chairman of the Isotopes Committee will be selected by the committee from those members who have been determined to possess the proper qualifications. If no member of the committee has the necessary qualifications, the Chairman will be selected from personnel of the individual Laboratories or the Institute for Exploratory Research, and will be appointed to membership on the committee.

(2) The Chairman of the committee, working in cooperation with the Radiological Protection Officer; Chief, Preventive Medicine; Supervisor of Radiation Facilities; and Safety Director, ECOM, will:

(a) Provide overall coordination, advice, and assistance in the use, procurement, and safe handling of radioisotopes and ionizing radiation hazards.

(b) Review all plans for the proposed use of radioisotopes and other sources of ionizing radiation such as accelerators, x-rays, and the like, prior to submission to the Isotopes Committee.

(c) Sign, as certifying official, all Applications for By-Product Material Licenses (AEC Form 313).

(d) Within the purview of his responsibilities, sign nonmilitary correspondence and approve for signature military correspondence, in accordance with current regulations.

5. RADIOLOGICAL PROTECTION OFFICER

a. The Isotopes Committee will nominate the Radiological Protection Officer. He must have knowledge of and training in radiation safety and monitoring as well as some knowledge of nuclear radiation theory. He should be as far removed as possible from interests of the users of radiological material, and preferably be attached to the Safety Division, Installation and Services Directorate. Before an individual officially assumes the duties of the Radiological Protection Officer, a complete statement of his training and background in radiation must be submitted to the AEC for approval. When AEC approval is given, the individual nominated must then be designated Radiological Protection Officer by ECOM orders.

b. The responsibilities of the Radiological Protection Officer are:

(1) Prescribe special conditions and regulations as necessary for the protection of personnel from radiological hazards, including the distribution of applicable instructions.

(2) Report infractions of regulations to the Isotopes Committee for appropriate action.

(3) Personally investigate any radiological incident or accident and submit a written report to the Isotopes Committee.

(4) Ascertain that the users of isotopes and sources of ionizing radiation comply with the required safety regulations.

(5) Check the ECOM area for unauthorized use or location of radioisotopes.

(6) Grant permission for an individual in a restricted area to receive a whole-body dose greater than $1\frac{1}{4}$ rems provided that the dose

during any calendar quarter does not exceed 3 rems and meets the other requirements of CFR, title 10, chapter I, part 20.101.

(7) Sign, as certifying official, all AEC Forms 313.

(8) Maintain liaison with AMC; The Surgeon General's Office, Department of the Army; and other interested agencies in connection with established controls relative to radiological safety.

6. SUPERVISOR OF RADIATION FACILITIES

a. The Supervisor of Radiation Facilities will be designated on ECOM orders upon the recommendation of the Isotopes Committee. The recommendation will be based on the qualifications of the individual and, when possible, the selection will be made from the activity of the principal user of radiological material.

b. Responsibilities of the Supervisor of Radiation Facilities will be:

(1) Supervise decontamination of all areas, equipment, and personnel.

(2) Supervise the calibration of all instruments used for radiological safety.

(3) Provide general and emergency health physics functions and services, such as film badges, personnel dosimetry, and radiation surveying.

(4) Maintain records as required by The Surgeon General and the AEC.

(5) Maintain inventory controls for all radioactive materials in possession of using activities. Radioactive materials are considered expended when issued to operating activities. This action does not eliminate internal inventory and control as outlined above. Special protective containers marked "Returnable" are determined to be nonexpendable and will be handled in accordance with current operating instructions issued by the Logistics Division, R&D Directorate.

7. SAFETY DIRECTOR, ECOM. The Safety Director, ECOM, will render assistance and will advise on safety matters in carrying out the responsibilities for radiological safety.

8. POST SURGEON. The Post Surgeon will:

a. Be responsible for the medicinal aspects of radiation hazard control.

b. Perform routine annual physical examinations, including medical laboratory work as indicated, of individuals beginning work with or working regularly with ionizing radiations.

c. Perform additional physical examinations in cases of over-exposure or contamination accidents of a serious nature.

d. Advise the Isotopes Committee on medical aspects of the radiological safety program.

9. SUPERVISORS. Supervisors will insure that personnel inform and coordinate with the Supervisor of Radiation Facilities on all matters involving ionizing radiation, prior to the use of such material. (This coordination will in no way relieve the supervisor of the responsibility for strict control required by this regulation.)

10. REFERENCES

a. AR 40-14, "Control and Recording Procedures - Occupational Exposure to Ionizing Radiation"

b. AR 40-403, as changed, "Health Records"

c. AR 385-30, "Safety Color Code Markings and Signs"

d. AR 385-40, "Accident Reporting and Records"

e. AR 700-52, "Licensing and Control of Sources of Ionizing Radiation"

f. AR 700-323, as changed, "Safe Handling, Storage, and Transportation of the Radioactive Source Set M3"

g. AR 755-380, "Disposal of Unwanted Radioactive Material"

h. TA 50-914, "Individual Safety Protective Clothing and Equipment"

i. TM 38-230, as changed, "Preservation, Packaging, and Packing of Military Supplies and Equipment"

j. Code of Federal Regulations, title 10, chapter I, parts 20, 30, 40, and 70

k. National Bureau of Standards (NBS) Handbooks 42, 48, 49, 51, 52, 53, 54, 55, 56, 58, 59, 60, 61, 62, 63, 66, 69 (and revisions of or future NBS Handbooks pertaining to radiation)

l. Specification MIL-M-19590C, "Marking of Commodities and Containers to Indicate Radioactive Material"

m. AMCR 385-9, "Procedures to Obtain Authority to Possess, Use, and Transfer Radioactive Material"

Appendix I

PROCUREMENT, SHIPMENTS, TRANSFER, STORAGE, AND DISPOSAL OF RADIOACTIVE MATERIAL

1. PROCUREMENT

a. Requests for procurement of radioisotopes and ionizing radiation producing machines will be forwarded on DA Form 2496 (DF) (exempt report, para 39c, AR 335-15) to the Chairman of the Isotopes Committee, for review and submission to the committee for approval. AEC Form 313 will be used only by the Isotopes Committee to apply for licenses, amendments, and renewals, and will not be used for internal purposes.

b. The DF will include the following information:

(1) Description of proposal

(2) Area, building, and room in which material will be used

(3) Source(s) of ionizing radiation

(4) Type of operation

(5) Detailed procedure of work to be accomplished, including the following:

(a) General safety precautions, to be stated in the first portion of the procedure.

(b) Special safety precautions, to be stated at the point in which the procedure requires them.

(c) Tools, equipment, and instruments to be used.

(d) Protective equipment to be used.

