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.)*

Department of the Army
US Army Electronics Command
Directorate of Research, Development and Engineering
Fort Monmouth, New Jersey 07703

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

Evans Area
Intersection of Marconi Road and Brighton Avenue
Neptune, New Jersey

2. DEPARTMENT TO USE BYPRODUCT MATERIAL

See Supplement A

3. PREVIOUS LICENSE NUMBER(S). *(If this is an application for renewal of a license, please indicate and give number.)* Renew and amend AEC License No. 29-01022-07 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.)*

See Supplement B

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.)*

James M. Garner, Jr., RPO
Wolfgang J. Ramm, Alternate RPO
(See Supplement D for training and experience).

6. (a) BYPRODUCT MATERIAL. *(Elements and mass number of each.)*

Cobalt 60

(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.)*

Sealed source, cobalt metal
(See Supplement C)

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.)*

a. The sealed source will be used in research, development and testing programs and may be used in calibration of high range instruments. See Supplement E of Application for Renewal of AEC License No. 29-01022-06 dated 11 May 1973 for detail information regarding research, development and testing programs.

b. See Figs. E-5, 6, 7 & 8 and para. 5, 6, 7 & 8 of Supplement E for information regarding sealed source storage and use containers.

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Ex 2 FF/2

(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			Yes No	Yes No
b. Radioactivity measurement standardization and monitoring techniques and instruments	See Supplement D		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 Supplement D		

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 Supplement G of Application for Renewal and Amendment of AEC License No. 29-01022-06 dated 11 May 1973.					

11. METHOD, FREQUENCY, AND STANDARDS USED IN CALIBRATING INSTRUMENTS LISTED ABOVE. See Supplement H of Application for Renewal and Amendment of AEC License No. 29-01022-06 dated 11 May 1973.

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

See Supplement I of Application for Renewal and Amendment of AEC License No. 29-01022-06 dated 11 May 1973.

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), No

See Supplement E

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 Supplement F

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.

Disposal in accordance with AR755-15.

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.

US Army Electronics Command, RD&E Dir.
Applicant named in item 1

Date ______

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By: [signature]
WALTER S. MC AFEE
CG's Representative on the USAECOM'S
Title of certifying official
Ionizing Radiation Control Committee

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.

SUPPLEMENT A

Departments to Use Byproduct Material

Reference: Form AEC-313, Item 2.

SUPPLEMENT A

SUBJECT: Departments to Use Byproduct Material

1. Reference: Form AEC-313, Item 2.

2. Organizations within or under the DIRECTORATE OF RESEARCH, DEVELOPMENT, & ENGINEERING (RD&E), US Army Electronics Command (ECOM), of the Department of the Army (DA).

SUPPLEMENT B

Individual Users

Reference: Form AEC-313, Item 4.

SUPPLEMENT B

SUBJECT: Individual Users

1. Reference: Form AEC-313, Item 4.

2. Users of radioactive material. The use of radioactive material covered by this license shall be limited to:

   a. The RD&E RPO, Alternate RPO, and Technical Staff of RPO.

   b. Personnel to Perform Leak Tests.

   c. Individuals approved by the Committee who are:

      (1) RD&E employees stationed at Fort Monmouth.

      (2) Non-RD&E employees working at Fort Monmouth on RD&E research, development or test programs.

   d. An individual(s) working under the direct supervision of an RD&E employee approved by the Committee to directly supervise the individual's work with the radioactive material involved. The individual performing the work need not be an RD&E employee. The work will take place in the vault area of Bldg 401, Evans area. The primary duty station of the employee performing the direct supervision will be Fort Monmouth, New Jersey.

   Note that direct supervision means that the supervisor is in a physical location where he can see the individual(s) being supervised or he is in a nearby area where he can hear a call or signal from said individual(s) and be able to reach the location where the individual(s) is working within a few moments.

3. Qualifications of Users and "Radiation Supervisors" Approved by the Committee. The Committee evaluates an applicant's (a) experience with radiation and radioactive material, (b) training 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 radiation, and (c) his familiarity with pertinent regulations and procedures, to insure they are commensurate with the hazard and activity of the radioisotopes requested in his application.

SUPPLEMENT B

4. See Supplement F of application for renewal and amendment of AEC License No. 29-01022-06 dated May 11, 1973, for:

   a. List of individuals who serve as:

      (1) Members of Committee.

      (2) RPO, Alternate RPO, and Technical Staff of RPO.

      (3) Personnel to perform leak tests.

   b. Training and Experience of Individuals who serve in the above mentioned capacities.

SUPPLEMENT C

Cobalt 60 Sealed Source

Reference: Form AEC-313, Item 6(b)

SUPPLEMENT C

SUBJECT: Cobalt 60 Sealed Source.

1. Reference: Form AEC-313, Item 6(b).

2. See sealed source drawing Fig. E-7 on page E-8 for details of source construction.

SUPPLEMENT D

Training and Experience

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

SUPPLEMENT D

SUBJECT: Training and Experience.

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

2. See Supplement F of application for renewal and amendment of AEC License No. 29-010122-06 dated May 11, 1973.

SUPPLEMENT E

Facilities and Equipment

Reference: Form AEC-313, Item 13

SUPPLEMENT E

SUBJECT: Facilities and Equipment.

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

2. The location of the underground area, consisting of the Vault Console and Exposure Rooms, in relation to the remainder of Bldg. 401 is shown in Fig. E-1.

3. The Vault Exposure Room (see Figs. E-2 & E-3) was designed for the use of a 10,000 Ci cobalt-60 sealed source. The figures show the 18" thick wall that extends the maze 5'4" into the Vault Exposure Room. Interlocking ferrite brick were used in the construction of the wall. The ferrite block used on each side of the Zinc Bromide Window in the wall between Vault Console and Exposure Rooms is also shown in the same figures.

4. Fig. 4 shows the relative locations of the various radiation alarm sensors, a warning light that is lit when the source is "Up" and other pertinent components. Other warning lights that are lit when the source is "Up" are located on top of the earth mound (Fig. 3), in the hall at the top of the stairs, and on the control console.

5. The components shown in Figs. E-5, E-6, E-7, E-8, and the pneumatic and electrical systems (see E-9 & E-10) make up the source storage and use device. The Shield and Rise Tube Adaptor of the Rise Tube Assembly shown in Fig. E-6 fits into the Plug Well, Item 3, of Fig. E-5. The Rise Tube Assembly is held in place by a Plug Plate that fits over the shoulder of the Shield and Rise Tube Adaptor and the top of the Primary Source Storage Shield. The Plug Plate is held down by nuts screwed onto the stainless steel lugs (see Item 4 of Fig. E-5).

6. The Rise Tube Extension is screwed and bolted onto the top of the Rise Tube (Fig. E-6).

7. The Bowden Cable passes through the shield wall between the Exposure Room and the Console Room (see Fig. E-3). Thus the catch (see Fig. E-6) for holding the rise tube plug may be released from the Console Room.

8. The Master/Slave Manipulators (Fig. E-3) are used to raise and lower the Rise Tube Plug.

9. The sealed source is in an outer capsule (see Figs. E-6 & E-8) that is raised and lowered pneumatically.

10. The electrical control system schematic is shown in Fig. E-10. The electrical interlock system will cause the source to be blown into the

Primary Source Storage Shield and Base if:

a. the maze door is opened,

b. the zinc bromide in the observation window is low,

c. the radiation level in the Console Room is above 5 mR/hr or the monitor is "Off", or

d. the remote control switch in the Exposure Room, or the main control switch are switched to the "down" position.

The connection TB 4-5 was closed when the system was tested with a dummy source; however, now this connection is open so that it is impossible to raise the source from inside the Exposure Room.

11. A pair of Argonne Type D-8 slave manipulators (see Fig. E-3) is installed to move equipment located in the Exposure Room while the operator is in the Control Room. These manipulators are used routinely to raise and lower the source shield plug.

12. The sump in the Exposure Room is connected to the radioactive waste dilution system (see para. 7, Supplement J of Application for Renewal of AEC License No. 29-01022-06 dated 11 May 1973).

13. An alarm bell rings if the radiation level in the Console Room goes above 5 mR/hr. The alarm bell is audible throughout Bldg. 401.

14. The pneumatic controls and solenoids are located in the Control Room. An emergency generator and an air compressor take over automatically in case of an interruption or failure of the electrical power system.

15. A new survey was made in June & July 1973. The console room was surveyed with the source and the tube plug in the "down" position. Readings were made in the maze, console room, above the top of the plug in the ceiling of the Exposure Room, and above the earth mound when the source was in "Up" or expose position. See Attachment for results of these surveys.

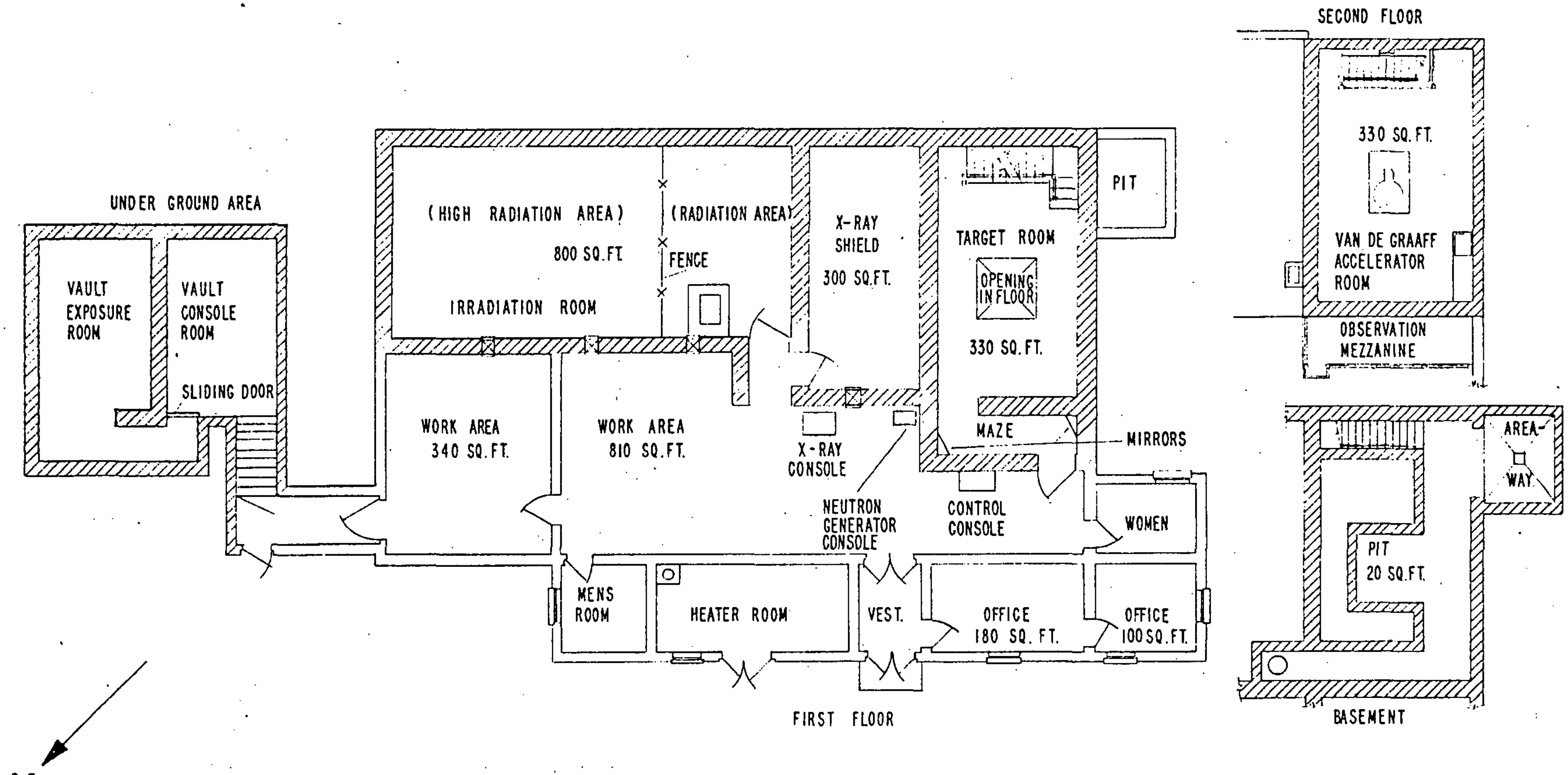


FIG. E-1 BLDG 401, EVANS AREA

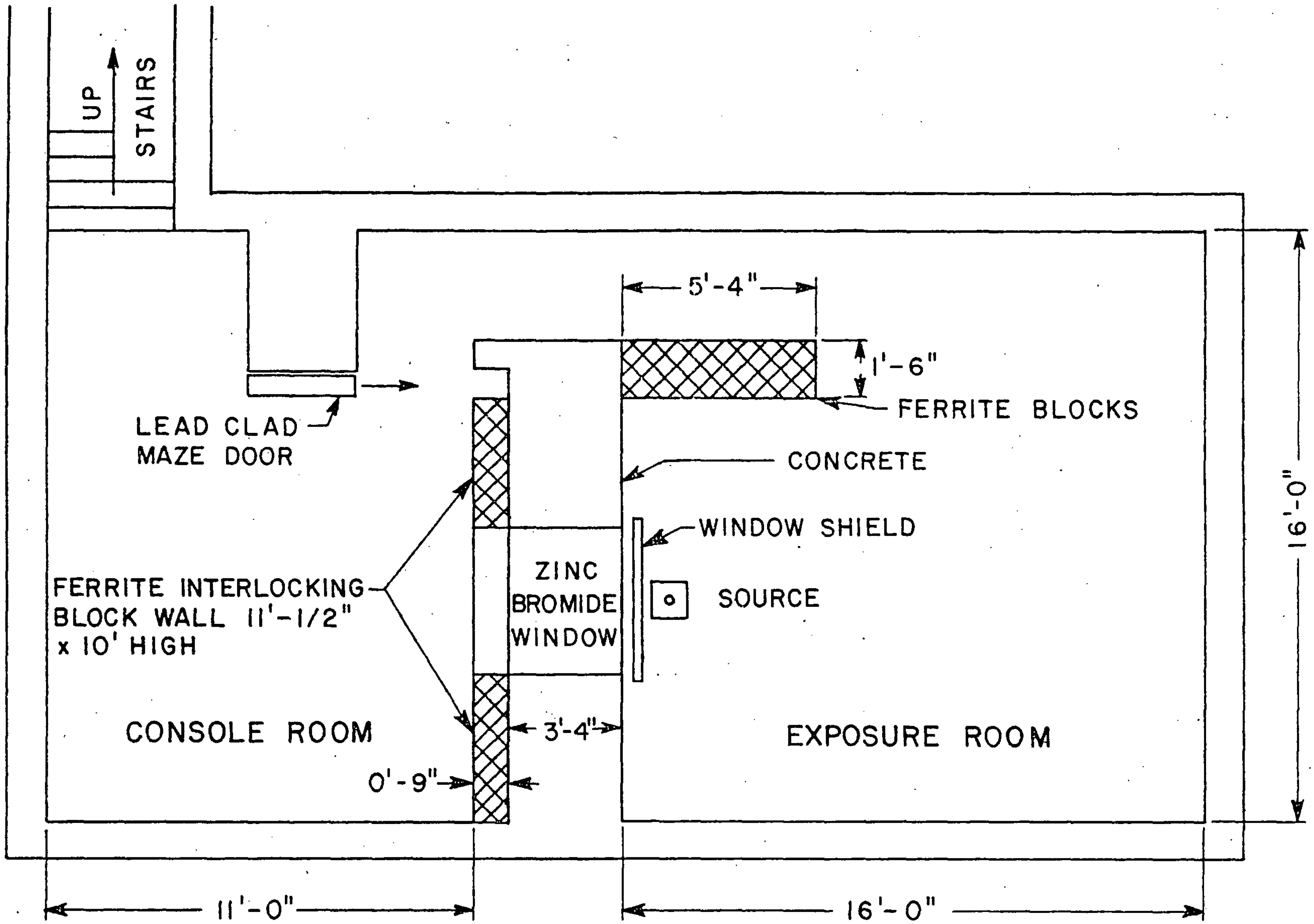


FIG. E-2. PLAN VIEW UNDERGROUND VAULT

SCALE $\frac{1}{4}$" = 1'-0"

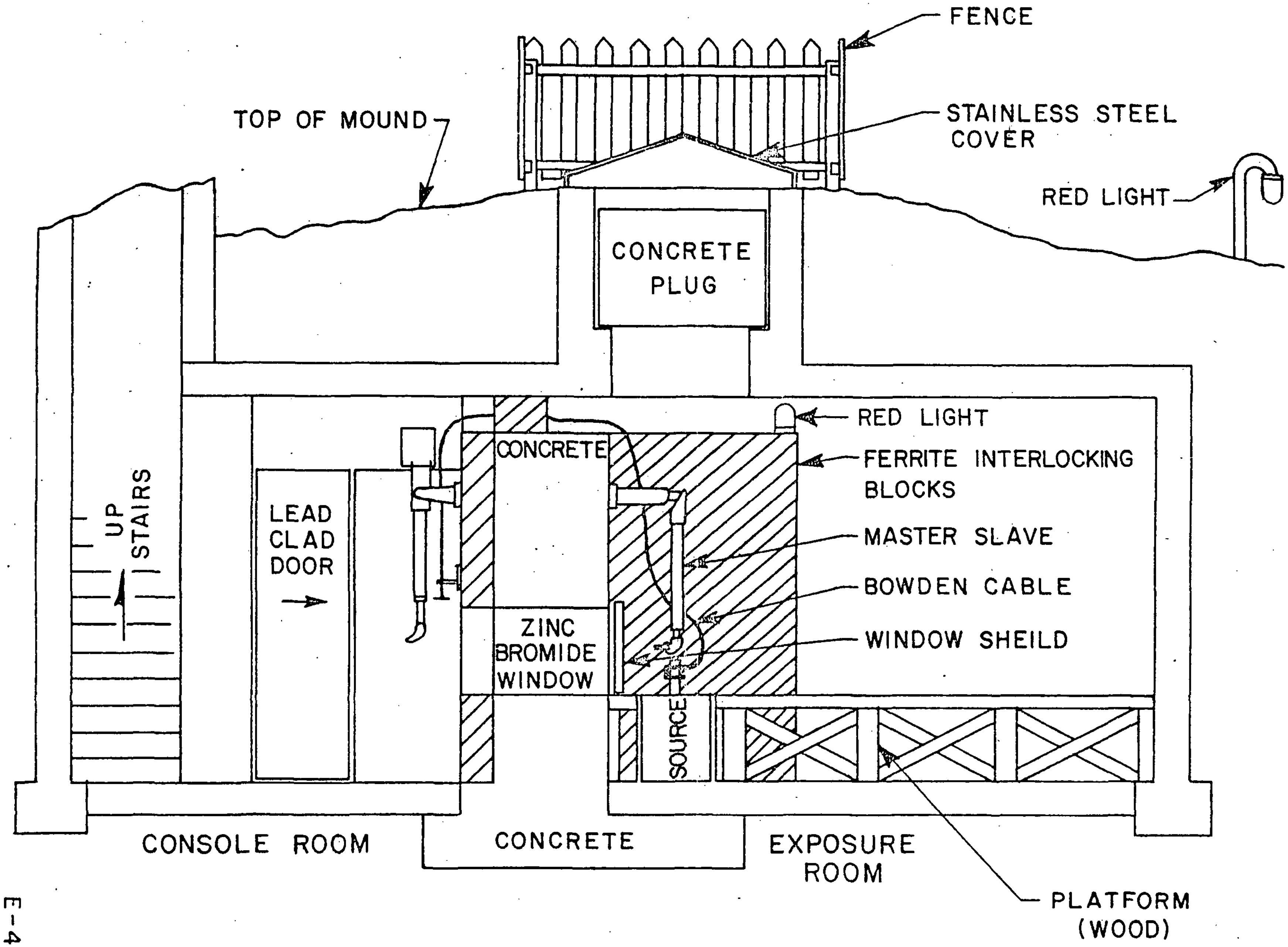
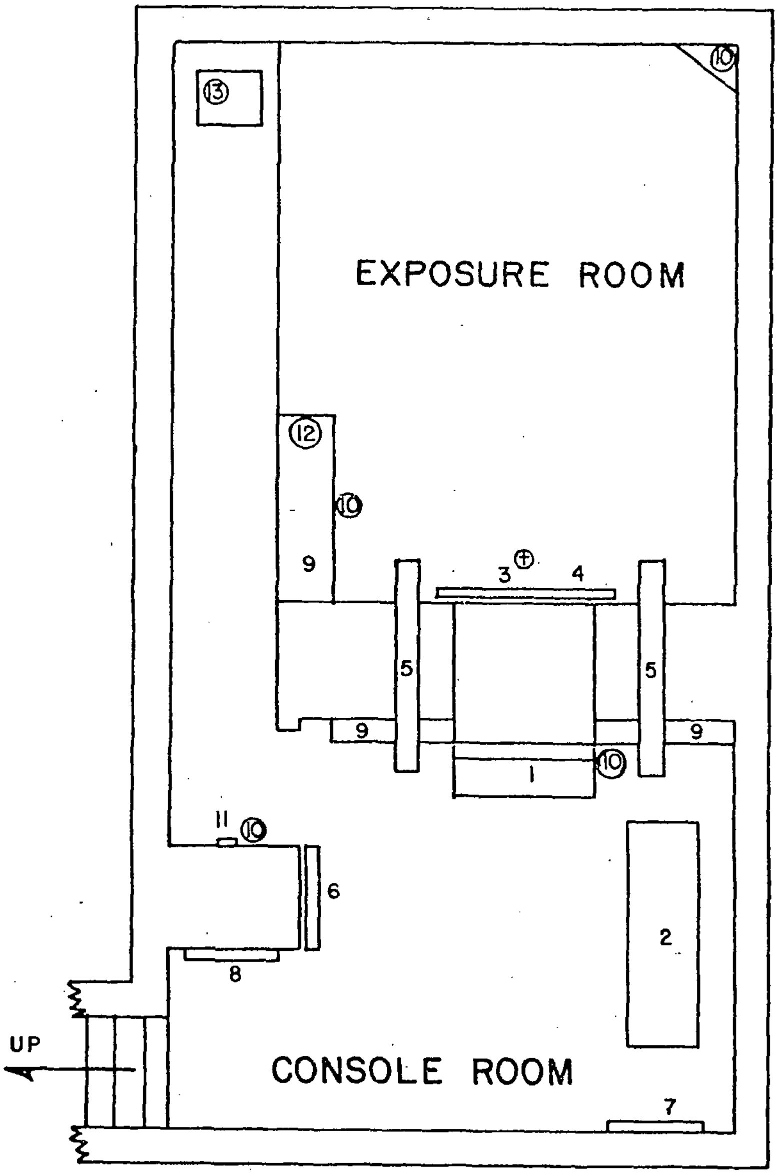


FIG. E. 3. ELEVATION VIEW UNDERGROUND VALT



1. CONTROL CONSOLE
2. MONITOR CONSOLE
3. SOURCE POSITION
4. WINDOW SHIELD
5. SLAVE MANIPULATORS
6. MAZE DOOR
7. PNEUMATIC CONTROL SYSTEM
8. ELECTRICAL PANEL
9. FERRITE INTERLOCKING BLOCK
10. RADIATION ALARM SENSORS
11. MANUAL ALARM SENSORS
12. WARNING LIGHT
13. SUMP PUMP

FIG. E-4. UNDERGROUND VAULT INSTRUMENTATION

SCALE $\frac{3}{16}$ = 1"-0"

1. AISI 1/4" TYPE 316 STAINLESS STEEL (ANNEALED, PICKLED & OILED)
2. STAINLESS STEEL ARC WELDING (ALL WELDING)
3. PLUG WELL 3" I.D. X 12 $\frac{1}{2}$" DEEP
4. STAINLESS STEEL LUGS FOR PLUG PLATE
5. 1" DIA. STAINLESS STEEL RODS
6. LIFTING HOLES
7. THREADED PLATE
8. BASE MOUNTING
9. PLUG PLATE

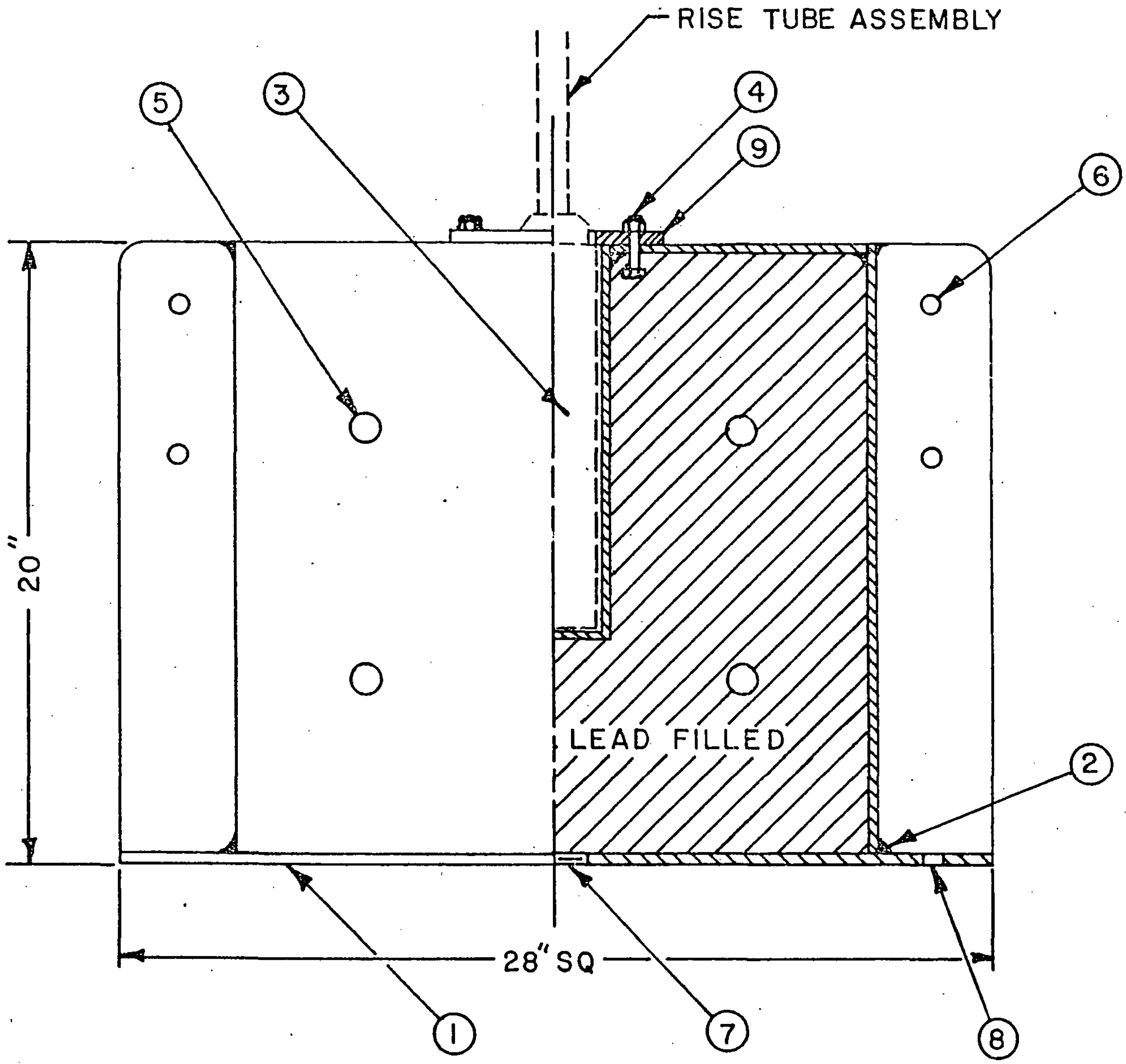


FIG. E-5. PRIMARY SOURCE STORAGE SHIELD

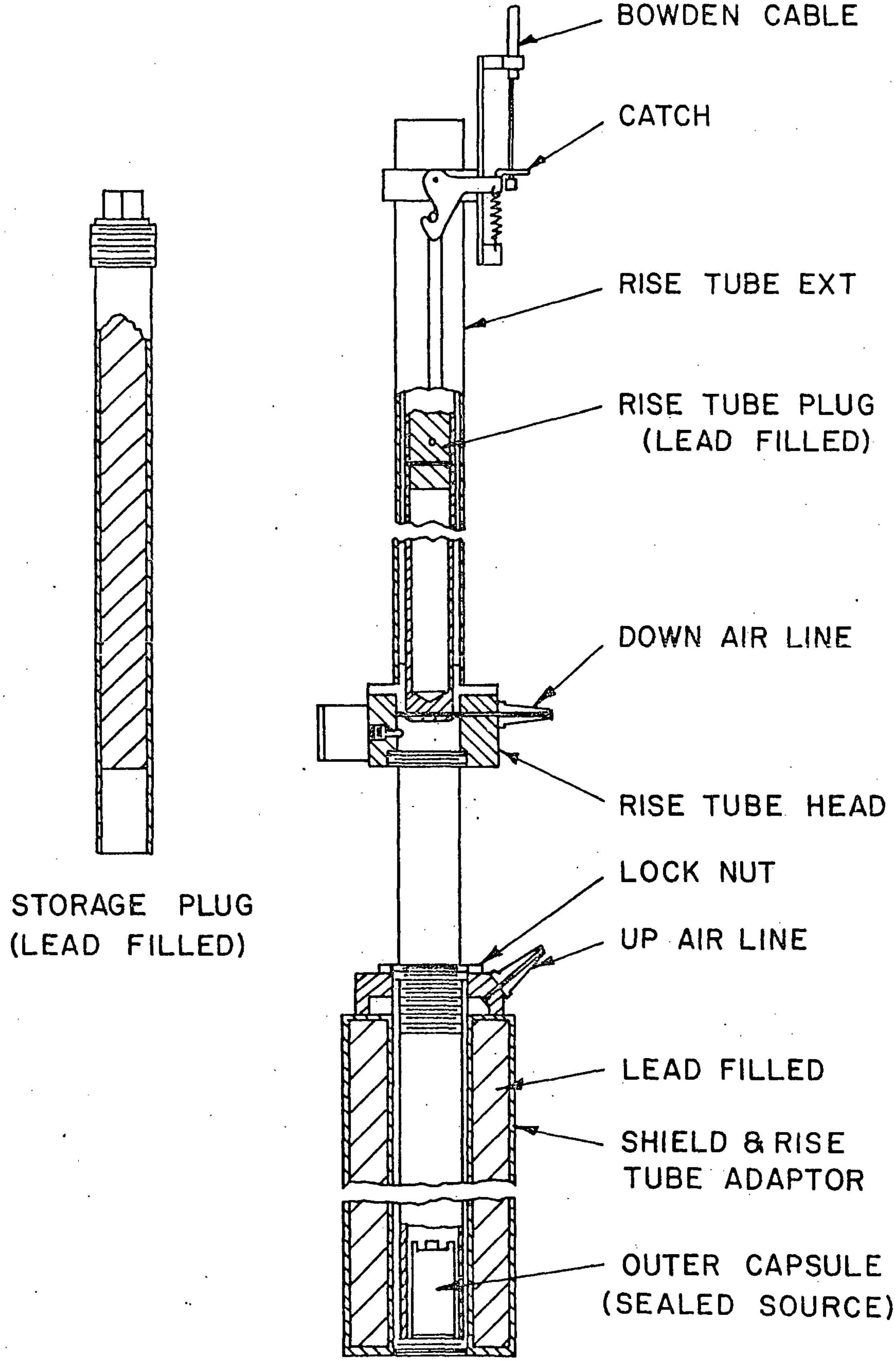
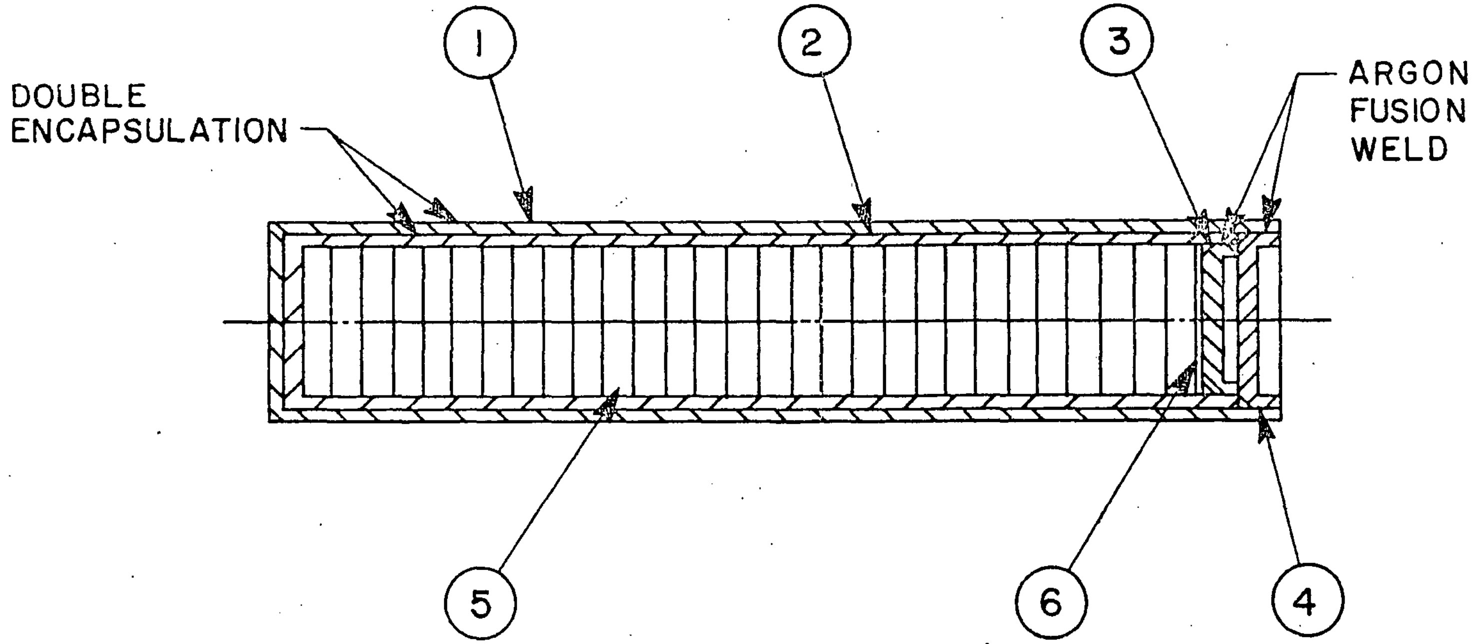