(e) Disposal of materials, including:

1. Decontamination requirements

2. Storage (space to be required)

3. Waste disposal (type)

(6) Personnel involved

(7) A statement as to whether trial runs will be made. Trial runs will be required when new personnel are involved or when there are any changes in procedure. Trial runs will be conducted without the use of radioactive material.

c. All purchasing documents resulting from requests for procurement which have been approved by the Isotopes Committee will be certified by the Radiological Protection Officer.

2. SHIPMENTS

a. Incoming

(1) Immediately upon receipt of radioactive material, the activity Supply Officer, before opening the container, will notify the Radiological Protection Officer.

(2) The shipment will be promptly monitored and logged in by a trained monitor.

(3) The radioactive material will then be delivered to the user or stored in a radioisotope storage vault, as circumstances warrant.

b. Outgoing

(1) Radioactive material to be shipped out will be monitored and logged in by the Radiological Protection Officer before and after packaging.

(2) The outgoing shipment will be packaged and labeled to conform with Interstate Commerce Commission regulations as well as those of The Surgeon General, AEC, Navy Ships Systems Command, and Chemical Corps.

(3) Shipments will be cleared with the Accountable Property Officer.

c. Hand-Carried. No radioactive materials will be hand-carried into or out of this command in greater than trace amounts. Trace amounts are defined as amounts of byproduct material whose concentration is not in excess of that listed in CFR, title 10, chapter I, part 30.70, or whose total activity is not in excess of that listed in CFR, title 10, chapter I, part 31.100.

3. TRANSFER

a. Before any radioactive material is transferred from one location to another, the Radiological Protection Officer will be notified so that the location can be surveyed and proper authority obtained for the move.

b. Radioactive materials will not be transferred from one use to another without proper authorization from the Chairman of the Isotopes Committee.

4. STORAGE

a. Permanent. There is an approved radioisotope storage vault, Bldg T-383, Evans Area. This facility is available to isotope users, subject to space limitations. Other permanent storage locations may be approved by the Isotopes Committee.

b. Temporary. Every individual user of radioactive material stored in a temporary location is directly responsible for the manner in which it is stored. Barriers and radiation warning signs stating the type and amount of radiation must surround the area so that access to all points where the intensity is greater than 2 mrem/hr is properly restricted.

5. DISPOSAL

a. Disposal of radioactive waste will be made under the direct supervision of the Supervisor of Radiation Facilities in accordance with AR 755-380.

b. Radioactive wastes will be collected and stored in Bldg T-383, Evans Area. When a sufficient amount is collected it will be disposed of in accordance with AR 755-380.

6. RECORDS. A record of the receipt, location, and use of all radioactive material will be maintained by the Supervisor of Radiation Facilities as long as the material remains in ECOM; this record will be placed in inactive files after final disposal of accountable material. The disposition for inactive files will be: COFF end of calendar year; transferred RHA after 1 year; retired to USARC after 2 years, for permanent retention.

RADIOLOGICAL HAZARDS

1. CATEGORIES OF RADIATION HAZARDS. Radiation hazards fall into the following two broad categories:

a. External Radiation: Radiation from sources outside the body. These sources may be radioactive materials emitting gamma rays, beta particles, or neutrons, or they may be machines producing radiation, such as x-rays. Since the body penetration by alpha particles is insignificant, such particles are not considered an external hazard. External radiation causes body damage due to tissue penetration.

b. Internal Radiation: Radiation from sources within the body.

(1) This hazard is created by ingestion, by inhalation, or through skin wounds and deposition of radioactive material in the body organs. While alpha particles are not considered an external hazard, the internal hazard of these particles is extreme and they are considered to be 20 times as hazardous as beta-gamma radiation.

(2) Classification of Isotopes. The degree of the hazard resulting from exposure to an isotope is dependent upon its action in the human body. To ascertain the extent of the possible hazard, representative isotopes are divided into three groups as follows:

(a) Group I - Slight Hazard

Na^{24}, K^{42}, Cu^{64}, Mn^{52}, As^{76}, As^{77}, Kr^{85}, Hg^{197}

(b) Group II - Moderately Dangerous

C^{14}, P^{32}, Na^{22}, S^{35}, Cl^{36}, Mn^{54}, Fe^{59}, Co^{60}, Sr^{89}, Cb^{95}, Ru^{103}, Ru^{106}, Te^{127}, Te^{129}, I^{131}, Cs^{137}, Ba^{140}, La^{140}, Ce^{141}, Pr^{143}, Nd^{147}, Au^{198}, Au^{199}, Hg^{203}, Hg^{205}

(c) Group III - Very Dangerous

H^3, Ca^{45}, Fe^{55}, Sr^{90}, Y^{91}, Zr^{95}, Ce^{144}, Pm^{147}, Bi^{210}

Isotopes not listed should be classed according to their biologic half-lives, energy of radiation, and action in the human body. If the action with the human body is not known with reasonable certainty, the isotope should be classed according to the best determination which can be made and assigned to a group classification which will provide an appropriate margin of safety.

(3) Hazardous exposure should be considered a definite possibility when the following amounts, for the applicable group of isotopes, are involved in any physical disappearance, alleged theft, accident, fire, or other incident:

Group I - 500 millicuries

Group II - 50 millicuries

Group III - 5 millicuries

2. MISCELLANEOUS SOURCES

a. In addition to the common sources of radiation, such as radioisotopes and ionizing radiation producing machines, there are sources which might be classed as miscellaneous; these include:

(1) Self-Luminous Markers. These items contain Radium-226 and present an external radiation hazard due to beta-gamma, and a serious internal hazard due to the emission of Radon-222, an inert gas.

(2) Compasses. Dials are self-illuminated by radium compounds.

(3) Transits (Night-Illuminated). Leveling vials and sights are coated with radium compounds.

(4) Metascopes. The modified type marked with an "S" contains Strontium-90, a bone seeker when ingested. A few older types contain radium.

(5) Static Eliminators. These devices usually contain Polonium-210, one of the most hazardous of radioactive materials when deposited within the body.

(6) Alphairon Vacuum Gages. Contain Radium-226 which is not hermetically sealed, thus creating a radon hazard in small confined areas. The radiation at the surface of these gages may be 100 mrem/hr.

(7) Electron Tubes. Some special types of tubes contain such radioisotopes as Radium-226, Cobalt-60, Carbon-14, or Cesium-137. Broken tubes may create serious internal hazards.

(8) X-Rays from High Voltage Tubes. Certain tubes, such as hydrogen thyratrons, emit x-rays as a by-product when operated at high voltage. The rate may be as high as 10,000 to 15,000 mrem/hr. Examples: No. 1257, 5948/1754, and 5549/1907.

b. In case of any doubt concerning possibilities of radiation hazards, the Radiological Protection Officer should be requested to make a radiological survey.

NOTE: Radium-activated markers have been condemned. Most have been removed from the supply system and disposed of as radioactive waste. The known existence of any such markers should be reported and disposal procedure taken. Transits and metascopes should also be reported, as should all broken or unserviceable compasses.