FIG. E-6. CAPSULE & RISE TUBE ASSEMBLY



1. OUTER CAN, 304L STAINLESS STEEL

2. INNER CAN " " "

3. INNER CAP " " "

4. OUTER CAP " " "

5. WAFER, NICKEL PLATED COBALT

6. SPRING, 020 DIA WIRE STAINLESS STEEL

FIG. E-7. COBALT 60 SEALED SOURCE

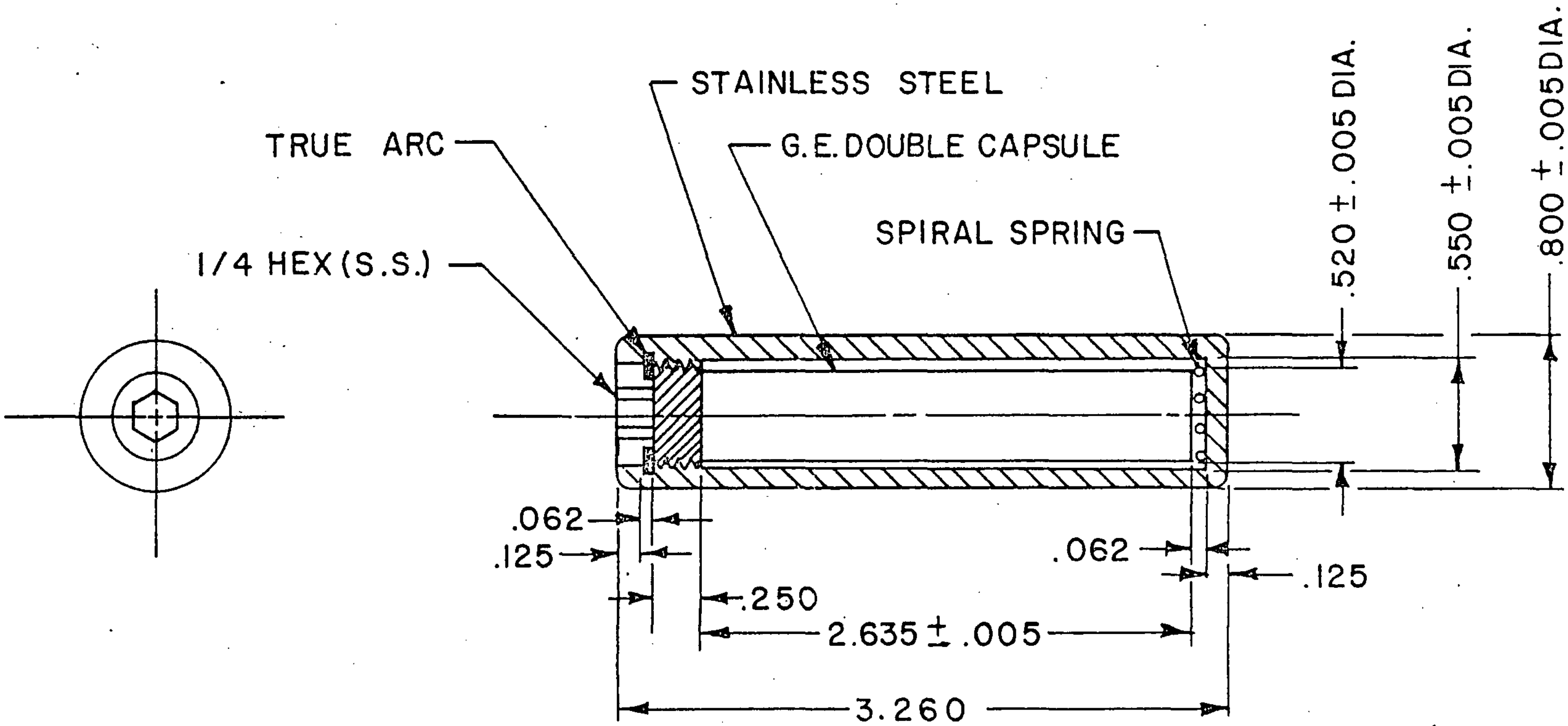


FIG. E-8. OUTER CAPSULE FOR 3.5 KILOCURIE SOURCE

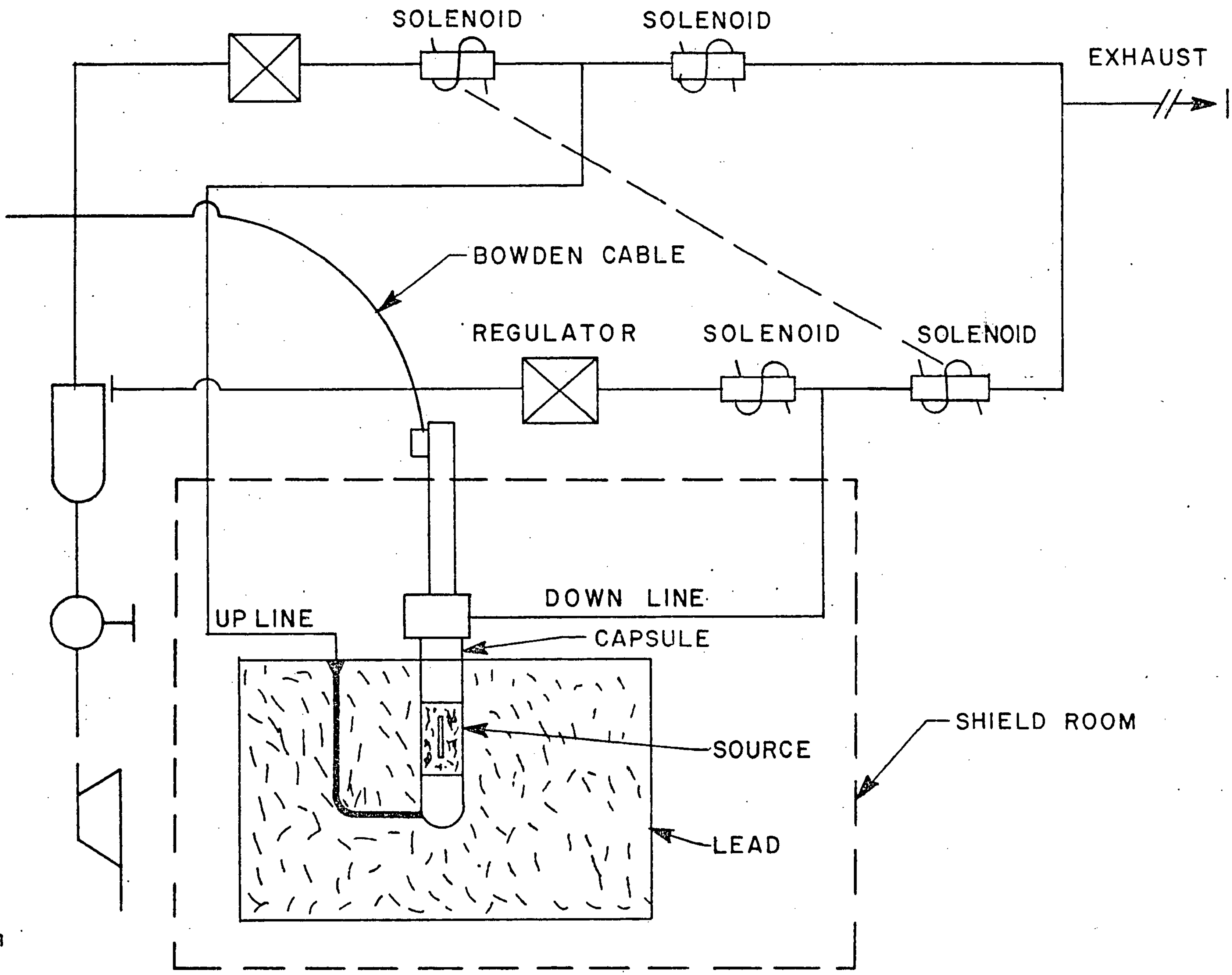
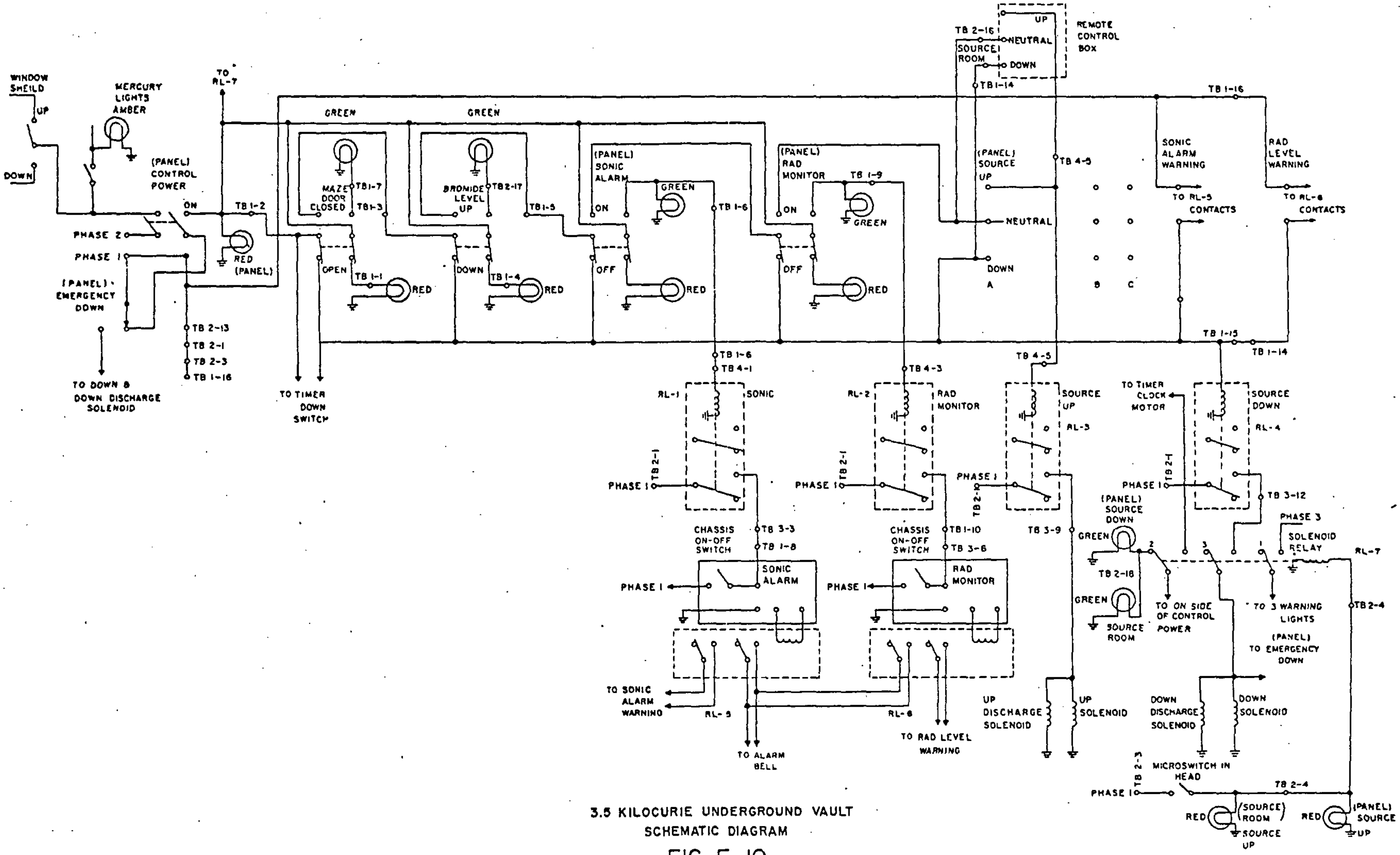


FIG. E-9. PHEUMATIC CONTROL SYSTEM



3.5 KILOCURIE UNDERGROUND VAULT
SCHEMATIC DIAGRAM
FIG. E-10

ATTACHMENT TO SUPPLEMENT E

UNDERGROUND VAULT AIR DOSE RATES

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<u>ATTACHMENT</u>

UNDERGROUND VAULT AIR DOSE RATES

1. PURPOSE.

   a. To determine the present air dose rates: (1) at various locations in the vault exposure room when the source and the rise tube plug are in the "Down" position, (2) in areas surrounding the exposure room and near the end of the maze when the source is in the "Up" or expose position.

   b. To estimate the approximate air dose rates that would exist if the present source was replaced with a new Co-60 source or a Co-60 source.

2. INSTRUMENTS.

   a. One Army Type IM-141/PDR-27J GM tube type survey meter that used a large GM tube for the low ranges and a small tube for the high ranges.

   b. One ionization chamber type survey meter, Victoreen Model 440RF.

   c. One Victoreen Model 740V "Cutie Pie".

   d. One Victoreen Model 712 radiation area monitoring system and four of its remote detectors.

3. PROCEDURE.

   a. The Radiation Area Monitoring System was used to insure that the source was in the down position before entering the exposure room. A portable survey instrument was used during entry to insure that the radiation level was low.

   b. The exposure room was surveyed while the rise tube plug and the source were in the down position. The IM-141/PDR-27J with its small GM tube and the Victoreen 440RF were used in this area. The detectors of both instruments were held about 24 to 30 inches above the platform that is above the concrete floor of the room.

      (1) The small GM tube was used for the measurements above the source.

      (2) The 440RF was used to determine the distances along five radii from the source that gave readings of 20, 10, 1, and 0.5 mR/hr.

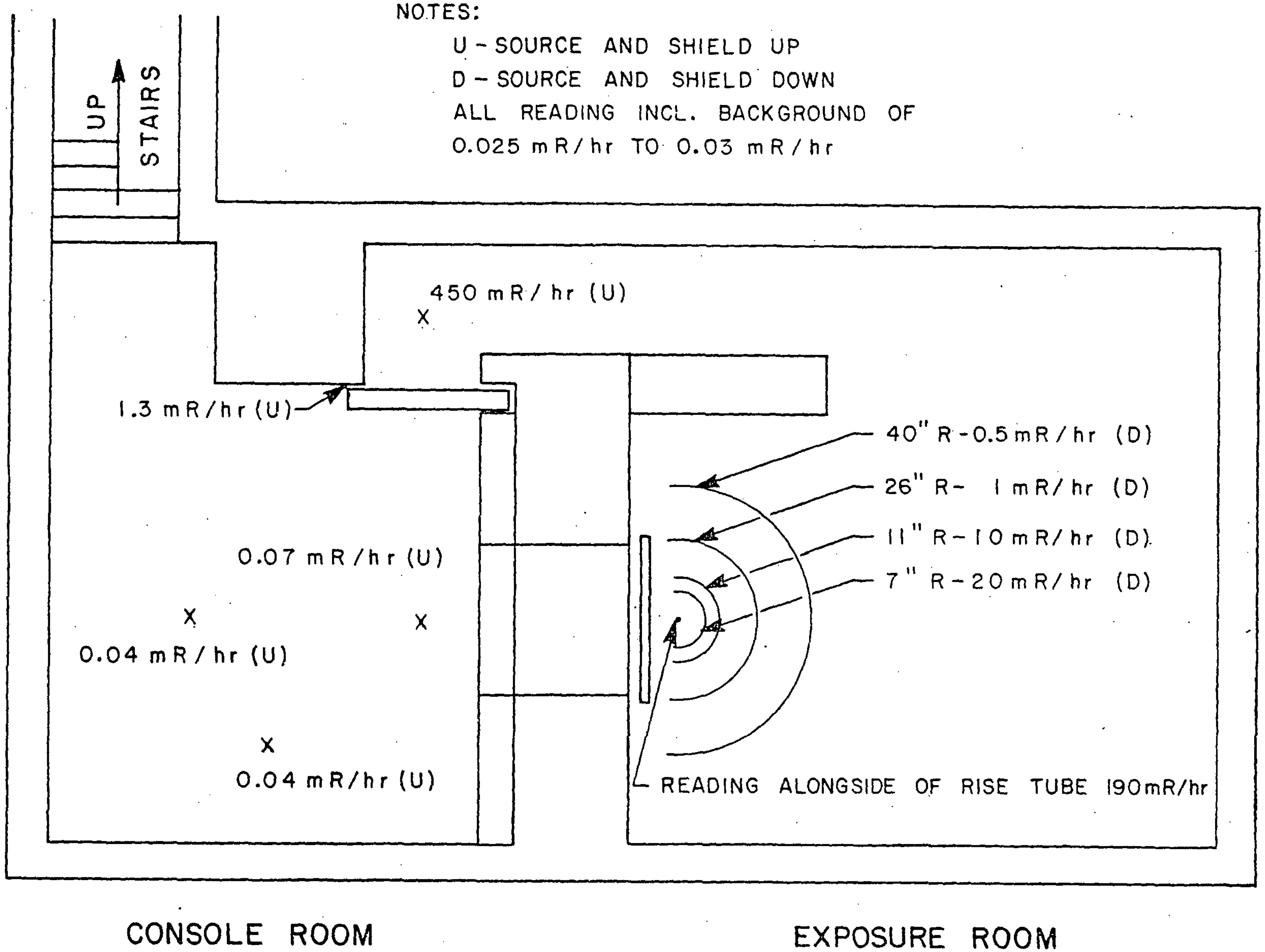

FIG. 1. PLAN VIEW UNDERGROUND VAULT
SCALE 1/4 = 1'-0"

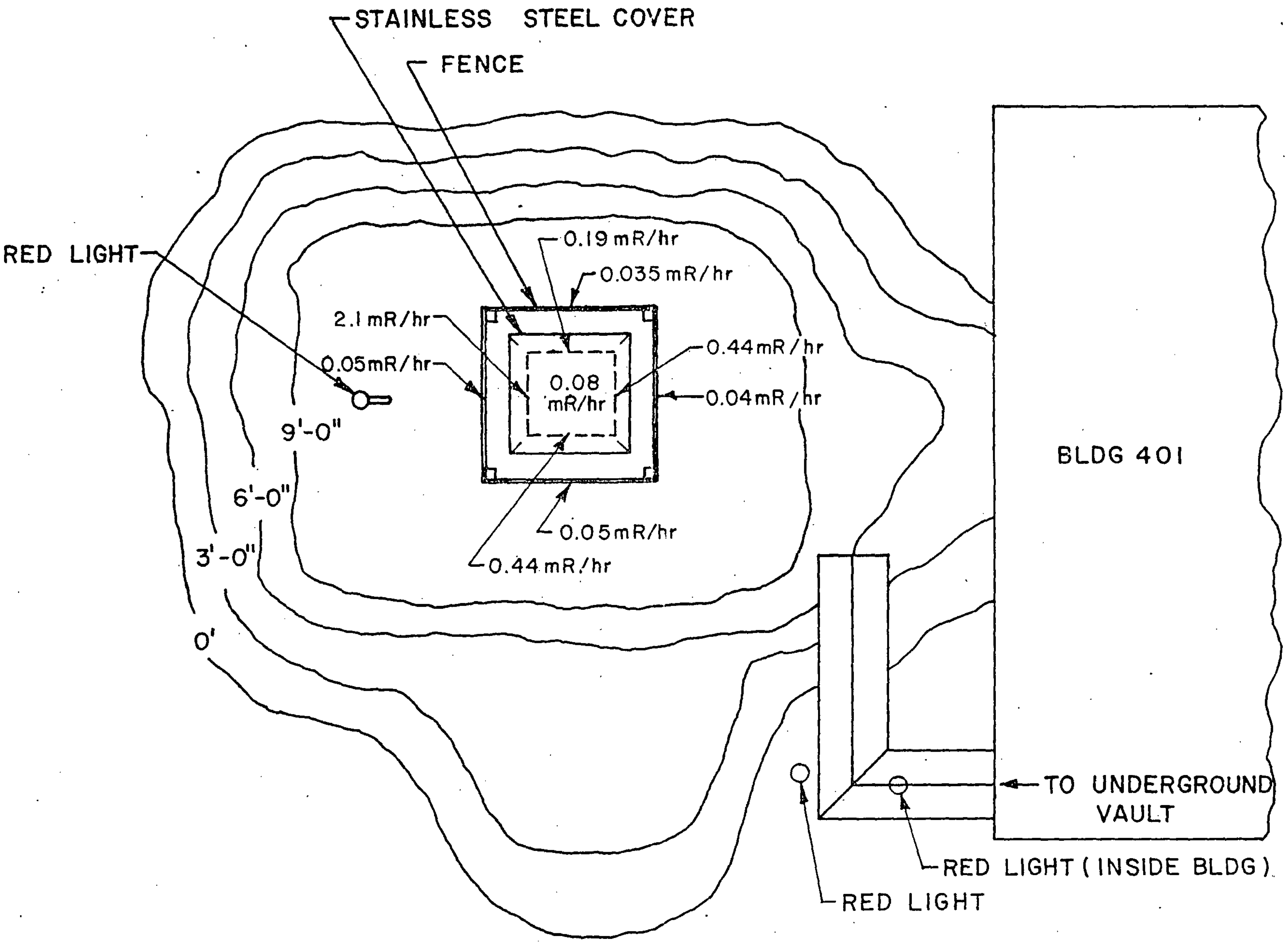

FIG. 2. PLAN VIEW OF MOUND

c. The Radiation Area Monitoring System was used to determine the approximate air dose rate in the maze with the source up. Then, readings were made with the "Cutie Pie" held about 30 inches above the floor of the maze at the location shown on Fig. 1 while the source was up.

d. The GM tube survey meter and its large tube were used to survey (1) the control room, (2) the cover over the concrete in the ceiling of the exposure room, (3) around the fence and, (4) the top of the mound and the area around the mound. See Fig. 2.

The detector was held about 30 inches above the surface of the floor in the control room, the surface of the mound and the area around it during the surveys of these area. It was held near the surface of the cover and the ground close to the fence when they were being surveyed.

e. The estimates of the approximate air dose rates that would exist if the present source were replaced with a 3,500 Ci or a 10,000 Ci of Co-60 source were made. The estimates were made by subtracting a background value of 0.025 mR/hr from the reading obtained from the present 944 Ci source (was 3,500 Ci before decay), multiplying by the ratio of the activity of a new source to that of the existing one and adding background of 0.025 mR/hr.

4. RESULTS

Most of the dose rates measured are shown on Fig. 2. All readings include background of from 0.025 to 0.03 mR/hr.

a. In the exposure room with the source and rise tube plug in the "Down" position:

(1) A narrow beam of gamma rays was found to be escaping along the edge of the rise tube plug. The highest reading obtained was 190 mR/hr.

(2) The distance from the source, along the five radii, for the 20, 10, 1 and 0.5 mR/hr readings were the same on each radii. The distances were 7, 11, 26 and 40 inches respectively.

b. The instrument readings obtained in the console room when the source was in the "Up" or expose position were:

(1) 0.07 mR/hr at the control console, in front of the zinc bromide window.

(2) 0.04 mR/hr at the instrument console and most of the remainder of the room, and

(3) at the crack at the rear edge of the maze door the readings ranged from 0.17 mR/hr at the top of door to 1.3 mR/hr through the middle portion of the crack down to 1 mR/hr 1 ft. above the floor and back up to 1.2 mR/hr 3 inches above the floor.

c. The following results were obtained above the exposure room with the source in the "Up" or expose position.

(1) 0.08 mR/hr was found on the surface at the center of the metal cover plate over the concrete plug in the hole in the top of the exposure room.

(2) A relatively high thin line of radiation was found on top of the metal cover plate. The line formed a square that was 5 ft 4 inches on a side. The high readings found on each side of the square are shown in Fig. 2.

(3) The highest levels along the fence were found at the center of each side. The values are shown on Fig. 2.

(4) Background was found at the edges of the top of the earth mound and along the sides of the mound.

d. Some of the air dose rates that could be expected if the present [ ] Co-60 source were replaced with one of [ ] or [ ] are given in the table.

5. CONCLUSIONS.

a. [ ] Co-60 Source.

With the existing source the following conclusions may be drawn.

(1) Console Room. If the source is to be in the "Up" position more than 77 hours in any seven consecutive days the room must be classified as a Restricted Area during the time the source is "Up". If the source is to be in the "Up" position more than 77 hours in any five consecutive days the room must be classified as a Radiation Area during the time the source is "Up".

(2) Area Above the Exposure Room. The area inside the fence on top of the mound must be classified as a Restricted Area when the source is "Up". If the source is to be "Up" more than 47 hours in any five consecutive days the area must be classified as a Radiation Area during the time the source is up.

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(3) Exposure Room. The high leakage around the rise tube plug when it is in the down position causes the room to be classified as a High Radiation Area all of the time.

(4) Shielding Between the Console Room and The Exposure Rooms. The shielding between the rooms is adequate.

b. [ ] Co-60 Source. If the existing source is replaced with a [ ] source, the following changes must be made in the above conclusions.

(1) Console Room. The room must be classified as a Restricted Area any time the source is "Up". If the source is to be "Up" more than 21 hours in any five consecutive days the room is to be classified as a Radiation Area during the time the source is "Up".

(2) Area Above The Exposure Room. The area inside the fence on top of the mound must be classified as a Radiation Area when the source is "Up".

c. [ ] Co-60 Source. If the existing source is changed to one of [ ] the Console Room must be classified as a Radiation Area when the source is "Up".

d. Signs. The areas mentioned in these conclusions must be posted in accordance with the conditions described herein.

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TABLE

AIR DOSE RATES AT VARIOUS LOCATIONS
FOR THREE SOURCES

LOCATION	[ ]	mR/hr [ ]	[ ]
Source & shield plug down: Above source	190	700	2,000
7 inches from source	20	74	210
11 inches from source	10	37	110
25 inches from source	1	3.6	10.3
40 inches from source	0.50	1.8	5.1
Source & shield plug up:			
Maze	450	1700	4,800
Back of maze door	1.30	4.7	14
Control console operator	0.07	0.19	0.50
Control Room--General	0.04	0.08	0.16
Highest level above exposure room	2.1	7.8	22
Highest level at fence	0.05	0.12	0.29

SUPPLEMENT F

Radiation Protection Program

Reference: Form AEC-313, Item 14

SUPPLEMENT F

SUBJECT: Radiation Protection Program

1. Reference: Form AEC-313, Item 14.

2. The Radiation Protection Program is described in ECOM Regulation 385-9. (See copy attached to Supplement K of Application for Renewal and Amendment of AEC License No. 29-01022-06 dated 11 May 1973.

3. Sealed Source Leak Tests. The leak test methods used are described in para. 3, 4 and 6 of Supplement K of Application for Renewal and Amendment of AEC License No. 29-01022-06 dated 11 May 1973.

4. See Supplement F of Application for Renewal and Amendment of AEC License No. 29-01022-06 dated 11 May 1973 for the names, training and experience of persons to perform leak tests. A list of the persons is in para. 4. Para. 4 also gives the page numbers of Supplement F where the training and experience of the several individuals may be found.

5. An initial survey of the facility was made a number of years ago by the RPO present at the time the source was installed.

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INCLOSURE #1

Resumes of RPO, Alternate RPO and others authorized to perform leak test operations

Resume of Training and Experience
of Stanley B. Potter

1. Educational background:

Ex 6

Colorado State University	4 yrs		BS, Physics
Chemical Corps School	2 wks	1964	Compl Radiation Safety Course
Naval Postgraduate School	2 yrs	1969	Compl Nuclear (Effects) Engineering Curriculum
Nuclear Weapons School	8 wks	1969	Compl SONAC, NET OPS, NHTC

2. Vocational experience with radiation:

1961-1964 At Nuclear Defense Laboratory, Edgewood Arsenal, Md, as research physicist.

1964-1967 With US Army in Germany, as Radiation Protection Officer for the 32d Army Air Defense Command.

1969-1972 With Defense Nuclear Agency in Albuquerque, New Mexico, as Chief, Radiation Safety Support Division, Nuclear Weapons School.

1972 With Pan American Airways, Environmental Health contractor for NASA and the Air Force at Cape Kennedy, Florida, as Chief, Health Physics Division

1972-1978 With US Army Electronics Command, Fort Monmouth, NJ as Health Physicist

1978-Pres Electronics Research & Development Command, Fort Monmouth, NJ, as Health Physicist

3. Formal Training in Radiation:

a. Principles and practices of radiation protection.

Where Trained	Duration of Training
Colorado State University	24 weeks
Chemical Corps School	2 weeks
Naval Postgraduate School	2 years
Nuclear Weapons School	8 weeks

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

Where Trained	Duration of Training
Colorado State University	12 weeks
Chemical Corps School	2 weeks
Naval Postgraduate School	36 weeks
Nuclear Weapons School	8 weeks

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

Where Trained	Duration of Training
Colorado State University	24 weeks
Chemical Corps School	2 weeks
Naval Postgraduate School	2 years
Nuclear Weapons School	8 weeks

d. Biological effects of radiation.

Where Trained	Duration of Training
Chemical Corps School	2 weeks
Naval Postgraduate School	36 weeks
Nuclear Weapons School	2 weeks

4. On-the-job training in radiation.

a. Principles and practices of radiation protection.

Where Trained	Duration of Training
Nuclear Defense Laboratory	3 yrs - 1961-1964
Germany	3 yrs - 1964-1967
Albuquerque, New Mexico	3 yrs - 1969-1972
Cape Kennedy, Florida	1 mo - 1972
Fort Monmouth, New Jersey	5 yrs - 1972-Present

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

Where Trained	Duration of Training
Nuclear Defense Laboratory	3 yrs - 1961-1964
Germany	3 yrs - 1964-1967
Albuquerque, New Mexico	3 yrs - 1969-1972
Cape Kennedy, Florida	1 mo - 1972
Fort Monmouth, New Jersey	5 yrs - 1972-Present

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

Where Trained	Duration of Training
Nuclear Defense Laboratory	3 yrs - 1961-1964
Germany	3 yrs - 1964-1967
Albuquerque, New Mexico	3 yrs - 1969-1972
Cape Kennedy, Florida	1 mo - 1972
Fort Monmouth, New Jersey	5 yrs - 1972-Present

5. Experience with radioisotopes.

Isotope	Maximum Activity	Place of Experience	Duration of Experience
^{226}Ra	Less than 10 curies	Colorado State University	3 mo
		Naval Postgraduate School	3 mo
		Fort Monmouth, New Jersey	5 yrs
^{60}Co	Kilocuries	Colorado State University	3 mo
		Chemical Corp School	6 mo
		Naval Postgraduate School	3 mo
		Albuquerque, New Mexico	3 yrs
		Fort Monmouth, New Jersey	5 yrs
^{241}Am	Millicuries	Albuquerque, New Mexico	3 yrs
^{147}Pm	Hundreds of curies	Cape Kennedy, Florida	1 mo
		Albuquerque, New Mexico	3 yrs
		Cape Kennedy, Florida	1 mo
		Fort Monmouth, New Jersey	5 yrs
^{239}Pu	Curies	Albuquerque, New Mexico	3 yrs
		Fort Monmouth, New Jersey	5 yrs
^{57}Co	Millicuries	Albuquerque, New Mexico	1 yr
		Fort Monmouth, New Jersey	5 yrs
^{232}Th	Kilocuries	Albuquerque, New Mexico	3 yrs
		Fort Monmouth, New Jersey	5 yrs
^{229}Th	Curies	Edgewood, Maryland	3 yrs
Tritium	Hundreds of curies	Edgewood, Maryland	3 yrs
		Albuquerque, New Mexico	3 yrs
		Fort Monmouth, New Jersey	5 yrs
^{131}I	Millicuries	Edgewood, Maryland	1 yr
		Naval Postgraduate School	1 yr
^{210}Po Be	Curies	Edgewood, Maryland	3 yrs
^{239}Pu Be	Curies	Edgewood, Maryland	3 yrs
^{192}Ir	Hundreds of curies	Cape Kennedy, Florida	1 mo
^{85}Kr	Hundreds of curies	Cape Kennedy, Florida	1 mo
		Fort Monmouth, New Jersey	5 yrs
^{238}U	Millicuries	Albuquerque, New Mexico	3 yrs
		Fort Monmouth, New Jersey	5 yrs

Isotope	Maximum Activity	Place of Experience	Duration of Experie
^{90}Sr	Millicuries	Germany	3 yrs
		Albuquerque, New Mexico	3 yrs
		Colorado State University	3 mo
		Fort Monmouth, New Jersey	5 yrs
^{90}Y	Millicuries	Germany	3 yrs
		Albuquerque, New Mexico	3 yrs
		Colorado State University	3 mo
		Fort Monmouth, New Jersey	5 yrs

6. Experience with devices equivalent to that of actual use of radioisotopes.

DEVICE	PLACE OF EXPERIENCE	DURATION
Cockroft Walton Accelerator	Edgewood, Maryland	2 years
Betatron	Edgewood, Maryland	1 year
Van de Graaff Accelerator	Naval Postgraduate School	1 year
	Fort Monmouth, New Jersey	5 years
Neutron Generator	Fort Monmouth, New Jersey	5 years
X-Ray Machines	Fort Monmouth, New Jersey	5 years

Resume of Training and Experience
of Robert L. Pfeffer

1. Educational background:

City College of New York, New York, NY	[ ] 6	BS, Physics
University of PA, Philadelphia, PA	1963-1964:	Graduate courses in physics, astronomy, electrical engineering
Stevens Institute of Technology Hoboken, NJ	[ ] 6	MS, Physics
Stevens Institute of Technology Hoboken, NJ	1969-Present:	PhD course, work and thesis research, Physics

2. Formal Training and Experience in Radiation Protection Methods, Measurements, and Effects.

a. Undergraduate Courses:

Undergraduate Courses:	Dates	Formal Semester Hours
Atomic Physics	1962	3
Atomic Physics Laboratory	1962	1.5
Nuclear Physics	1963	3
General Physics	1960-61	10
Electricity & Magnetism	1962	4.5

b. Graduate Courses:

Graduate Courses:	Dates	Formal Semester Hours
Advanced Physics Laboratory	1964	3
Modern Physics	1966-67	5
Nuclear Physics	1968	3
Electricity & Magnetism	1963-64, 1966-67	11

c. On the job training, including radiation safety, detection instrumentation, radioisotope handling, high energy accelerators, nuclear weapons simulators, dosimetry, nuclear weapons effects:

1963-Present

3. Experience with Radioisotopes: includes laboratory analysis, experiments and evaluations utilizing these sources. Duration of experience: 1963 - present. Place of experience: US Army ERADCOM, Fort Monmouth, NJ.

Isotope	Maximum Activity (Ci)
^{241}Am	1
^{252}Cf	1
^{60}Co	120,000
^{137}Cs	100
^{3}H	1
^{226}Ra	1
^{90}Sr	1
^{57}Co	1
^{22}Na	1
^{210}Po	1
^{239}Pu	1

4. Experience with other Radiation Producing Machines:

Machine	Duration of Experience	Type of Experience
2 MeV Van De Graaff accelerator, US Army ERADCOM, Ft Mon, NJ	15 years	Operation involving diverse nuclear radiation physics experimen
250 KV X-ray machine US Army ERADCOM, Ft Mon, NJ	15 years	"
14-Mev neutron generator (Cockcroft-Walton type) US Army ERADCOM, Ft Mon, NJ	15 years	"
Fast Burst Reactor Aberdeen Proving Ground, Aberdeen, MD	2 weeks	"
Fast Burst Reactor White Sands Missile Range, NM	1 month	"
Linear Accelerator Rennsalêr Polytechnic Inst. Troy, NY	2 weeks	"
Linear Accelerator General Atomics Corp. San Diego, California	2 weeks	"

Machine	Duration of Experience	Type of Experience
FX-100 pulsed Van de Graaff Accelerators, Kirtland AFB, NM	2 weeks	Operation involving diverse nuclear radiation physics experiments.
PI Pulsed Gamma Ray Generators, Kirtland, AFB, NM	2 weeks	"
14-MEV neutron generators (cockcroft-Walton type) Kaman Nuclear Co Colorado Springs, Colorada	2 weeks	"
PI Pulsed Gamma Ray Generators, Physics International Corp. San Leadro, California	2 weeks	"

Resume of Training and Experience
of Michael J. Davison

1. Educational background

US Army Facilities Engineering Support Agency School	52 weeks	1977	Compl Nuclear Power Plant Operator (Health Physics Process Control Specialty

2. Vocational experience with radiation

1977	1 week OJT aboard MH-1A (Nuclear Power Barge STURGIS at Fort Belvoir, VA as Health Physics Technician.
1977-1978	Facilities Engineering Support Agency, Fort Belvoir, VA as Instructor, Health Physics Training Division.
1978-Pres	Electronics Research & Development Command, Fort Monmouth, NJ, as Health Physics Technician.

3. Formal training in radiation

a. Principles and practices of radiation protection

Where Trained	Duration of Training
Nuclear Power Plant Operator School	52 weeks

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

Where Trained	Duration of Training
Nuclear Power Plant Operator School	36 weeks

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

Where Trained	Duration of Training
Nuclear Power Plant Operator School	52 weeks

d. Biological effects of radiation.

Where Trained	Duration of Training
Nuclear Power Plant Operator School	20 weeks

4. On-the-job training in radiation

a. Principles and practices of radiation protection.

Where Trained	Duration of Training
MH-1A (Nuclear Power Barge STURGIS)	1 wk 1977
Fort Monmouth, NJ	6 mo 1978

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

Where Trained	Duration of Training
MH-1A (Nuclear Power Barge STURGIS)	1 wk 1977
Fort Monmouth, NJ	6 mo 1978

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

Where Trained	Duration of Training
MH-1A (Nuclear Power Barge STURGIS)	1 wk 1977
Fort Belvoir, VA	4 mo 1977-1978
Fort Monmouth, NJ	6 mo 1978

5. Experience with radioisotopes

Isotope	Maximum Activity	Place of Experience	Duration of Experience
^{241}Am	Millicuries	Nuclear Reactor School Fort Monmouth, NJ	15 months 6 months
^{14}C	Millicuries	Nuclear Reactor School Fort Monmouth, NJ	15 months 6 months
^{36}Cl	Millicuries	Nuclear Reactor School Fort Monmouth, NJ	15 months 6 months
^{60}Co	Millicuries 125,000 Curies	Nuclear Reactor School Fort Monmouth, NJ	15 months 6 months
^{137}Cs	Millicuries Hundreds of Curies	Nuclear Reactor School Fort Monmouth, NJ	15 months 6 months

Isotope	Maximum Activity	Place of Experience	Duration of Experience
^{3}H	Curies	Fort Monmouth, NJ	6 months
^{147}Pm	Millicuries	Nuclear Reactor School	15 months
^{239}Pu	Millicuries	Nuclear Reactor School Fort Monmouth, NJ	15 months 6 months
^{239}Pu-Be	Curies	Nuclear Reactor School	15 months
^{90}Sr, ^{90}Y	Millicuries Curies	Nuclear Reactor School Fort Monmouth, NJ	15 months 6 months

6. Experience with devices equivalent to that of actual use of radioisotopes.

Device	Place of Experience	Duration
Van de Graaff Accelerator	Fort Monmouth, NJ	6 months
X-Ray Diffraction	Fort Monmouth, NJ	6 months
Positive Ion Accelerator	Fort Monmouth, NJ	6 months
Radiographic X-Ray System	Fort Monmouth, NJ	6 months
Medical X-Ray Unit	Fort Monmouth, NJ	6 months

Resume of Training and Experience
of Dr. Stanley Kronenberg

1. Educational background: Ex 6

PhD in Physics, University of Vienna, [redacted]

2. Vocational experience with radiation:

1951-1952	With Institute for Radium Research, Vienna, Austria as Researcher.
1952-1953	At the General Hospital of Vienna, Austria, as Radio-isotope and nuclear radiation researcher, medical applications.
1953-Present	With US Army Signal Labs, Fort Monmouth, NJ Electronic Command, ERADCOM Supervisor Research Physicist

3. Formal Training in Radiation:

a. Principles and practices of radiation protection.

Where Trained	Duration of Training
University of Vienna	1948-1952

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

Where Trained	Duration of Training
University of Vienna	1948-1952

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

Where Trained	Duration of Training
University of Vienna	1948-1952

4. On-the-job training in radiation.

a. Principles and practices of radiation protection.

Where Trained	Duration of Training
University of Vienna	1948-1952
Institute for Radium Research	1950-1952
Vienna General Hospital	1952-1953
Fort Monmouth, NJ	1953-Present

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

Where Trained	Duration of Training
University of Vienna	1948-1952
Institute for Radium Research	1950-1952
Vienna General Hospital	1952-1953
Fort Monmouth, NJ	1953-Present

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

Where Trained	Duration of Training
University of Vienna	1948-1952
Institute for Radium Research	1950-1952
Vienna General Hospital	1952-1953
Fort Monmouth, NJ	1953-Present

5. Experience with radioisotopes.

Isotope	Maximum Activity	Place of Experience	Duration of Experience
Radium and Derivitives	2 Ci	Inst of Radium Res, Vienna	2 yrs
^{131}I	1 Ci	Inst of Radium Res, Vienna	2 yrs
^{90}Sr	3 Ci	Inst of Radium Res, Vienna	2 yrs
^{137}Cs	220 Ci	Fort Monmouth, New Jersey	25 yrs
^{60}Co	125 kCi	Fort Monmouth, New Jersey	25 yrs
^{90}Sr	5 Ci	Fort Monmouth, New Jersey	25 yrs
^{210}Po	10 Ci	Fort Monmouth, New Jersey	25 yrs
^{241}Am	100 uCi	Fort Monmouth, New Jersey	25 yrs
Ra & Be neutron source	20 mCi	Fort Monmouth, New Jersey	25 yrs
^{239}Pu	20 lbs (fast burst reactor)	Aberdeen Proving Ground, Md.	5 yrs
^{235}U	20 lbs (fast burst reactor)	Aberdeen Proving Ground, Md.	5 yrs
^{85}Kr	1 Ci	Fort Monmouth, New Jersey	25 yrs
^{27}Na	100 mCi	Fort Monmouth, New Jersey	25 yrs
^{3}H	90 Ci	Fort Monmouth, New Jersey	25 yrs

6. Experience with devices equivalent to that of actual use of radioisotopes.

DEVICE	PLACE OF EXPERIENCE	DURATION
2 Mev Van de Graaff	Fort Monmouth, New Jersey	25 yrs
X-ray Machines	Fort Monmouth, New Jersey	25 yrs
Linear accellerator	White Sands Missile Range	25 yrs (occassional use)
Cocroft Walton Accellerator	Edgewood, Maryland	25 yrs (occassional use)
Flash X-Rays (e.g. FX 100)	Fort Monmouth, New Jersey	25 yrs
Cyclotrons	Brookhaven National Laboratory	25 yrs (occassional use)
Nuclear Reactors	Oak Ridge, Tennessee	25 yrs (occassional use)

Authored 45 scientific papers and reports in the areas of nuclear radiation, dosimetry, biology, radiation transport, tactical dosimetry, etc.