Appendix III

MAXIMUM PERMISSIBLE DOSES

1. Except as provided in paragraph 2, no individual in a restricted area will be allowed to receive in any period of a calendar quarter, a dose from radioactive material and other sources of radiation in excess of the following:

a. Whole body; head and trunk; active blood-forming organs; lens of eyes; or gonads: 1¼ rem

b. Hands and forearms; feet and ankles: 18-3/4 rem

c. Skin of whole body: 7½ rem

d. Minors (individuals under 18 years): 10 percent of a, b, or c above

2. An individual may be allowed to receive a dose to the whole body greater than that indicated in paragraph 1, provided:

a. During any calendar quarter his whole-body dose does not exceed 3 rems.

b. The dose to the whole body, added to the accumulated occupational dose to the whole body, does not exceed:

$$5 (N - 18) \text{ rems}$$

Where N is the individual's age in years at his last birthday.

c. The individual's accumulated occupational dose to the whole body has been determined on AEC Form 4 or on a clear legible record containing all the information required by that form, and has otherwise complied with the requirements of CFR, title 10, chapter I, part 20.102.

d. Approval is granted by the Radiological Protection Officer.

3. Except as authorized by the AEC, radiation levels in unrestricted areas will be such that:

a. If an individual were continuously present in the area, he could not receive a dose in excess of 2 mrem in any 1 hour.

b. If an individual were continuously present in the area, he could not receive a dose in excess of 100 mrem in any 7 consecutive days.

Appendix IV

MAXIMUM PERMISSIBLE CONTAMINATION LEVELS

1. Contamination of personnel and equipment will be kept to the absolute minimum. Wipe tests of surfaces of equipment and worktables will not be allowed to show any detectable alpha, beta, or gamma activity. Radiation levels caused by combined beta-gamma contamination will not exceed twice the normal background level.

2. For body surfaces, decontamination will be carried out when any detectable radioactivity is found and will be continued until background levels are reached.

3. Exceptions to the above will be certain hoods, dry boxes, protective clothing, and other equipment located in areas specifically designated as "hot areas".

4. Air contamination will not exceed the following levels per milliliter of air:

a. For alpha emitters: 5×10^{-12} microcuries.

b. For beta or gamma emitters: 10^{-9} microcuries.

5. Waste water contamination will not exceed 10^{-7} microcuries per milliliter for combined alpha, beta, and gamma emitters, at the outlet of the waste disposal plant. For Evans Area, in which radiochemical operations are conducted, the maximum discharge of combined alpha, beta, and gamma emitters from the high-level radiochemical laboratory will not exceed 20 microcuries per day. This is based upon dilution with a minimum discharge of 50,000 gallons of waste water per day from Evans Area.

6. Wipe tests of sealed sources will assay at less than .005 microcurie or as specified in CFR, title 10, chapter I, part 20.

PERSONNEL PROTECTION

1. FILM BADGES. Each individual who enters a restricted area under such circumstances that he receives, or is likely to receive, a dose in any calendar quarter in excess of the following will wear a film badge:

a. Over 18 years of age:

300 mrem - total body

4,700 mrem - hands or feet

1,800 mrem - skin of whole body

b. 18 years of age or under:

60 mrem - total body

940 mrem - hands or feet

360 mrem - skin of whole body

Film badges must be worn only by the individual to whom they are assigned, and, when not on the person, will be stored only in an area known to be free of radiation. Supervisors will request film badges from the Supervisor of Radiation Facilities.

2. POCKET DOSIMETERS. When the anticipated level is high enough to make it possible to receive 100 mrem total body radiation in 1 day, pocket dosimeters (quartz fiber) will be utilized as well as film badges. The pocket dosimeters must be checked to see that the quarterly tolerance is not exceeded except by written permission of the Radiological Protection Officer.

3. SURVEY METERS. When the anticipated level is unknown, involves alpha and beta, or is likely to be over 100 mrem per hour, a survey meter will be used to make certain that the quarterly tolerance is not exceeded except by written permission of the Radiological Protection Officer.

4. DOSIMETRY RECORDS

a. Dosimetry records will be maintained in accordance with AR 40-14.

b. All entries in the column marked "Dose" on DD Form 1141 (Record of Occupational Exposure to Ionizing Radiation) will be in rems. When applicable and available, the "relative biological effectiveness (RBE)" will also be noted.

c. When an entry in the "Dose" column is greater than 1.25 rems in a calendar quarter, a brief explanation of the probable cause of over-exposure will be attached, whether or not the badge was worn.

d. Dosimetry records are maintained by the Army Federal Civilian Employee Health Service, Patterson Army Hospital.

5. URINE COLLECTION AND HANDLING

a. When there is reason to believe that an individual has been internally contaminated with radioactive material, a 24-hour urine sample will be initiated as soon as possible. A 24-hour urine sample is defined as follows:

All urine voided in a 24-hour period will be considered a 24-hour sample. For example, if urine is voided at 0800 hours and discarded, then the sample will consist of all urine voided and collected from that time up to and including 0800 hours the following day.

b. Samples will be collected in polyethylene bottles (preferably $2\frac{1}{2}$ liters), appropriately identified as to name of individual and inclusive dates of sampling. The average amount of urine excreted per individual per day is 1.5 liters. It is recommended that a number of bottles be stocked by activities using radioisotopes, to cover an emergency, based on the average number of individuals involved in any one operation involving the use of isotopes. Benzoic acid will be used as a preservative in the ratio of 1 gram of benzoic acid per liter of urine.

c. A 3- by 5-inch index card or tag will be attached to the bottle with the following information:

(1) Front of card:

Name, grade, and employee number/service number

Date of incident

Inclusive dates of collection

Suspected isotopes

(2) Reverse of card:

"A 24-hour urine sample will be collected as follows:

(a) Wash hands before collecting a portion of the sample.

(b) Void urine at 0800 hours (or any other convenient time) and discard it. Do not collect it in the bottle.