Member: American Nuclear Society

Holds 5 patents in the area of radiation dosimetry.

Served on 5 occasions as project officer at nuclear weapon tests.

Resume of Training and Experience
of Vernon Bryan

1. Vocational experience with radiation:

1952-1954	Health Physics Section, Evans Area, Fort Monmouth, NJ
1954-Present	Electronics Technology and Devices Laboratory, Nuclear Hardening Research Tech Area, Fort Monmouth, NJ with experiments also conducted at Nevada Test Site, Mercury, Nevada, Colorado Test Site, Grand Junction, Colorado.

2. Formal training in radiation:

a. Principles and practices of radiation protection.

Where Trained	Duration of Training
Fort Monmouth, NJ	1 week

3. On-the-job training in radiation.

a. Principles and practices of radiation protection.

Where Trained	Duration of Training
Fort Monmouth, NJ	25 years
Nevada Test Site, Nevada	1.5 years
Colorada Test Site, Grand Junction, Colorada	3 months

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

Where Trained	Duration of Training
Fort Monmouth, NJ	25 years
Nevada Test Site, Nevada	1.5 years

4. Experience with radioisotopes.

Isotope	Maximum Activity	Place of Experience
^{137}Cs	220 Ci	Fort Monmouth, NJ
^{60}Co	125 KCi	Fort Monmouth, NJ
^{90}Sr	1 Ci	Fort Monmouth, NJ
^{3}H	90 Ci	Fort Monmouth, NJ
^{210}Po	10 Ci	Fort Monmouth, NJ
^{241}Am	100 uCi	Fort Monmouth, NJ
^{226}Ra	10.3 mCi	Fort Monmouth, NJ
RaBe	20 mCi	Fort Monmouth, NJ
^{239}Pu	2 uCi	Fort Monmouth, NJ
^{147}Pm	300 mCi	Fort Monmouth, NJ
^{85}Kr	50 mCi	Fort Monmouth, NJ

5. Experience with devices equivalent to that of actual use of radioisotopes.

Device	Place of Experience	Duration
Van de Graaff Accelerator	Fort Monmouth, NJ	5 years
X-ray Machine	Fort Monmouth, NJ	5 years
Neutron Generator Accelerator	Fort Monmouth, NJ	3 months

INCLOSURE #2

IONIZING RADIATION CONTROL COMMITTEE

Ionizing Radiation Control Committee

The Ionizing Radiation Control Committee will consist of persons working in the positions indicated below. From time to time different individuals will work in these positions. The characteristic qualifications that are required of the individual in each position are indicated.

Chief Radiologist, Patterson Army Hospital

Physician with extensive experience in use of diagnostic radiation.

Safety Director, CERCOM

Extensive experience in industrial safety with administrative experience in radiological safety.

Chief of Environment and Health Activity, Patterson Army Hospital

Industrial Hygienest or Environmental Engineer with varying amount of training and experience in radiological safety (from very little to quite extensive).

Chief of Equipment Management Branch of ERADCOM Technical Support Activity

Supply expert with little or no experience in radiological safety.

Health Physicist, CERCOM Safety Office

Extensive formal and practical training in radiological safety.

Health Physicist, ERADCOM Technical Support Activity Safety Office

Extensive formal and practical training in radiological safety.

Safety Specialist, CERCOM Safety Office

Extensive experience in industrial safety and ordinarily 2 to 4 weeks formal training in radiological safety.

Chief, Radiation Research Branch, Electronic Technology and Devices Laboratory

Extensive training and experience in use of radiation, radiation measurement and detection, and radiological safety.

Physicist, research, Radiation Research Branch

Extensive experience and training in use of radiation, radiation measurement and detection and radiological safety procedures.

Leader, Dosimetry and Calibration Team, Radiac Research and Development Group

Minimum of a bachelors degree in a physical science or engineering with extensive experience in radiation detection, measurement and safety.

Scientific Advisor to Commander ERADCOM

Extensive education and experience in science and engineering. At least familiarization training and experience in radiological safety.

Maintenance Engineer, Maintenance Directorate, CERCOM

An expert in Maintenance Engineering with little or no experience in radiological safety.

INCLOSURE #3

DRAWINGS OF SOURCES

INCLOSURE 3

SUBJECT: Cobalt 60 Sealed Sources

1. Reference: Form NRC-313, Item 6(b).

2. Sealed source drawings are attached in figures 3-1, 3-2, and 3-3 for details of construction of sources.

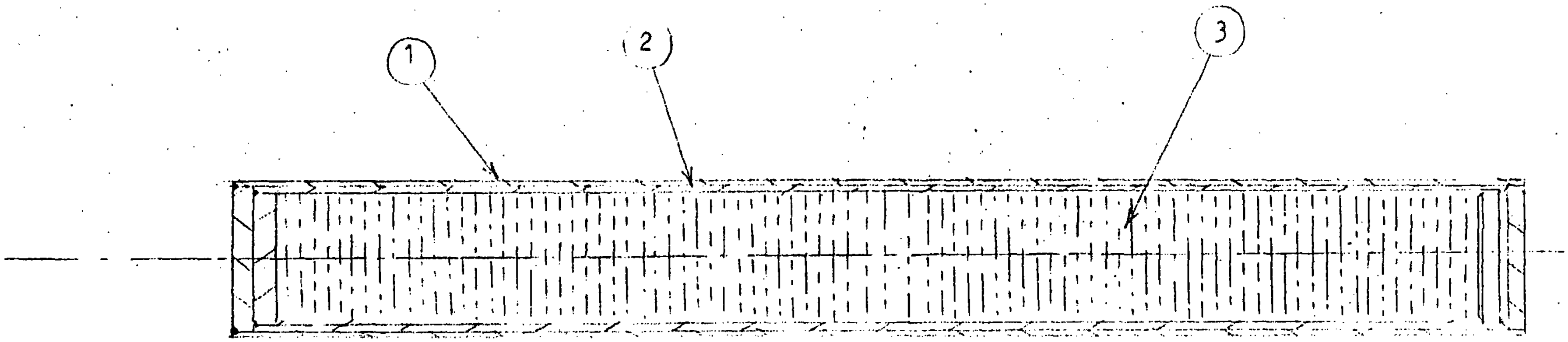
3. Source activity as of 29 Feb 1976.

   a. Source No. 1 -

   b. Source No. 2 -

4. The manufacturer of Source 2 is Picker Corp. The design of the source is as specified in Picker Corp drawing dated May 3, 1962 and titled "Brookhaven Proposal #1".

Ex 2



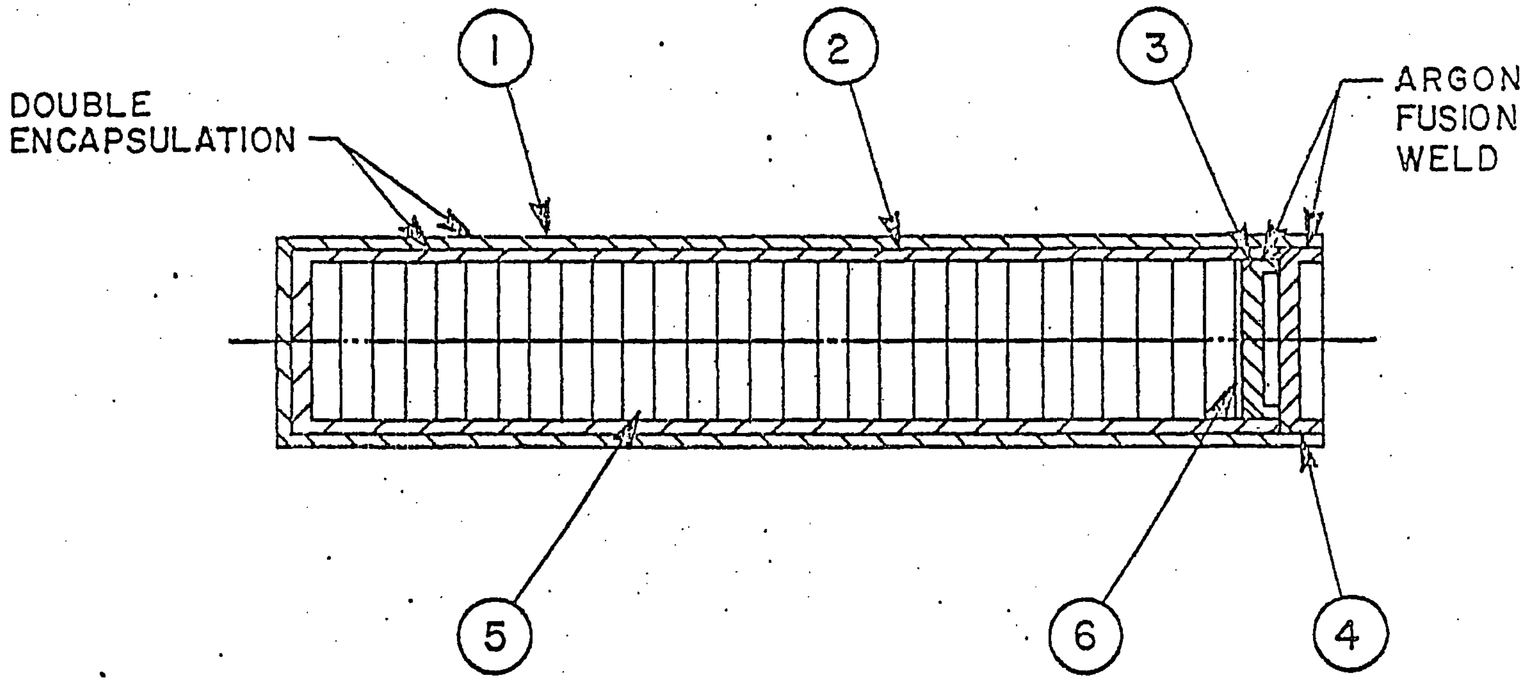
1. Outer Can, Type 347 Stainless Steel

2. Inner Can, Type 347 Stainless Steel

3. Cobalt-60 Standard Wafers

Source is doubly encapsulated by welding. Outside dimensions of external capsule is 0.935 inch outside diameter by 7.570 inch long. Capsule walls are 0.035 inch thick.

Figure 3-1. 2048 curie sealed source.



1. OUTER CAN, 304L STAINLESS STEEL
2. INNER CAN " " "
3. INNER CAP " " "
4. OUTER CAP " " "
5. WAFER, NICKEL PLATED COBALT
6. SPRING, 020 DIA WIRE STAINLESS STEEL

FIG 3-2. COBALT 60 SEALED SOURCE

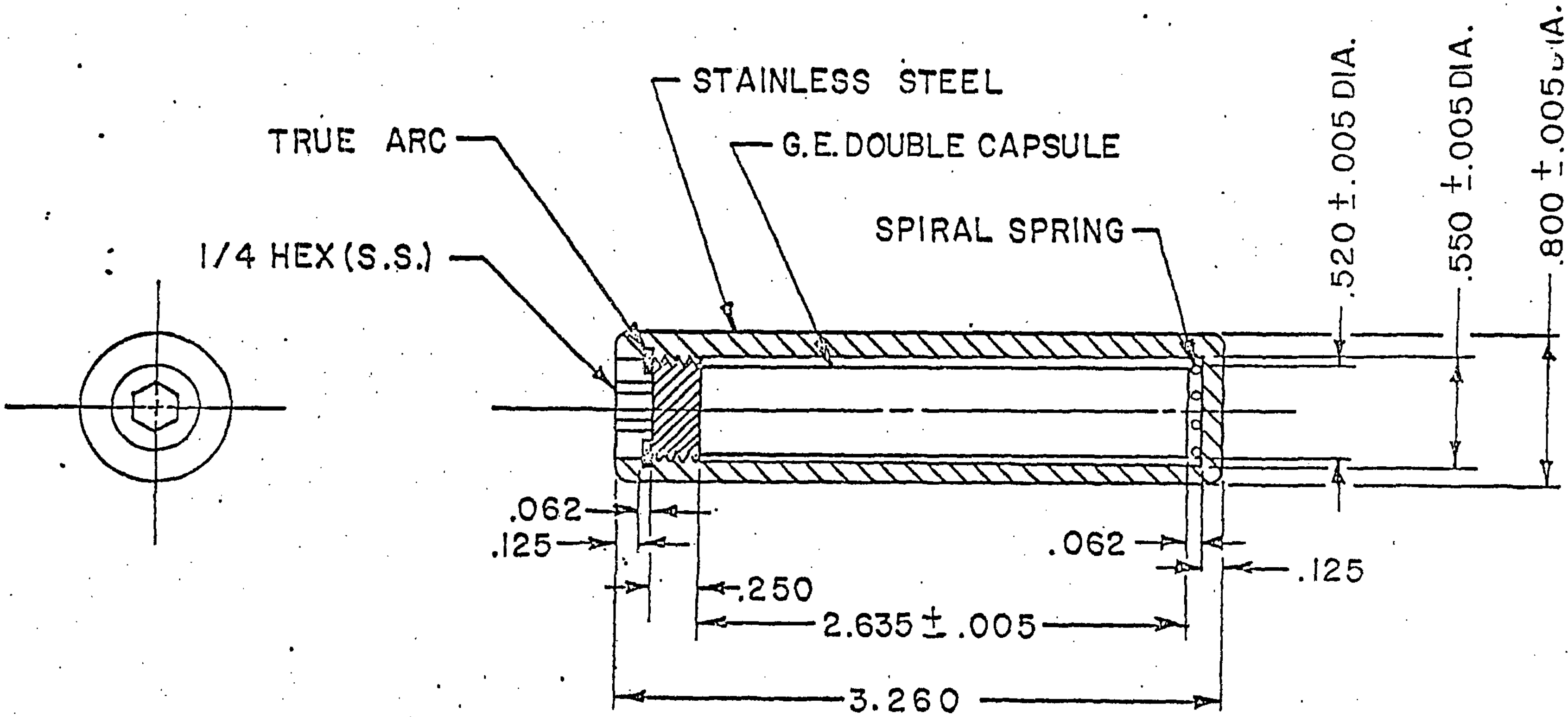


Fig. 3-3. OUTER CAPSULE FOR SOURCE

INCLOSURE #4

RADIATION DETECTION INSTRUMENTS

INCLOSURE 4

RADIATION DETECTION INSTRUMENTS

1. The radiation detecting and measuring instruments listed in this supplement are the instruments now on hand. Instruments may be added or deleted from this inventory during the normal course of use and procurement, but the general overall capabilities of radiation detection and measurement will be maintained. Attached table lists the portable radiation detection instruments.

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

a. Scalers for use with shielded GM tubes, gas flow and scintillating detectors.

b. Single channel pulse height analyzers.

c. Victoreen R meters with reader.

d. 1024 channel pulse height analyzer with 3" x 3" NaI(Tl) Crystal.

INCLOSURE 4. PORTABLE RADIATION DETECTION INSTRUMENTS

TYPE INSTRUMENT	NUMBER AVAILABLE	RADIATION DETECTED	SENSITIVITY RANGE	WINDOW THICKNESS	USE
Bendix 611	3	Gamma	5,000 mR	NA	Dosimeter
Bendix 862	3	Gamma	200 mR		Dosimeter
Victoreen 541A	4	Gamma	200 mR		Dosimeter
Landsverk IM9EPD	3	Gamma	200 mR		Dosimeter
JAN IM147	5	Gamma	50,000 mR		Dosimeter
Bendix 884 Tissue equivalent	4	Gamma neutron(fast)	200 mR		Dosimeter
Bendix 609	4	neutron (thermal)	120 mrem		Dosimeter
Nucleus Tissue Equivalent	1	Gamma neutron(fast)	200 mR		Dosimeter
Victoreen 440RF	2	Gamma	300 mR/hr	1 mg/cm^2 mylar & 0.005 magnesium	Survey Measuring
Victoreen 440	2	Beta Gamma	300 mR/hr	1 mg/cm^2 mylar & 0.005 magnesium	Survey Measuring
Victoreen 740	2	Alpha Beta Gamma	2500 mR/hr	0.005 mylar	Survey Measuring
Radiac Set AN/PDR 27	3	Beta Gamma	500 mR/hr (4 scales)	GM Tubes JAN 5980 & JAN 5979 Mil-E-1	Survey Measuring
Radiac Set AN/PDR-39	2	Gamma	50,000 mR/hr	thick wall Ion ch	Survey Measuring

Nuclear-Chicago 2610-A-P.15	2	Beta Gamma	20 mR/hr	Thin wall GM tube D50	Survey Measuring
Nuclear-Chicago 2612-P.16	2	Beta Gamma Alpha	20 mR/hr	1.4 mg/cm^2	Survey Measuring
Baird-Atomic 420E	2	Beta Gamma Alpha	12½ mR/hr	End window GM tube	Survey Measuring
Nuclear-Chicago 2612	1	Beta Gamma	20 mR/hr	Thin wall GM tube	Survey Measuring
Eberline PIC-6	2	Gamma	1000 mR/hr		Survey Measuring
AN/PDR-52	1	Beta Gamma Alpha	1000 mR/hr	Thin mylar	Survey Measuring
Eberline PRM 5-3 w/HP 260 probe	2	Beta Gamma Alpha	500,000 CPM	2 mg/cm^2	Survey Measuring
Eberline E-500B	1	Beta Gamma	2000 mR/hr	Thin wall GM	Survey Measuring
Chirpee 904517	3	Gamma	1 chirp/.1 mR	GM tube	Warning Dosimeter
Chirpee PRM 253	5	Gamma	1 chirp/.1 mR	GM tube	Warning Dosimeter
Mighty Mite	2	air sampler			Air Sampling
Ludlum Model 28	2	Beta Gamma	To 500K CPM on 4 scales	Thin wall GM	Alarm Measuring

INCLOSURE #5

CALIBRATION

Inclcsure #5

Form NRC - 313 question 11

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

INCLOSURE #6

DOSIMETRY

Inclosure #6

Form NRC - 313 - question 12

Lexington-Blue Grass Army Depot Activity film badge service is used for personnel monitoring on a monthly basis.

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 Personal Radiation Monitors (Chirpees, rad-Tad, Monitalert).

INCLOSURE 7

FACILITY AND CONTAINERS

Inclosure #7

NRC - 313 question 13

The following facilities and containers are described:

I. Building T-383 - Isotope Storage Vault

II. Building S-45

III. Underground Vault

I. Material Storage Vault Bldg T-383. (Sketch on page 7-4)

Drawing, Fig. 7-A, shows the radioactive material storage vault. This building is used to store radioactive materials and radioactive waste.

II. Building S-45. (Sketch on page 7-5)

Drawing, Fig. 7-B, 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). A Scott airpack breathing system is available. Cover-alls, surgical caps and gloves, and booties are also available in various sizes. All work surfaces are stainless steel designed to contain spills.

The decontamination room contains a shower, sink, absorbent paper with waterproof backing, and decontamination chemicals. 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 waiting use.

III. Underground Vault

1. The location of the underground area, consisting of the Vault Console and Exposure Room, in relation to the remainder of Bldg 401 is shown in Fig. 7-1.

2. The Vault Exposure Room (see Figs. 7-2 & 7-3) was designed for the use of a[ ] cobalt-60 sealed source. The figures show the 18" thick wall that extends the maze 5'4" into the Vault Exposure Room. Interlocking ferrite brick were used in the construction of the wall. The ferrite block used on each side of the Zinc Bromide Window in the wall between Vault Console and Exposure Room is also shown in the same figures.

3. Fig. 7-4 shows the relative locations of the various alarm sensors, a warning light that is lit when either source is "up" and other pertinent components. Other warning lights that are lit when either source is "up" are located on top of the earth mound (Fig. 7-3), in the hall at the top of the stairs, and on the control console.

4. The components shown in Figs. 7-5 and 7-6 and the pneumatic and electrical systems (see Figs. 7-7 and 7-8) make up the storage and use device for the 660 curie source. The Shield and Rise Tube Adaptor of the Rise Tube Assembly shown in Fig. 7-6 fits into the plug well, Item 3 of Fig. 7-5. The Rise Tube Assembly is held in place by a Plug Plate that fits over the shoulder of the Shield and Rise Tube Adapter and the top of the Primary Source Storage Shield. The Plug Plate is held down by nuts screwed onto the stainless steel lugs (see item 4 of Fig. 7-5). The Rise Tube Extension is screwed and bolted onto the top of the Rise Tube (Fig. 7-6).

5. An assembly which raises the lead storage plug for the [ ] source (shown in Figure 7-6b is mounted on the wall containing the zinc bromide window. After a 10-second warning period, the motor-driven spool raises the plug. A magnetic clutch releases to lower the plug.

6. The electrical control system schematic is shown in Fig. 7-8. The electrical interlock system will cause both sources to be lowered into their respective Source Storage Shields if:

   a. The maze door is opened,

   b. The zinc bromide in the observation window is low,

   c. The radiation level in the Console Room is above 5 mR/hr or the monitor is off, or

Ex 2

d. The remote control switch in the Exposure Room or the main control switch are switched to the "down" position.

e. An electrical power failure occurs.

The connection TB 4-5 (Fig 7-8) was closed when the system was tested with a dummy source; however, now this connection is open so that the sources cannot be raised from inside the Exposure Room.

7. A pair of Argonne Type D-8 Slave manipulators (see Fig. 7-3) is installed to move equipment located in the Exposure Room while the operator is in the Control Room.

8. The sump in the Exposure Room is connected to the radioactive waste dilution system in building S-45. (Described on Page 7-1)

9. An alarm bell rings if the radiation level in the Console Room goes above 5 mR/hr. The alarm bell is audible throughout Bldg. 401.

10. The pneumatic controls and solenoids are located in the Control Room. An emergency generator and an air compressor take over automatically in case of an interruption or failure of the electrical power system.

11. The pneumatic control system is shown in Fig. 7-7. The hand operated valves (in the Console Room) in the up line allow either or both sources to be raised for use when the system is in operation. An emergency generator and air compressor take over automatically in case of an interruption or failure of the electrical power system.

12. The components shown in Figures 3-1, 7-9A and 7-9B and the pneumatic and electrical systems (See Figs. 7-7 and 7-8) make up the 2048 Ci source storage and use device. The exposure window allows irradiation in an arc of 110°, with 8 inches of lead (encased in ½ inch of stainless steel) shielding in all other directions. The storage/shipping container is marked as being manufactured by the Edlow Lead Co, Columbus, Ohio, under BE Permit No. 1462. As depicted in Fig. 7-7, activation of any of the interlocks cuts the power to the solenoids, resulting in the sources being lowered. In the event of power failure the sources will be automatically lowered the same as an interlock action. In the event of air failure without power failure the source can still be lowered by cutting the power to the solenoids. The weight of the lead-filled plug will force the source into the storage container.

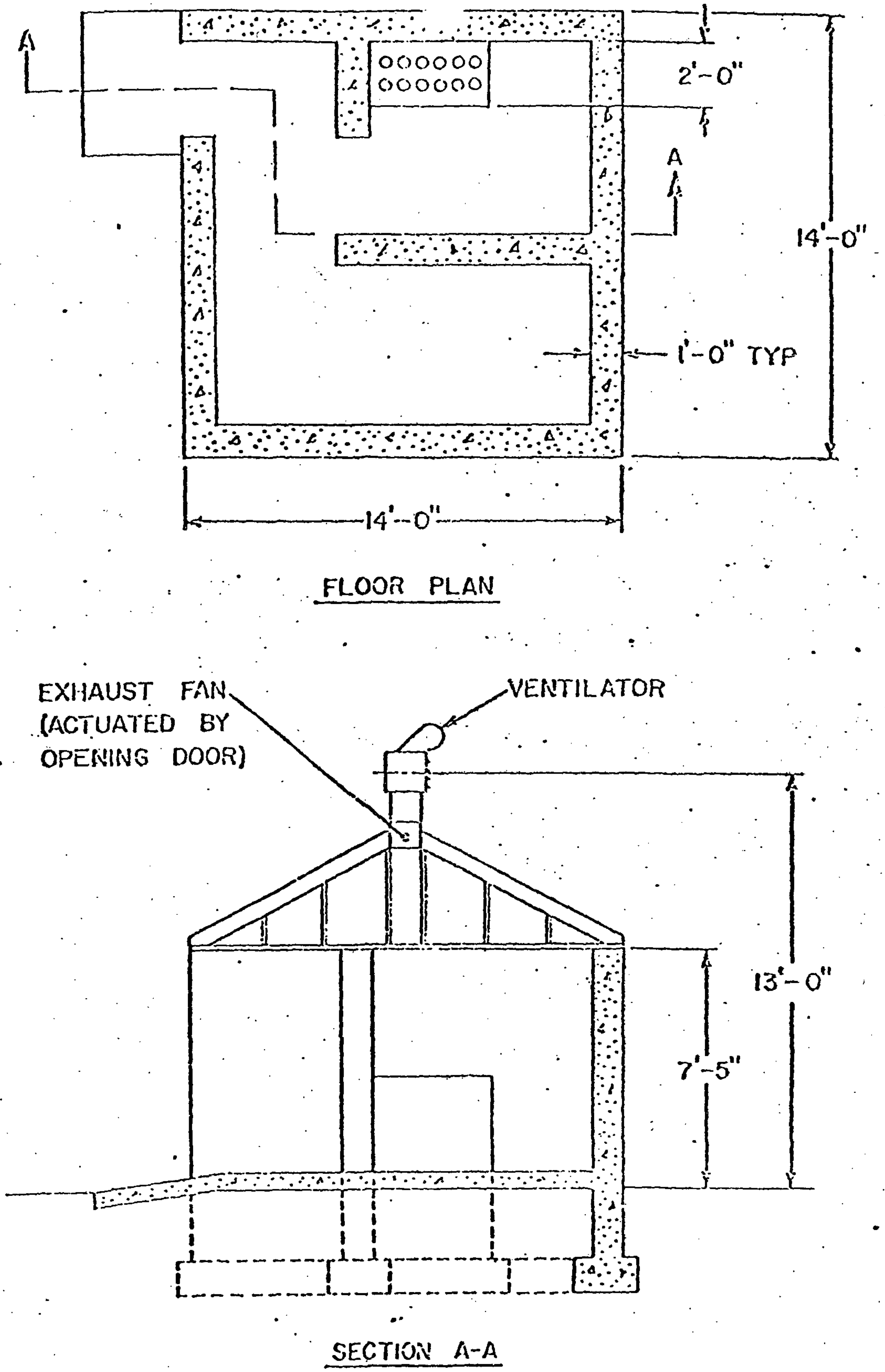


FIG. 7-A. BUILDING T-383 RADIOACTIVE STORAGE VAULT, EVANS AREA

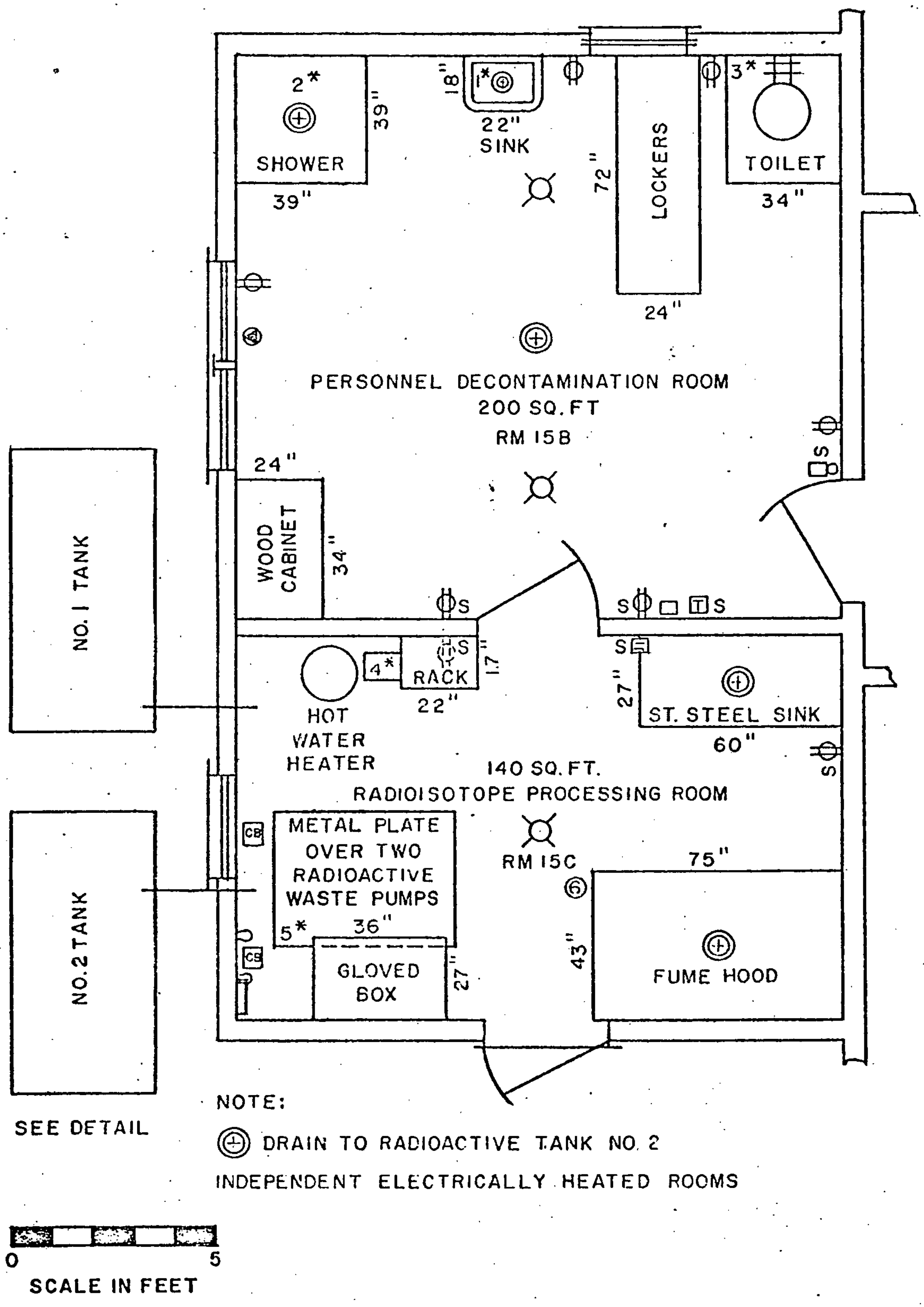


FIG. 7-B. DECONTAMINATION AND PROCESSING ROOMS, BLDG S-45, EVANS AREA

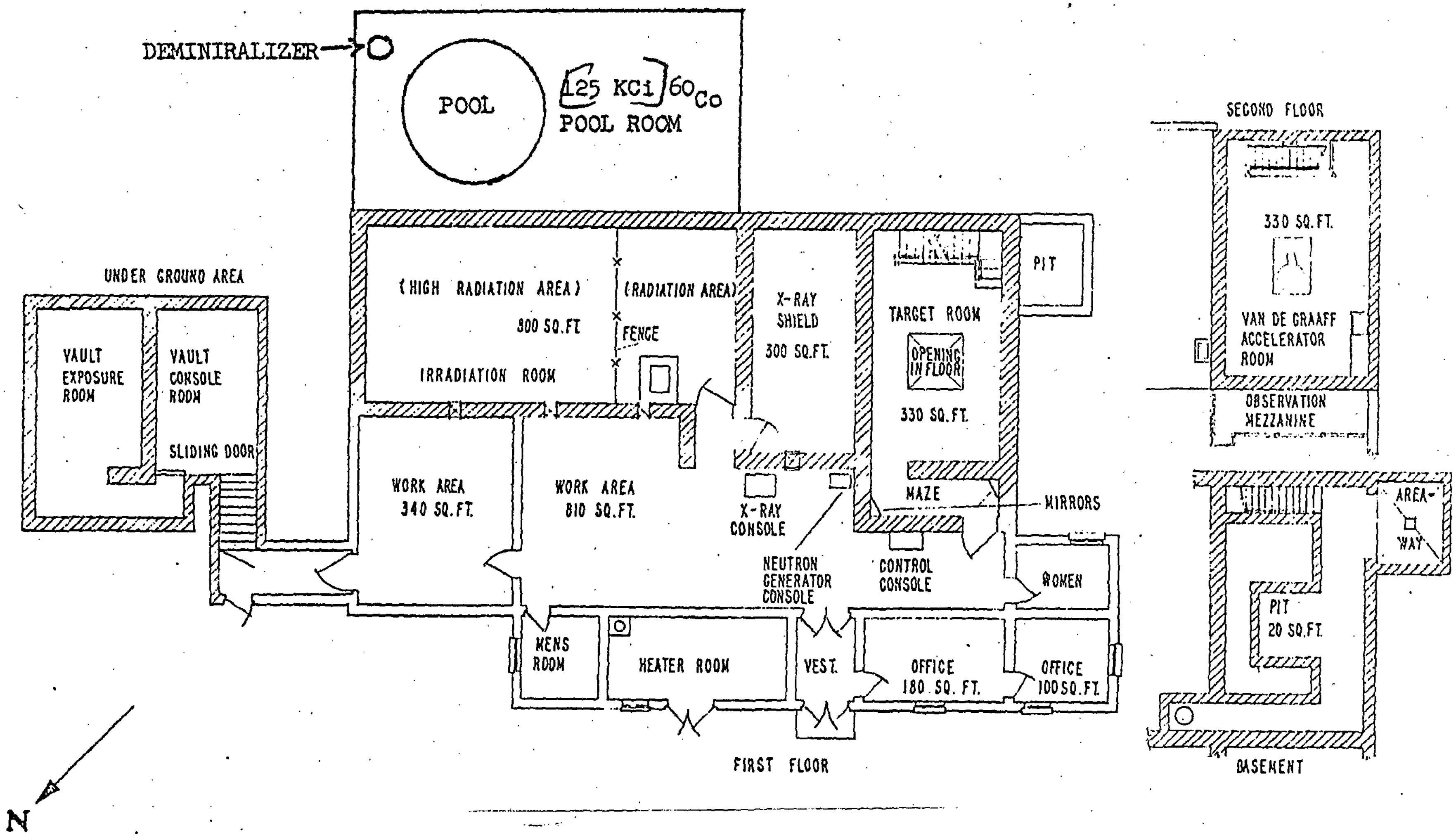


Fig. 7-1. [ ] EVANS AREA

7-3

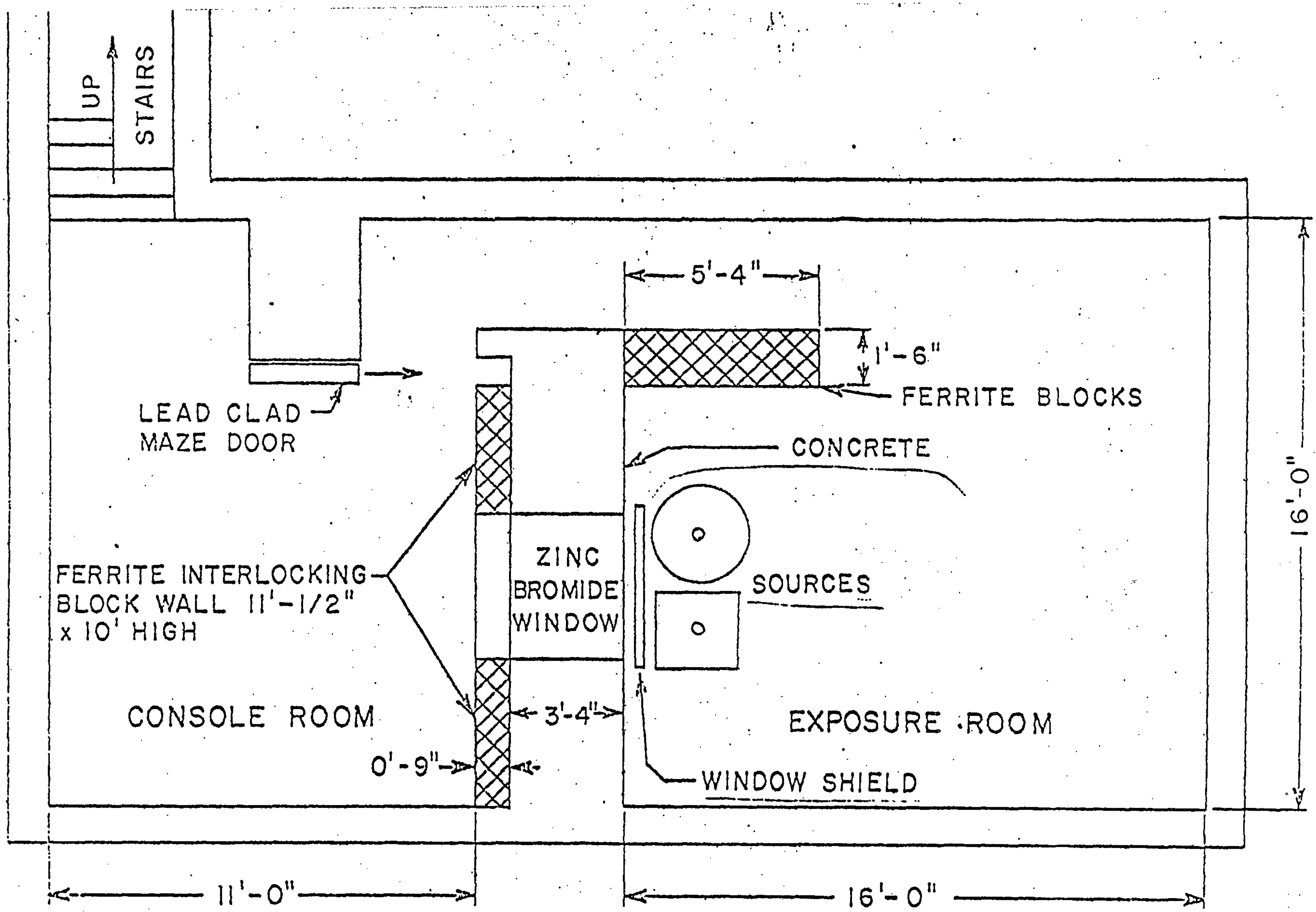


FIG. 7-2. PLAN VIEW UNDERGROUND VAULT

SCALE ¼" = 1' - 0"