(c) Collect all urine from that time up to and including the corresponding hour the following day. ALL URINE MUST BE COLLECTED; LOSS OF A SIGNIFICANT AMOUNT MAY RENDER THE SAMPLE USELESS."

d. Samples will be held by the Post Surgeon pending disposition instructions from The Surgeon General. When so directed, samples will be forwarded by the most expeditious means as follows:

THRU: Commanding General
Walter Reed Army Medical Center
Washington, D. C. 20012

TO: Director
Walter Reed Army Institute of Research
Walter Reed Army Medical Center
ATTN: Department of Biophysics

Appendix VI

CONTAMINATION AND DECONTAMINATION

1. Contamination of personnel, areas, and equipment should be kept to a minimum by working with unsealed sources of radiation only in the Hot Laboratory, Bldg 45, Evans Area. In that laboratory the following precautions should be taken:

a. Wear protective clothing, such as lab coats, coveralls, rubber gloves, booties, etc.

b. Wear masks or respirators if inhalation hazards are present.

c. Wear dosimeters and film badges.

d. Monitor areas, personnel, and equipment before, during, and after operations.

e. Use handling tools.

f. Label and tag radioactive material used in experiments with complete information, such as date, experiments, materials involved, level of activity, special precautions, etc.

g. Post work areas with appropriate warning signs, and mark contaminated areas.

h. Take care to prevent any material from entering the mouth from hands, pipettes, or other means. Smoking, drinking, and eating are prohibited in all radiation areas where possibility of contamination exists. Pipetting by mouth is prohibited.

i. Prevent contamination from being taken from or escaping from any radiation area.

j. Use proper instrumentation for radiation measurement and detection.

k. Keep contaminated clothing and equipment in marked containers in radiation area until proper disposition can be made.

l. In general, "Good Housekeeping Rules" and common sense precautions will greatly decrease occurrence of contamination.

2. DECONTAMINATION

a. Decontamination procedures will depend upon the type and degree of contamination and the material contaminated. In minor spills the person using the radioisotope will confine the contamination of liquids by means of absorbent paper, etc., and of dry material by wetting and absorption by paper or other safe method. It is most important that the user be familiar not only with all rules and regulations concerning the handling of radioactive materials, but also with the immediate-action steps to be taken in cases of serious contamination. These steps apply not only to confining and removing the contamination, but also include action which will protect the user and all other personnel.

b. In case of serious contamination, the person involved should insure that the Radiological Protection Officer and the Supervisor of Radiation Facilities are notified immediately. The Radiological Protection Officer will determine what is required as pertains to the health and safety aspects of the situation and will call for medical aid. The Supervisor of Radiation Facilities will take charge of the contaminated area and decontaminate it to decrease hazards to other personnel.

Appendix VII

EMERGENCY PROCEDURES

1. GENERAL RULE. It is impossible to list a set of rules to cover the range of situations which might occur due to accidents involving radioactivity; however, this rule will always apply: "ALL CASES INVOLVING ACTUAL OR SUSPECTED PERSONNEL INJURY WILL IMMEDIATELY BE REPORTED TO THE RADIOLOGICAL PROTECTION OFFICER." This rule also covers:

a. Accidental overexposure to external radiation

b. Ingestion or inhalation of radioactive material

c. Wounds (including slight scratches)

2. SPECIFIC PROCEDURES FOR ACCIDENTAL SPILLS. The following procedures will apply in emergency conditions involving accidental spills:

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a. Spills Involving no Immediate Radiation Hazard to Personnel

(1) Notify immediately all other persons in the room.

(2) Permit in the area only the minimum number of persons necessary to deal with the spill.

(3) Confine the spill immediately.

b. Accidental spills may be:

(1) Liquid spills. In such case:

(a) Don protective gloves.

(b) Drop absorbent paper on spills.

(2) Dry spills. In such case:

(a) Don protective gloves.

(b) Dampen the spill thoroughly, taking care not to spread the contamination (water may generally be used except where chemical reaction with the water would generate an air contaminant; in such case, oil should be used).

(c) Notify the Supervisor of Radiation Facilities as soon as possible.

(d) Decontaminate.

c. Spills Involving Radiation Hazard to Personnel

(1) Notify all persons not involved in the spill to vacate the room at once.

(2) If the spill is liquid, and the hands are protected, right the container.

(3) If the spill is on the skin, flush thoroughly.

(4) If the spill is on clothing, discard outer or protective clothing at once.

(5) Vacate the room.

(6) Notify the Radiological Protection Officer, Supervisor of Radiation Facilities, and responsible safety representative as soon as possible.

3. SPECIFIC PROCEDURES FOR ACCIDENTS INVOLVING RADIOACTIVE DUST, MISTS, FUMES, ORGANIC VAPORS, AND GASES

a. All persons will vacate the room immediately.

b. Turn off all air circulating devices, hoods, etc., by turning off electrical power to building (emergency disconnect switch or main switch to building).

c. Notify the Radiological Protection Officer and Supervisor of Radiation Facilities at once. Notify the responsible safety representative as soon thereafter as possible.

d. Ascertain that all doors giving access to the room are closed, and post conspicuous warnings or guards to prevent accidental opening of doors.

e. If probability of ingestion exists, immediately notify by electrically transmitted message, The Surgeon General, ATTN: MEDCE-OH, Department of the Army, Washington, D. C. If any of the isotopes is in group III (see Radiological Hazards, appendix II), notify The Surgeon General by telephone since treatment should be given within 24 hours. Notification should include:

(1) Time and date of incident

(2) Strength of source, element, chemical and physical form

(3) Number of individuals suspected of suffering overexposure or contamination, whether treated, and how

(4) Extent of contamination as determined by immediate monitoring

f. Prepare DA Form 285 (Accident Report) (RCS CSGPA-147(R3)) in compliance with AR 385-40 and submit to the responsible safety representative in accordance with ECOMR 385-2.

4. SPECIFIC PROCEDURES FOR INJURIES TO PERSONNEL INVOLVING RADIATION HAZARDS

a. Notify Radiological Protection Officer at once, and the responsible safety representative as soon thereafter as possible.

b. Wash minor wounds immediately, under running water, while spreading the edges of the gash. Radioactive materials may be rapidly absorbed into the system from wounds. Do not use oil or solvents since these increase skin absorption.

c. Permit no person involved in a radiation injury to return to work without approval of the Post Surgeon.

5. RESPONSIBILITY IN ACCIDENT CASES. If radiation injury is known or suspected, or is involved in any fashion, the Radiological Protection Officer will initiate an investigation and prepare a complete case report, to be submitted to the Isotopes Committee for review and approval. The report will include:

a. Readings of dosimetry devices worn by or placed near the person at time he was injured.

b. Monitoring report. This report will establish the cause of inadvertent exposure and will indicate evidence of carelessness, defective shielding, or defective technique.

c. A pertinent medical report.

This report has been determined by the ECOM RCO to be exempt under the provisions of paragraph 39u, AR 335-15.

6. RECORDS. The supervisor will prepare DA Form 285 and a complete history of the event and subsequent activity related thereto, for transmittal to the Safety Director, ECOM. A copy of the form and history will be forwarded to the Isotopes Committee.

7. FIRES. It is not practicable to delay fire-fighting operations while hazards are surveyed; therefore, during fire-fighting operations in any radioactive area, hazards from radiation and air contamination will be considered as existing and all necessary precautions will be taken. The Supervisor of Radiation Facilities will keep the Fire Marshal informed as to location, amounts, and types of radioactive material.