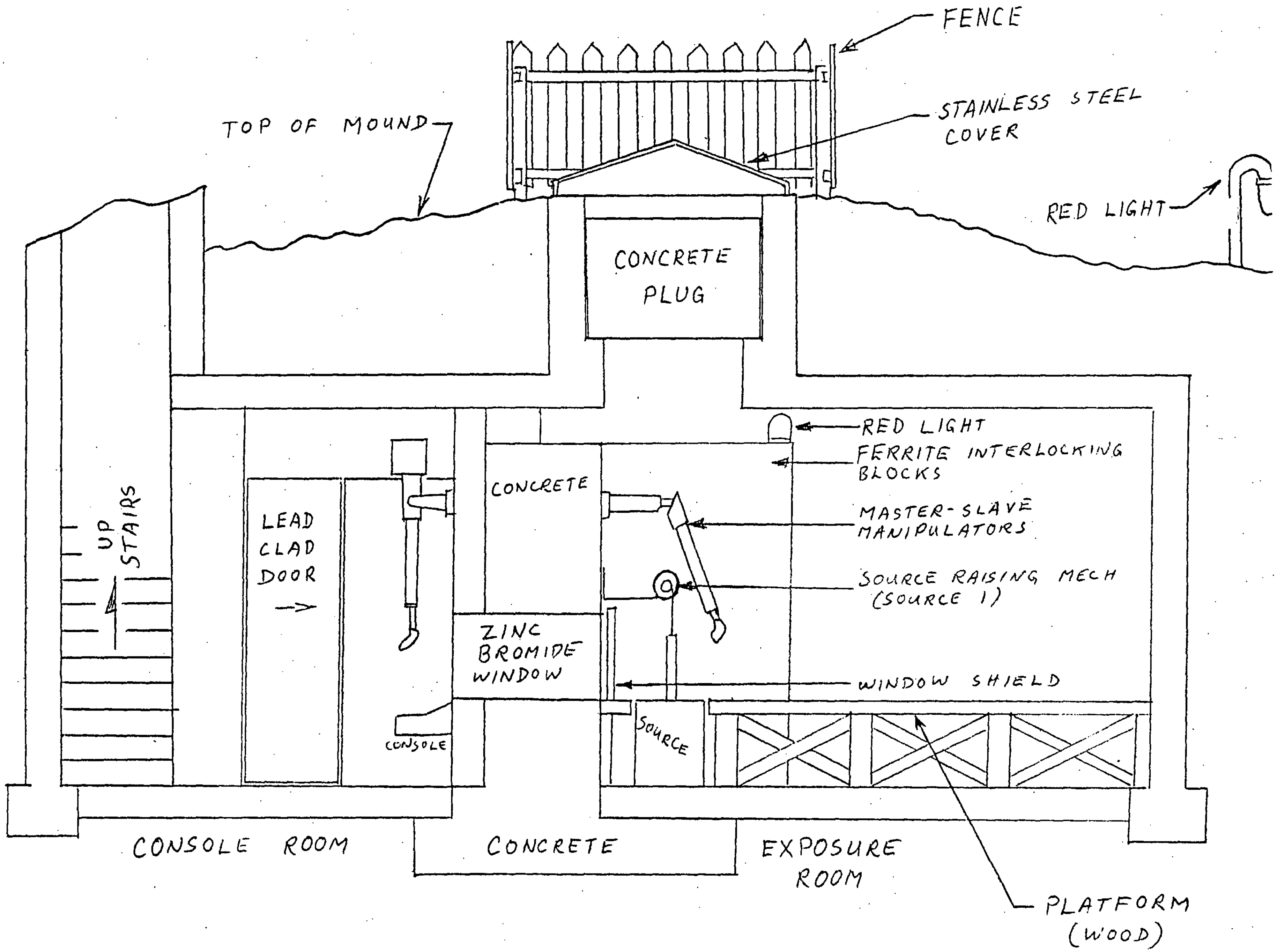
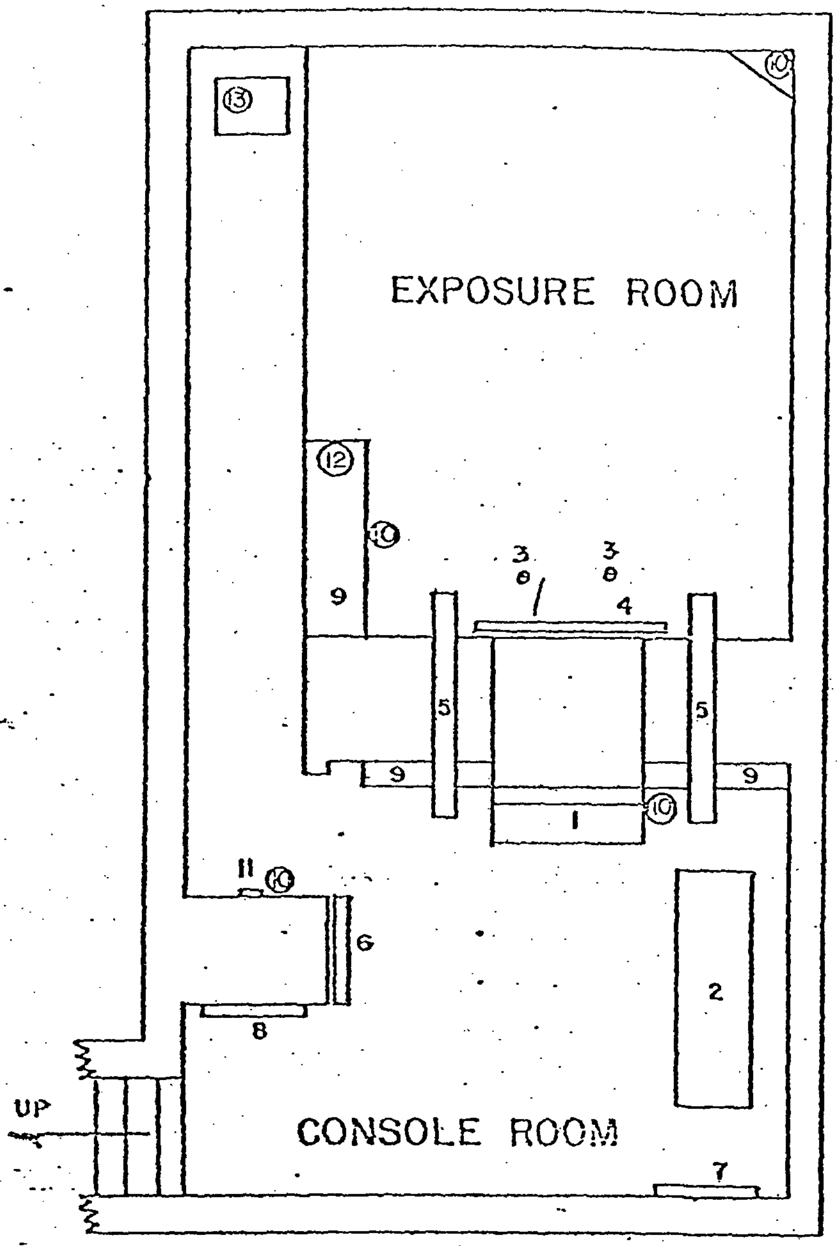


FIG. 7-3. ELEVATION VIEW UNDERGROUND VAULT



1. CONTROL CONSOLE
2. MONITOR CONSOLE
3. SOURCE POSITION
4. WINDOW SHIELD
5. SLAVE MANIPULATORS
6. MAZE DOOR
7. PNEUMATIC CONTROL SYSTEM
8. ELECTRICAL PANEL
9. FERRITE INTERLOCKING BLOCK
10. RADIATION ALARM SENSORS
11. MANUAL ALARM SENSORS
12. WARNING LIGHT
13. SUMP PUMP

FIG. 7-4. UNDERGROUND VAULT INSTRUMENTATION

SCALE $\frac{3''}{16} = 1'$

1. AISI 1/4" TYPE 316 STAINLESS STEEL (ANNEALED, PICKLED & OILEI
2. STAINLESS STEEL ARC WELDING (ALL WELDING)
3. PLUG WELL 3" I.D. X 12 $\frac{1}{2}$" DEEP
4. STAINLESS STEEL LUGS FOR PLUG PLATE
5. 1" DIA. STAINLESS STEEL RODS
6. LIFTING HOLES
7. THREADED PLATE
8. BASE MOUNTING
9. PLUG PLATE

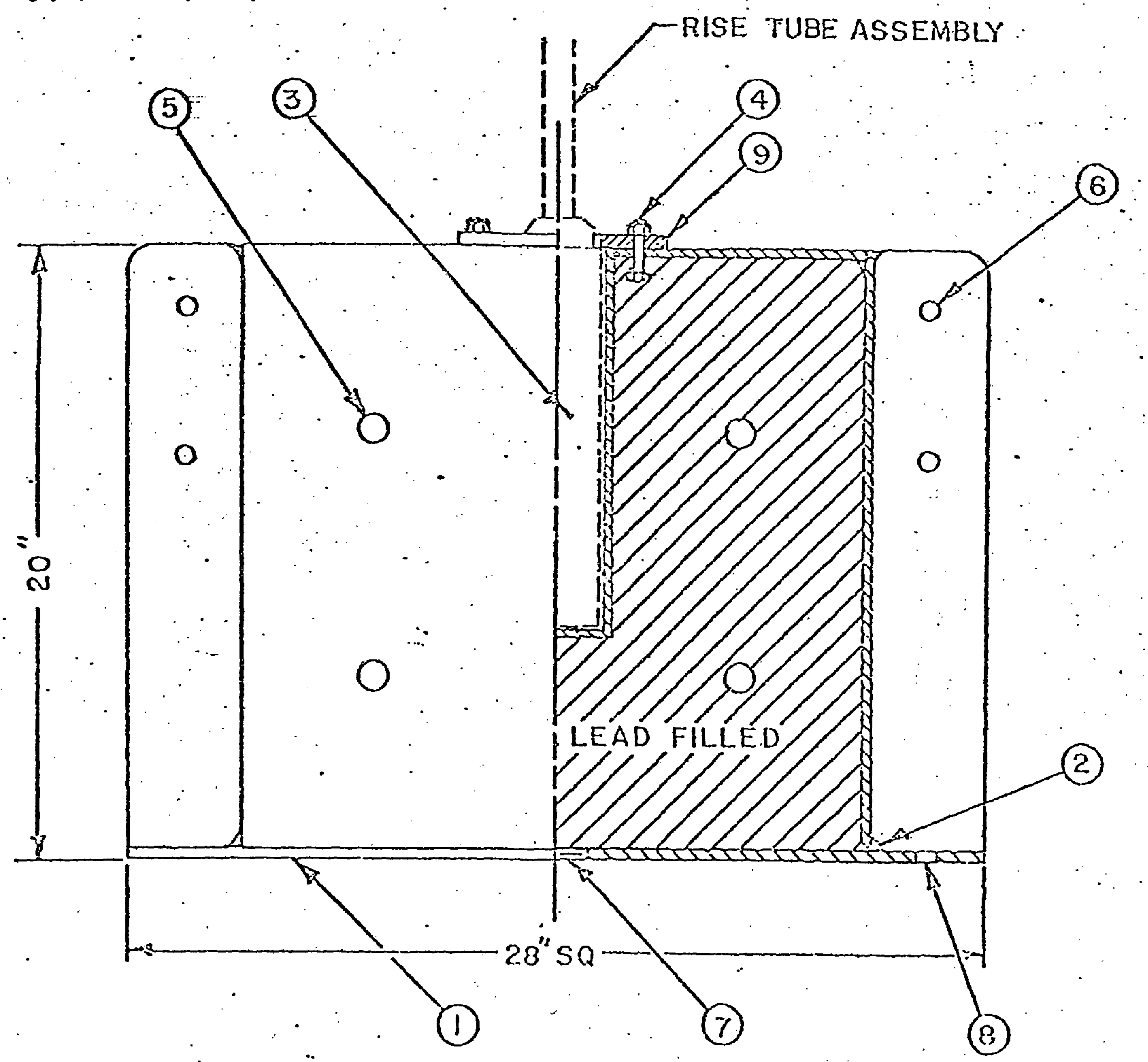


FIG. 7-5. PRIMARY SOURCE STORAGE SHIELD
SOURCE 1

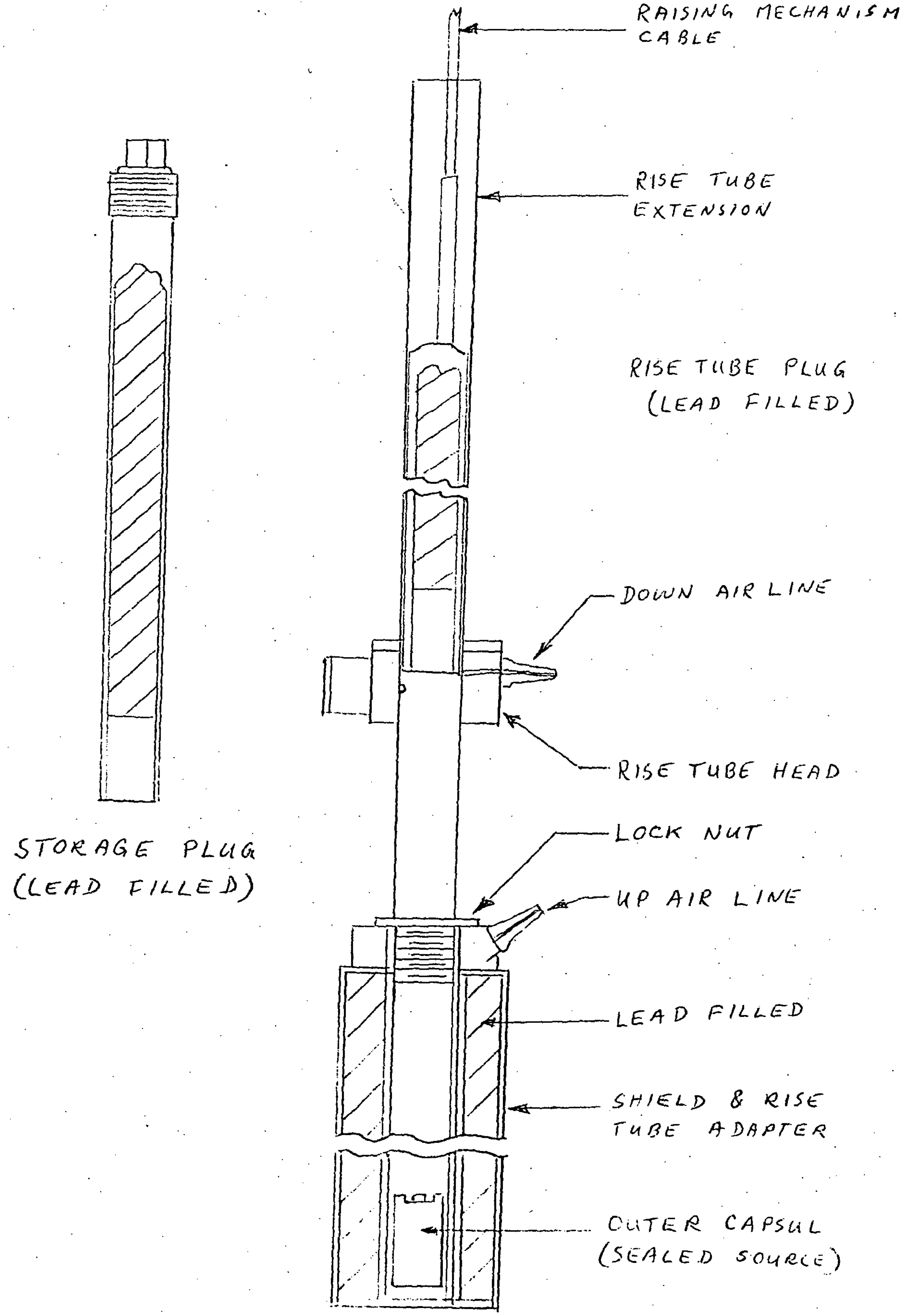


FIG. 7-6a. CAPSULE & RISE TUBE ASSEMBLY SOURCE 1

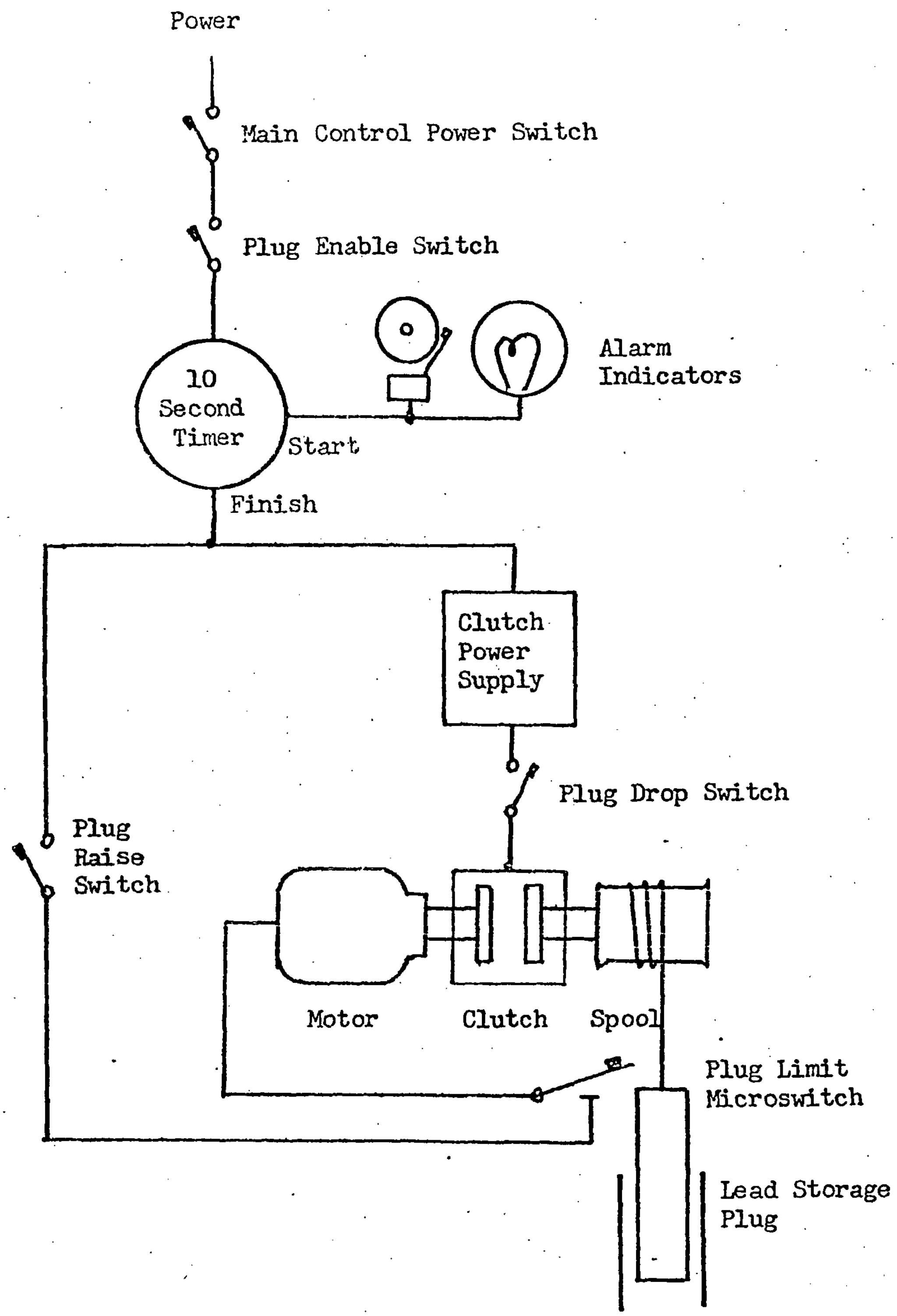


Figure 7-6b. SCHEMATIC OF STORAGE PLUG CONTROL MECHANISM
(SOURCE 1)