8. NOTIFICATIONS OF INCIDENTS

a. Based on the nature of the incident, the following will be notified as indicated in b through d below:

(1) Manager
New York Operations Office, AEC
376 Hudson Street
New York, New York 10014

(2) The Surgeon General
ATTN: MEDCE-OH
Department of the Army
Washington, D. C. 20315

b. Immediately. By telephone and electrically transmitted message, of any incident involving byproduct, source, or special nuclear material which may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 25 rems or more of radiation; exposure of the skin of the whole body to 150 rems or more; or exposure of the feet, ankles, hands, or forearms to 375 rems or more.

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 5,000 times the limits specified for such materials in CFR, title 10, chapter I, part 20, appendix B, table II.

(3) A loss of 1 working week or more of the operation of any facilities affected.

(4) Damage to property in excess of $100,000.

c. <u>24-Hour Notification</u>. By telephone and electrically transmitted message, of any incident involving licensed material which may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 5 rems or more of radiation; exposure of the skin of the whole body to 30 rems or more; or exposure of the feet, ankles, hands, or forearms to 75 rems or more.

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 500 times the limits specified in CFR, title 10, chapter I, part 20, appendix B, table II.

(3) A loss of 1 day or more of the operation of any facilities affected.

(4) Damage to property in excess of $1,000.

d. <u>30-Day Notification</u>. In writing, of any exposure of an individual to radiation or concentrations of radioactive material in excess of any applicable limit in CFR, title 10, chapter I, part 20, or of the ECOM isotope license; or any levels of radiation or concentrations of radioactive material (not necessarily involving overexposure of individuals) in an unrestricted area in excess of 10 times the limit set forth in CFR, title 10, chapter I, part 20; applicable Army Regulations; or the ECOM isotope license.

e. Any time it is necessary to notify the AEC or The Surgeon General, the individuals receiving the overexposure will also be notified in writing. The letter to the individual will contain the following paragraph:

"This report is furnished to you under the provisions of the Atomic Energy Commission regulations entitled 'Standards of Protection Against Radiation' (CFR, title 10, chapter I, part 20). You should preserve this report for future reference."

9. <u>WHOM TO CALL IN EMERGENCY</u>. In all locations where individuals may come in contact with radioactive materials or are likely to be exposed to radiation, AEC Form 3 will be prominently displayed, together with the office and home telephone numbers of the following:

a. Radiological Protection Officer

b. Supervisor of Radiation Facilities

c. Safety Director, ECOM

(AMSEL-IS)

FOR THE COMMANDER:

OFFICIAL:

WARREN R. KING
Colonel, GS
Chief of Staff

WILLIS E. JOHNSON
Major, AGC
Chief, Administrative Office

DISTRIBUTION:
C plus

Dir of R&D	25
Dir of P&P	10
Safety Director, ECOM	100
Adjutant, USAESC	2

Inclosure 10

Form AEC-313 question 15

Disposal of radioactive waste is accomplished in accordance with AR 755-15 a copy of which is included.

96856

ARMY REGULATION
No. 755-15

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *4 November 1966*

DISPOSAL OF SUPPLIES AND EQUIPMENT

DISPOSAL OF UNWANTED RADIOACTIVE MATERIAL

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Section I. GENERAL

1. Purpose. This regulation establishes responsibility and provides policy and instructions for the storage shipment, and disposal of unwanted radioactive material.

2. Scope. This regulation has Army-wide application, but does not apply to combat areas.

3. Definitions. For the purpose of this regulation, the following definitions apply:

a. Accumulating organization. Any Army activity, other than radioactive material disposal facility, which generates, accumulates, and/or stores unwanted radioactive material.

b. Local storage. Storage of unwanted radioactive material, on temporary basis only, at places other than the Army radioactive material disposal facility.

c. Army radioactive material disposal facility. A facility which receives unwanted radioactive material from accumulating organizations and which also stores, concentrates, packages, marks, labels, ships, and effects the ultimate disposal of this material.

d. Radioactive material. Any material or combination of materials that spontaneously emit ionizing radiation.

(1) *Radioisotope.* Any isotope which is radioactive.

(2) *Byproduct material.* Any material, except special nuclear material, which has become radioactive by exposure to the radiation incident to or which is yielded during the process of producing or utilizing special nuclear material. Cobalt-60 and strontium-90 are examples of byproduct material.

*This regulation supersedes AR 755-380, 10 April 1962.

(3) *Special nuclear material.* Plutonium, uranium-233, uranium enriched with the isotopes 233 or 235, and any other material which the U.S. Atomic Energy Commission determines to be special nuclear material, or any material artificially enriched with any of the aforementioned.

(4) *Source material.* Any material, except special nuclear material, which contains by weight one twentieth of one percent (0.05%) or more of uranium, or thorium, or any combination thereof.

(5) *SS material.* Collective term for both source and special nuclear material. Source and special material includes plutonium, thorium, uranium-233, uranium-235, and uranium-238. In addition, whenever deuterium, tritium, enriched lithium or compounds of these materials are employed in special weapons applications, they are considered to be source and special material and must be controlled and accounted for as such.

(*a*) *Collectible amounts of source and special material.* Tuballoy oxide oralloy, plutonium oxides or mixtures of oralloy and tuballoy oxides that can be separated from those materials with which they were picked up or collected.

(*b*) *Returnable amounts of source and special material.* Those amounts of source and special nuclear materials that are to be returned automatically to the nearest national stockpile site or operational storage site without specific authority of Commander, Field Command, Defense Atomic Support Agency (FC/DASA). The following amounts are considered minimum returnable quantities:

1. Any part made of tuballoy, oralloy, or plutonium which has not lost its identity even though it may be severely damaged.

2. Any piece of tuballoy, even though its identity as a part is no longer recognizable, which weighs 100 grams or more. This amount corresponds to a square of metal 1 inch on a side, approximately 5/16 of an inch thick.

3. Any collectible amounts of tuballoy oxide in quantities of 1000 grams (a volume of approximately 42 cubic inches or 2.75 cupfuls) or more.

4. Any piece of oralloy or plutonium metal which weighs 1.0 gram or more, even though its identity as a part is no longer recognizable. This amount corresponds to a bit of metal 1/4 inch by 1/4 inch by 1/16 inch (0.64 cm X 0.64 cm X 0.16 cm).

5. Any collectible amounts of oralloy or plutonium oxides or mixture of oralloy and tuballoy oxides, in quantities of 1 gram or more.

e. Disposal of radioactive material. The act of getting rid of unwanted radioactive material under proper authority. Disposal may be accomplished by removal from man's immediate habitat or by transfer, donation, or sale to persons authorized to receive it under AR 700-52.

f. Ultimate disposal. Ultimate disposal includes burial in the sea or land which removes the radioactive material from man's immediate habitat. It also includes incineration, release into sanitary sewerage systems, and dispersal into air or water under carefully controlled conditions. It does not include action taken to return source and special nuclear material to FC/DASA or the U.S. Atomic Energy Commission (AEC) for reprocessing.

g. Radioactive waste. Excess and surplus unwanted radioactive material and material contaminated with radioisotopes, including source and special waste as defined in *h* below, special weapons radioactive waste and radioactive waste associated with the production, possession, and use of radioactive material. Radioactive waste will include property which, while originally nonradioactive, has become contaminated to such an extent that it is economically unsound to decontaminate or the contamination cannot be reduced to an acceptable level for its intended use.

h. Source and special nuclear waste. Source and special nuclear residues which cannot be economically separated from those materials which have been contaminated.

i. Radiation controlled area. Any area, access into which is controlled for the purposes of protection of personnel from exposure to radiation or to radioactive materials.

4. Responsibilities. *a. Commanding General, U.S. Army Materiel Command.* The Commanding General, U.S. Army Materiel Command, is responsible for—

(1) Formulating policies, procedures, and methods for disposal of unwanted radioactive materials.

(2) Establishing Army radioactive material disposal facilities in CONUS.

(3) Conducting research and development programs to provide improved methods, techniques, and hardware for the disposal of unwanted radioactive material.

(4) Designing and developing specifications for special containers for radioactive waste, and producing such containers when a requirement is established.

(5) Providing technical assistance with regard to special radiological disposal problems.

(6) Providing technical advice for the establishment and operation of Army radioactive material disposal facilities overseas.

(7) Providing qualified technical escort personnel to accompany shipments of unwanted radioactive material when requested.

(8) Conducting an annual command inspection of the Army radioactive material disposal facilities located within CONUS.

b. The Surgeon General. The Surgeon General is responsible for providing advice, guidance, and medical assistance on the health hazards associated with and resulting from the disposal of unwanted radioactive materials. Requests for medical advice and assistance will be forwarded through command channels to The Surgeon General, ATTN: MEDPS-PE, Department of the Army, Washington, D.C. 20315.

c. Director of Transportation, ODCSLOG.

(1) The Director of Transportation, ODCSLOG, is responsible for—

(*a*) Providing staff supervision and policy guidance for transportation, movement, and related safety during transport of radioactive and fissile materials other than weapons.

(*b*) Reviewing designs, specifications, and test reports of shipping containers for unwanted radioactive and fissile materials.

(*c*) Providing the means for securing special permits from applicable Federal regulatory agencies.

(2) The above applies to the safe movement of radioactive and fissile materials other than weapons by the Army, within CONUS, and between CONUS, Alaska, Hawaii, and U.S. territories.

d. Oversea commanders. Major oversea commanders are responsible for the following:

(1) The establishment of oversea radioactive material disposal facilities as required. (*Exception:* Commander, U.S. Army Forces, Southern Command.)

(2) Operation of the radioactive material disposal facility in strict accordance with policies, procedures, and methods established by the Commanding General, U.S. Army Materiel Command, and published in pertinent DA directives, including technical manuals. (*Exception:* Commander, U.S. Army Forces, Southern Command.)

(3) The establishment of qualified escort of unwanted radioactive material shipments within the oversea theater as may be required.

(4) Safe transportation of unwanted radioactive materials. In oversea areas, Army commanders will be guided by this regulation and AR 55-55, except where sovereign states have requirements which differ from those contained in this regulation. In such cases, Army commanders will observe the more restrictive requirements of either regulation.

(5) Preparation of administrative procedures consistent with this regulation.

(6) Conducting an annual command inspection of the Army radioactive material disposal facilities located within their respective commands.

e. Local commanders. Commanders of organizations, units, and activities which generate and/or accumulate disposable radioactive waste and materials will—

(1) Insure that, in the case of property which is contaminated with radioactive

material, all possible efforts are made to decontaminate the items before taking disposal action. In the event it is economically unsound to decontaminate the property or if the contamination cannot be reduced to a safe level, the contaminated property will be treated as radioactive waste. Decontamination procedures and techniques are contained in TM 3-220.

(2) Provide for the local storage, the preparation for shipment, and subsequent shipment of radioactive material to the appropriate radioactive material disposal facility.

(3) Maintain an SOP to cover these activities at all times. Additional guidance is furnished in TM 3-261.

f. The Inspector General. The Inspector General, Headquarters, Department of the Army will be responsible for conducting inspections of all radioactive material disposal facilities. The Inspector General will assume this responsibility on 1 July 1967.

5. **Implementation.** Commanding Generals of U.S. Army Materiel Command; U.S. Continental Army Command; U.S. Army Combat Developments Command; U.S. Army Air Defense Command; U.S. Army Security Agency; U.S. Army Strategic Communications Command; U.S. Army Intelligence Command; U.S. Army Forces, Strike Command, the major oversea commands, the heads of Department of the Army staff agencies, the Commander, Military Traffic Management and Terminal Service, and Superintendent, U.S. Army Military Academy will issue instructions implementing this regulation. As a minimum, the implementing instructions will designate channels for requests for radioactive materials disposal assistance.

6. **Security.** *a.* The security plan for disposal of unwanted radioactive material will be prepared by the command, activity, or project manager responsible for the material. The security plan for disposal will be incorporated into the technical literature for the item. The plan will provide the continuity of security protection for the radioactive material which is commensurate with the level of security classification involved, and will provide procedures for declassification.

b. Activities preparing to ship classified radioactive material will alert the consignee, in advance of shipment, of the security classification involved and the procedures for declassification after receipt.

c. Areas in CONUS in which unwanted radioactive material is stored, either temporarily pending shipment, in a consolidation storage area, or in an ultimate land disposal area, will be designated, posted, and protected as Restricted Areas, in accordance with AR 380-20. Physical safeguards which are appropriate to the degree of hazard or security classification involved will be employed, as described in AR 380-20. Commanders outside CONUS will use the provisions of AR 380-20 as guidance in the establishment of area protection and physical safeguards for radioactive material in storage.

7. **Budgeting and funding.** *a.* The disposal of unwanted radioactive material will be budgeted and reported under account 2290.2, in accordance with AR 37-1. Functions include handling, processing, packaging, escort service, transportation of unwanted radioactive material for shipment to radioactive disposal facilities. All costs for the above functions will be financed by the shipping installation or activity. Costs for ultimate disposal will be borne by the command operating the radioactive material disposal facility.

b. Oversea commanders are responsible for budgeting and funding for all costs incurred in processing, shipment, and ultimate disposal overseas or return to CONUS Army radioactive material disposal facilities, including technical escort but excluding ocean transportation costs which are initially financed by the Military Sea Transportation Service and which will be budgeted and funded by the ODCSLOG, Director of Transportation.

8. **Support of equipment.** Each commander responsible for the procurement and issue of items of equipment which contain radioactive materials will insure that the specifications and technical literature for the item contain information as to the quantity and type of radioactive material contained and procedures for safe handling, storing, and disposal of these items.

9. **Special problems.** Special radioactive material disposal problems requiring logistical assistance will be directed to the Commanding General, U.S. Army Materiel Command, ATTN: AMCMA-DA, Washington, D.C. 20315. Radioactive material disposal problems involving licensing regulations, decontamination, and/or radiological safety will be routed to Commanding General, U.S. Army Materiel Command, ATTN: AMCAD-S.

Section II. ACTION BY ORGANIZATIONS HAVING UNWANTED RADIOACTIVE MATERIAL

10. Holding action. Activities generating or accumulating radioactive material, including waste, will place such material in a secure local storage area pending shipment to a radioactive material disposal facility. It is more economical to process large quantities of radioactive material for ultimate disposal than to process small quantities. Therefore, installations which have radiological protection officers (AR 40-14) and which are able to store and safely consolidate radioactive material intended for ultimate disposal are encouraged to consolidate their waste before requesting shipping instructions. Additional guidance is furnished in TM 3-261.

11. Local storage. *a.* A radiation controlled area will be established to store accumulated radioactive material on a temporary basis. This area will be posted according to AR 385-30 to restrict entry and adequate security must be provided to prevent unauthorized access into and/or removal of the radioactive material. Until such time as the material is received by the radioactive material disposal facility, radiation safety associated with the material will be the responsibility of the Army element which was authorized to use the material under an AEC license or Department of the Army radioactive material authorization issued in accordance with AR 700-52.

b. Where practicable, material will be segregated as follows:

(1) Combustible.
- (*a*) Liquid.
- (*b*) Solid.
- (*c*) Gases.

(2) Noncombustible.
- (*a*) Liquid.
- (*b*) Solid.
- (*c*) Gases.

c. Materials will be stored in covered containers. Each container having radioactive materials stored therein will display a DA Label 15 (Caution: Radioactive Materials) and, if applicable, a radioactive waste container log. The following information, if unclassified, will be shown on DA Label 15 or on the log:

(1) Radiation symbol and words "Caution—Radioactive Material."

(2) Nomenclature, Federal stock number, and, where applicable, serial number.

(3) Physical description.
- (*a*) Solid, liquid, or gas.
- (*b*) Quantity (number, weight, volume, and, if gaseous, pressure at standard conditions).

(4) Chemical description.
- (*a*) Hazardous chemicals present.
- (*b*) For liquids, solvent present.

(5) Radiological description.
- (*a*) Radioisotopes.
- (*b*) Millicuries of activity per radioisotope and date measured or determined.
- (*c*) Maximum dose rates (mrad/hr) at the surface and at 1 meter from the surface of the storage container.

d. The local fire department will be kept currently advised as to location and types of stored radioactive material and procedures for fighting fires adjacent to or involving radioactive material.

12. Serviceable or economically repairable items. Accountable radioactive property (source sets, etc.) which is serviceable or economically repairable will be reported to the appropriate national inventory control point (NICP) for disposition instructions unless otherwise instructed in the technical literature pertaining to the item. The national inventory control point should take one of the following actions:

a. Direct that the property be transferred for further utilization to another Army installation or agency which is authorized to receive such material.

b. Request authority through command channels from the Deputy Chief of Staff for Logistics, PEMA Execution Division, to transfer this property to authorized agency outside the control of the Army. (After a policy has been established for a particular type of equipment, further coordination is unnecessary for transfers of items covered by such policy.) Upon receipt of Department of the Army approval, the transfer of the material can be accomplished.

c. Direct the possessor of the property to decontaminate it or to process it for ultimate disposal as radioactive waste in accordance with paragraph 15. Guidance on decontamination is contained in TM 3-220.

13. Waste from special weapons. Radioactive waste such as paper, clothing, and dust contaminated with source and special material will be packaged and labeled in accordance with TM 39-20-6.

14. Returnable amounts of source and special nuclear material. Returnable amounts of source and special nuclear material from special weapons will be packaged, labeled and shipped in accordance with instructions in TM 39-N-11.

15. Disposition instructions for radioactive materials intended for ultimate disposal. *a.* Requests for disposition instructions should be submitted as follows:

(1) *CONUS, U.S. Army Forces, Southern Command and Greenland.* Installations and activities located in CONUS, U.S. Army Forces, Southern Command, and Greenland will forward disposal requests to Commanding Officer, U.S. Army Edgewood Arsenal, ATTN: SMUEA-ISDO, Edgewood Arsenal, Md., 21010.

(2) *Oversea commands.* Army installations and activities located outside CONUS, other than Greenland and the U.S. Army Forces, Southern Command, will forward disposal requests in accordance with instructions of the theater commander.

b. Requests for disposal will contain the following information:

(1) Nomenclature and Federal stock number and, where applicable, serial numbers.

(2) Physical description of items to include—

(*a*) Solid, liquid, or gases.

(*b*) Quantity (number, weight, and volume and, if gaseous, the standard pressure).

(*c*) Number of individual items per package and type of package.

(*d*) Number of shipping containers.

(*e*) Exterior dimensions and weight of packaged shipping container.

(*f*) Shielding material and thickness, if applicable.

(*g*) ICC, USCG, or CAB permit or waiver number, if applicable.

(3) Chemical and radioisotopic description, to include—

(*a*) Hazardous chemicals present.

(*b*) For liquids, the solvent present.

(*c*) Radioisotopes present.

(4) Radioactivity and radiation measurements, to include—

(*a*) Millicuries of activity of each radioisotope.

(*b*) Maximum radiation dose rates (mrad/hr) at the surface and at 1 meter from the surface of the radioactive items, if practical. If dose rate at 1 meter is undetectable, report dose rate at 1 foot from surface. For alpha sources, report counts per minute at surface.

(*c*) Maximum radiation dose rates (mrad/hr) at the surface and (mrad/hr) at 1 meter from the surface of the package.

(*d*) Security consideration.

1. Classification.

2. Procedures for declassification.

c. Emergency requests will be made by the most expeditious means available.

16. Replies to disposal requests. Replies to ultimate disposal requests will furnish the following minimum information:

a. Any packaging, labeling, shipping, and special transportation information beyond that established by AR 55-55 and AR 55-355.

b. Adequate radiation safety requirements to be observed.

c. Preferred date and time for receiving shipment.

d. Special instructions to be observed during transit and at transfer points.

17. Shipment of unwanted radioactive material. *a.* Containers for radioactive material will be substantial enough to endure the shocks of transportation without allowing escape of radioactive material. Containers should comply with ICC container specifications.

b. Unwanted radioactive materials for disposal, when moved locally within an installation, may be moved by unit transportation under the supervision of a technically qualified officer, enlisted person, or Department of the Army civilian of the installation.

c. The post transportation officer will arrange for shipments of all unwanted radioactive material to be transported beyond the limits of an installation. Certification of the contents as to hazards, special requirements, safety precautions, will be made to the post transportation officer in accordance with AR 55-55. The post transportation officer will insure compliance with AR 55-55, AR 55-162, and AR 55-355 and will take such other actions as are necessary under existing regulations to insure safe and secure transport from origin to destination.

d. Use of U.S. mails including parcel post is prohibited for forwarding unwanted radioactive material.

18. Special shipping instructions for CONUS, Alaska, and Hawaii. *a.* Transportation of radioactive material and waste materials can be accomplished by either military or common carrier, whichever is more advantageous to the Government, and in strict accordance with applicable regulations. If, in the best interests of the Government, a waiver or permit is required for a given shipment, application for waiver or permit will be made to the Deputy Chief of Staff for Logistics, ATTN: Director of Transportation, for approval prior to submission in accordance with paragraph 203019 or 216035, AR 55-355.

b. When radioactive material is shipped by common carrier, marking and labeling will conform to AR 380-20, 55-55, and 55-355. In addition, the following supplementary information, if unclassified, will also be marked on each package:

(1) Radiation symbol and "CAUTION RADIOACTIVE MATERIAL."
(2) Consignee.
(3) Maximum dose rate in mrad/hr at surface of package.
(4) Maximum dose rate in mrad/hr at 1 meter from package.
(5) Radioisotopes present.
(6) Amount of radioactivity, i.e., number of curies, millicuries, or microcuries contained in the package.
(7) Words "No removable surface contamination".

c. Shipments to or passing through Canada will also conform to Canadian requirements.

19. Special shipping instructions for oversea areas other than Alaska and Hawaii. *a.* In oversea theaters, local national or international regulations in force within the country of origin and countries through which the unwanted radioactive materials are moved will apply.

b. Shipments of radioactive material destined for CONUS, Alaska, and Hawaii will be labeled and marked as required in paragraph 18.

c. Shipments not destined for CONUS, Alaska, and Hawaii will be marked in accordance with the requirements of the regulations of those areas to which and through which the shipments are to be made. In addition, information indicated in paragraph 18*b* if unclassified, will be marked on each package containing radioactive material.

20. Escort of shipments of unwanted radioactive material. *a.* In special situations, material will be escorted from the point of shipment into the radioactive material disposal facility. This is done in the following cases when—

(1) The material cannot be packaged and shipped without waiver of an ICC, CAB, or USCG requirement. Requests for waivers for such shipments, will list Deputy Chief of Staff for Logistics, ATTN: Director of Transportation, Department of the Army, as an intermediate address.
(2) Security considerations require an escort.
(3) The commanding officer of the shipping agency considers an escort is in the best interests of the Government based on an evaluation of inherent factors of public relations, economics, and degree of hazard involved.

b. Where escort of shipment of unwanted radioactive material is required, escort will be arranged for in accordance with section VI, AR 55-16 and AR 55-55. If qualified personnel are not available, escort assistance can be obtained from Commanding Officer, U.S. Army Technical Escort Unit, Edgewood Arsenal, Md., 21010.

Section III. ULTIMATE DISPOSAL

21. Disposal by radioactive material disposal facilities. *a.* Local disposal of AEC licensed radioactive materials will be in accordance with Sections 20.106, 20.301a and b and 20.303 of 10 CFR, Part 20; with regulations of local civil regulatory bodies; and where applicable, with international agreement. In oversea areas, the more restrictive regulations, domestic or foreign, will be followed.

Note. Copies of 10 CFR 20 are available from the U.S. Atomic Energy Commission, Director of Materials Licensing, Washington, D.C. 20545.

b. The type of ultimate disposal operations conducted by each of the radioactive material disposal facilities located in CONUS or overseas will be coordinated with the Commanding General, U.S. Army Materiel Command. The operations of the radioactive material disposal facilities will be in accordance with TM 3-260. The Commanding General, U.S. Army Materiel Command, will conduct such liaison visits as are necessary to Army radioactive material disposal facilities to enable him to carry out his responsibilities, as outlined in paragraph 4. In addition, he will provide for necessary technical assistance visits at the request of oversea commands.

22. Disposal authorized locally. *a.* Normally, ultimate disposal is limited to radioactive material disposal facilities (TM 3-260). However, units other than authorized radioactive material disposal facilities may dispose of radioactive materials as follows:

(1) Dispose of specific types and quantities of radioactive material in accordance with disposition instructions obtained in accordance with paragraphs 15 and 16.

(2) Dispose of effluents (liquids and gases) into unrestricted areas in accordance with Title 10, Code of Federal Regulations, Section 20.106, provided local governments do not prohibit such disposal. Compliance with concentrations established in Appendix B of Title 10, Code of Federal Regulations, Part 20 will be determined by averaging concentrations on a monthly basis instead of on a yearly basis.

(3) Dispose of liquids into the sanitary sewage system in accordance with Title 10, Code of Federal Regulations, Section 20.303, provided local governments do not prohibit such disposal.

b. Incineration of Atomic Energy Commission (AEC) licensed radioactive material is not authorized except by units possessing a valid AEC license which authorizes incineration of such materials.

c. Incineration of radioactive materials other than AEC licensed material and land burial of radioactive materials on Army installations is not authorized without approval of Commanding General, U.S. Army Materiel Command. Request for such approval will be forwarded through channels to Commanding General, U.S. Army Materiel Command, ATTN: AMCAD-S, Washington, D.C. 20315 and will contain all the information required by paragraph 7*n*, AR 40-37.

d. Conventional disposal of solid material is authorized for waste material which has been controlled through the period of radioactive decay to a normal background level of activity, i.e., less than 0.002 microcuries per gram. This procedure is recommended for facilities with adequate local storage and for materials containing short, half-life radioisotopes to decay to background level within less than 12 months. This procedure is used by some hospitals and laboratories where short, half-life radioisotopes are used in tracer techniques and the resulting waste contains low level activity in such items as excreta, laboratory animals, infectious waste, absorbent tissue, and sputum.

e. Disposal operations outside the United States, its territories and possessions, will also be subject to the radiological safety requirements of the host nation. In the event of a conflict in regulations, the more severe regulation will govern.

f. Waivers to the above requirements will be granted only for unusual circumstances. Requests for such waivers will be addressed to the Commanding General, U.S. Army Materiel Command, ATTN: AMCAD-S, Washington, D.C. 20315.

23. Transfer, sale, or donation. Transfer, sale, or donation of radioactive materiel to other than authorized Army recipients requires prior approval of the Deputy Chief of Staff for Logistics (see AR 700-52).

[AMCAD]

By Order of the Secretary of the Army:

HAROLD K. JOHNSON,
General, United States Army,
Chief of Staff.

Official:
KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

Distribution:
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