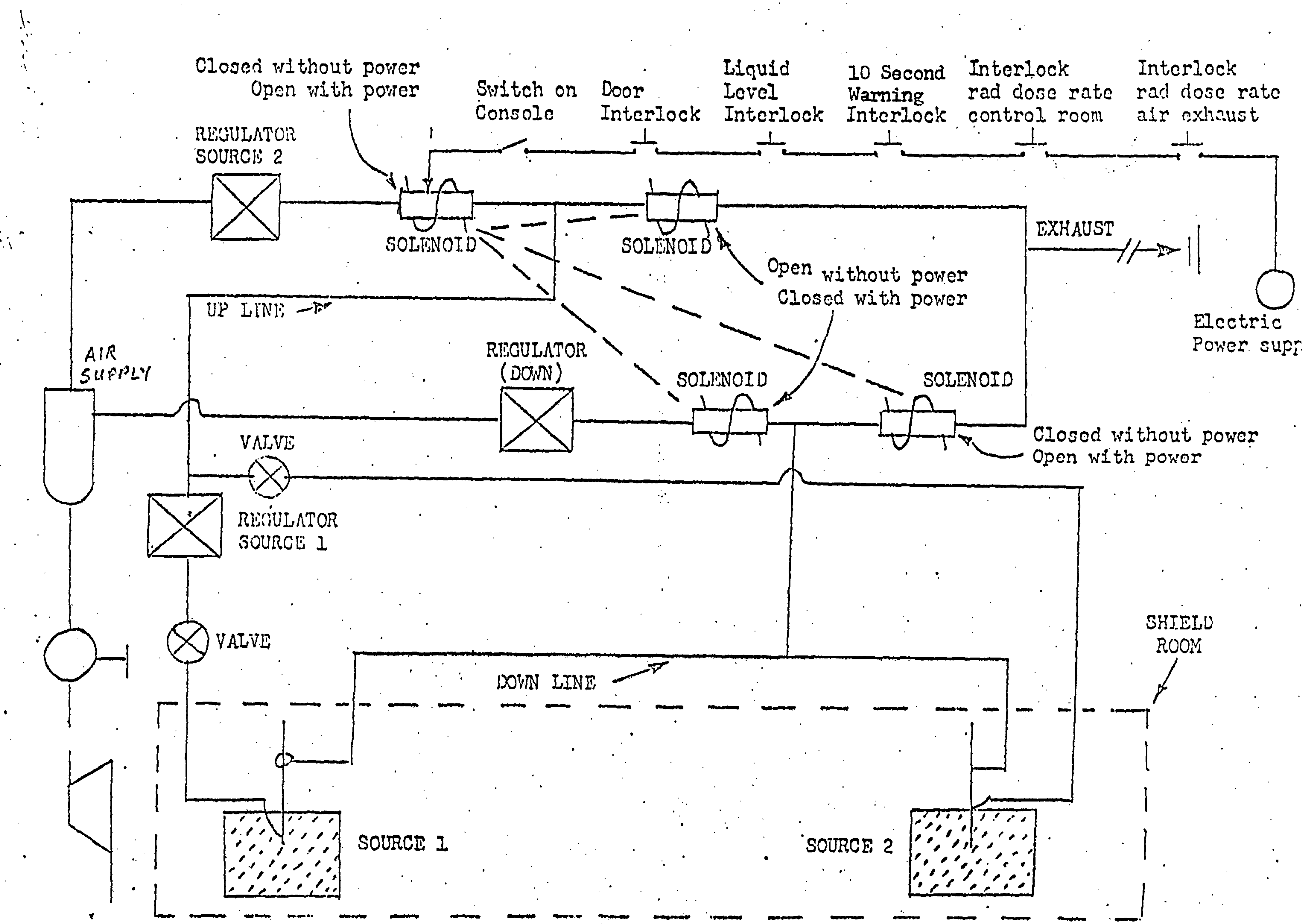
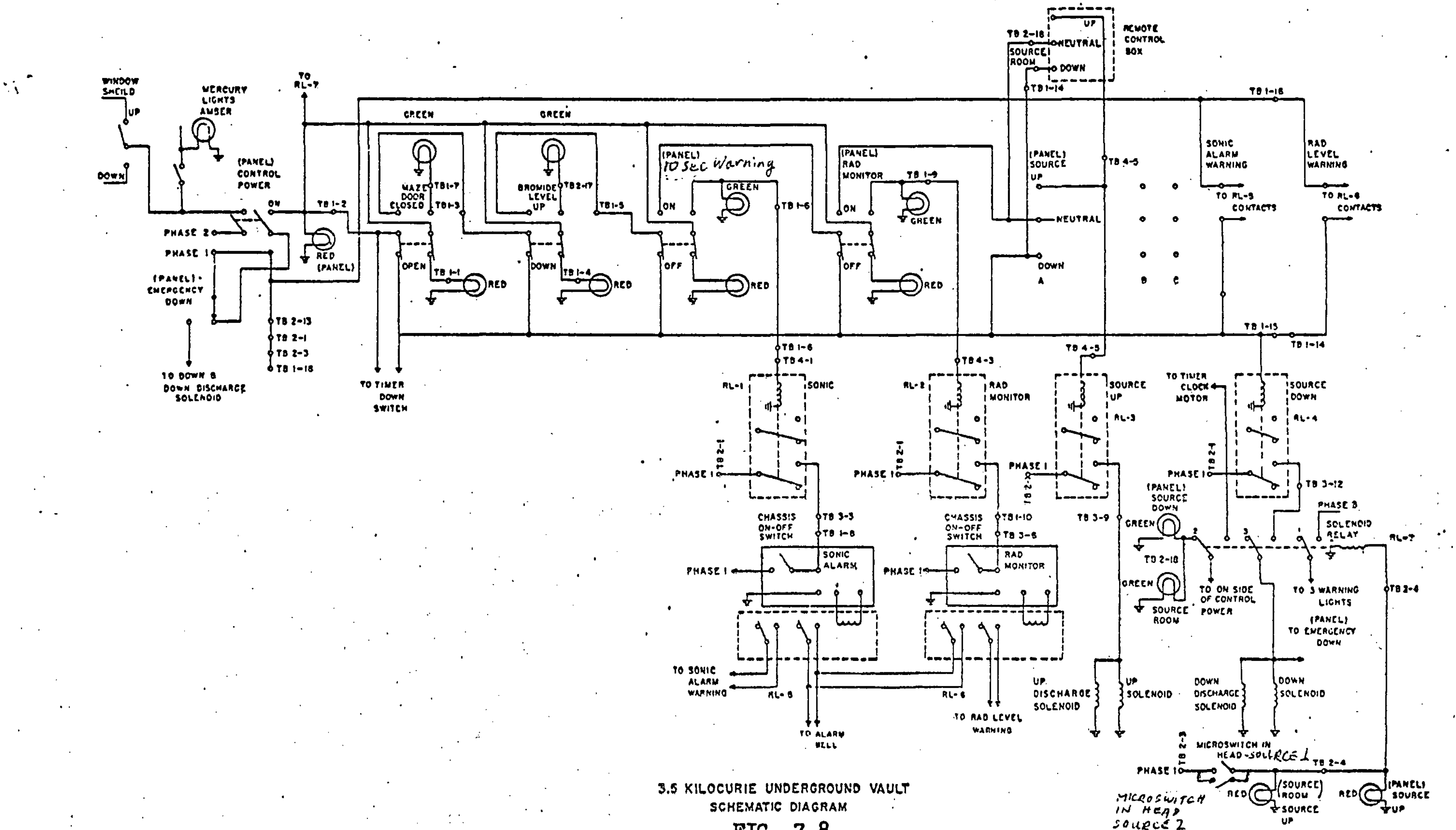


FIG. 7-7. PNEUMATIC CONTROL SYSTEM.



3.5 KILOCURIE UNDERGROUND VAULT
SCHEMATIC DIAGRAM

FIG. 7-8

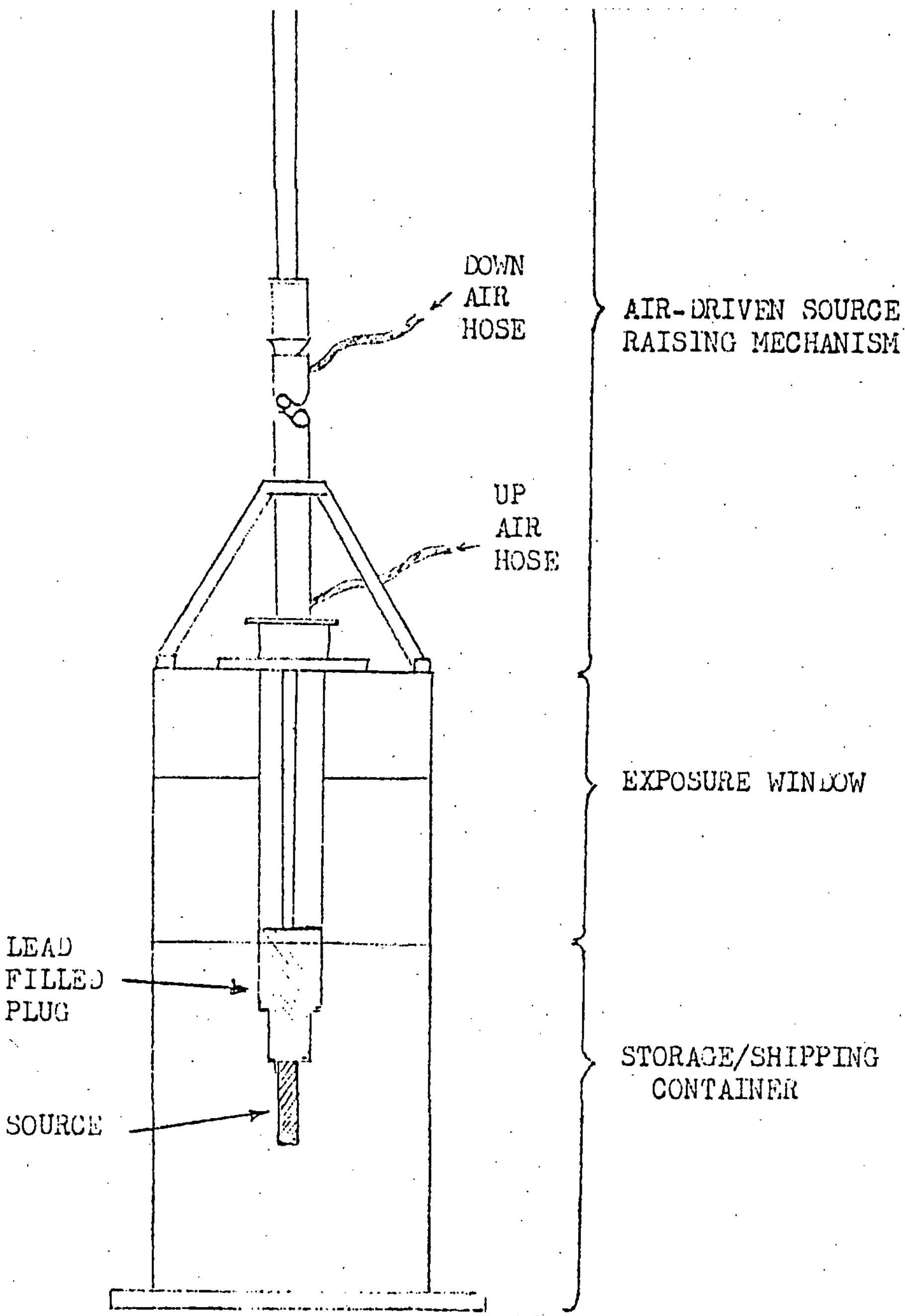


Figure 7-9A. Mechanism for 2048 curie source. Source in down (storage) position.

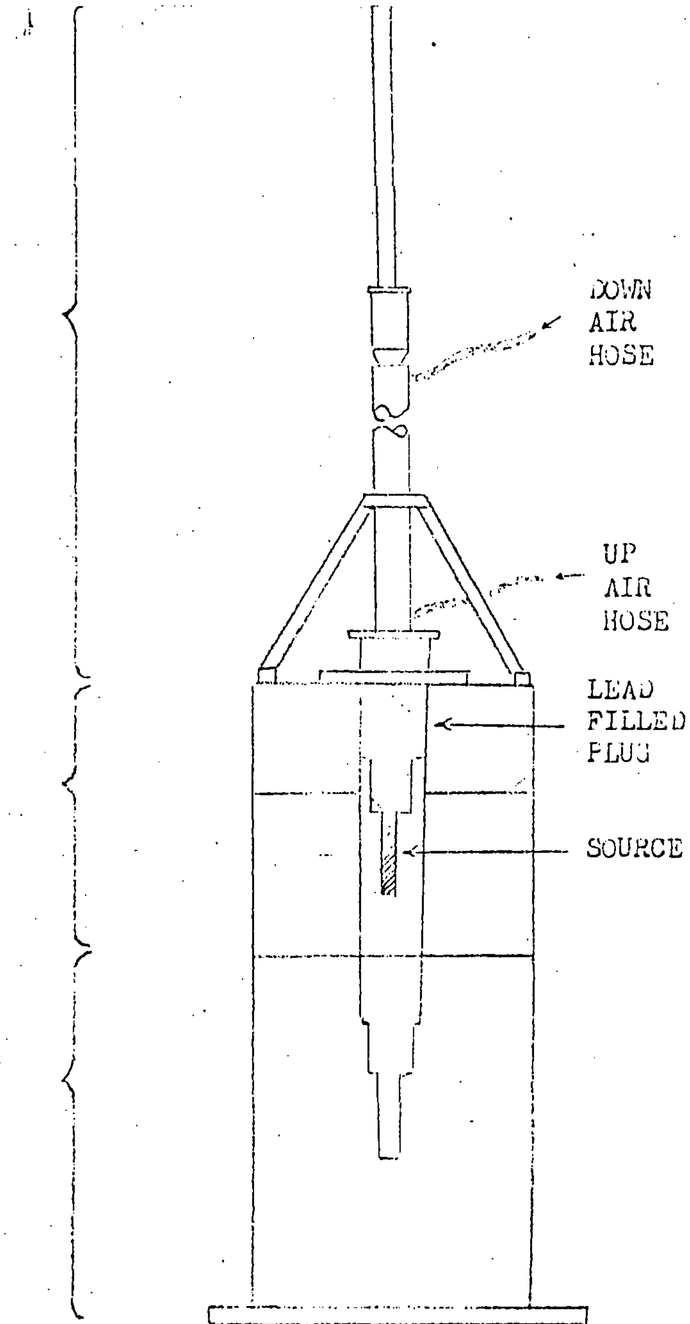


Figure 7-9B. Mechanism for 2048 curie source. Source in up (irradiating) position.

INCLOSURE 8

SOP AND RADIOLOGICAL PROTECTION PROGRAM

OPERATING PROCEDURES FOR THE UNDERGROUND VAULT
COBALT-60 IRRADIATION FACILITY

LOCATION: Bldg. 401, Evans Area of Fort Monmouth.

ORGANIZATION: Radiation Diagnostics/Applications Research Group; Electronics Materials Research Technical Area; Electronic Technology & Devices Laboratory; Electronics Research and Development Command.

1. References:

a. License application for renewal and amendment of NRC License No. 29-01022-07.

b. ECOMR 385-9.

c. DF, Subject "Radiation Protection, Combined Directive" dated 29 Jun 78 from Cmdr TSA, Cmdr CSTAL, Dir ETDL and Dir EWL.

NOTE: Copies of the above references are available in the Console Room in the Office of the Supervisor of Radiation Facilities (Bldg. 401, X65683) and the Radiological Safety Office (Room 150, Bldg. 37D, X65292).

2. Description of Facility: See Inclosure 7 of Reference 1a.

3. Purpose: The purpose of these procedures is to:

a. Provide guidance to individuals who may have occasion to enter the area.

b. Serve as a check list or reminder to operator of approved operations.

c. Serve as a training aid for individuals studying to become approved operators of the facility.

d. Minimize the exposure of personnel to radiation and radioactive material.

e. Minimize the release of radioactive material if the sealed source should rupture.

4. Applicability: These procedures apply to:

a. Visitors.

b. Custodial Personnel.

c. Maintenance Personnel.

d. Individuals who position material to be irradiated.

e. Facility Operators.

f. Operator Trainees.

g. Emergency Personnel (Firemen, Guards, Rescue Squad, etc...)

h. Inspectors.

i. Any other individuals who may have occasion to enter the areas involved.

5. Responsibility:

a. The leader of the Radiation Diagnostics/Applications Research Group or his designated representative is responsible for enforcement of these procedures.

b. The Supervisor of Radiation Facilities or his designated representative have the responsibility of insuring that individuals do not enter the exposure room without an approved operator being present to directly supervise the entrance.

c. Approved operators and individuals authorized to directly supervise the work of individuals undergoing operator training shall insure that the items listed in these Operating Procedures are carried out and that every individual entering the area involved are apprised of the potential hazards.

d. Individuals entering the areas involved have the responsibility of following the instructions given by the approved operator in charge at the time they are in the areas.

6. Personnel Limits:

a. Control Room.

(1) Up to 10 individuals may be in the Control Room when the sources are in their storage position.

(2) Up to 6 individuals may be in the Control Room when any of the sources are in the UP (expose) position. An approved operator must be present when anyone is in the Control Room and any source is in its UP (expose) position.

7. Radioactive Material Limits: The amount of COBALT-60 in the Exposure Room at any one time shall not exceed [ ]

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8. Radiation Limits:

a. Console Room. The shielding material between the Exposure Room and the Console Room shall be maintained in such a manner that the exposure rate in the Console Room does not exceed 5 mR/hour at locations near the Exposure Room door and the surfaces of other shielding between the two rooms. The average exposure rate in the room shall not exceed 2 mR/hour.

b. Exposure Room. (Sources and shield plug on [ ] source down).

(1) The exposure rate over either source, 30 inches above the platform, shall not exceed 250 mR/hour.

(2) The exposure rate 30 inches above the platform and 40 inches from a perpendicular line that passes through either source shall not exceed 1 mR/hour.

9. Exposure Limits: The exposure rates and the length of time spent in the Underground Vault Area shall be controlled so that the exposure limits given in ECOMR 385-9 are not exceeded. NOTE: A copy of ECOMR 385-9 is available for use in the Console Room and in the Office of the Supervisor of Radiation Facilities (Bldg. 401, X65683) and the Radiological Safety Office (Rm 150, Bldg. 37D, X65292).

10. Dosimetry Requirements:

a. Radiation workers shall wear their film badges while in the Underground Vault area.

b. Each individual who performs work in the Exposure Room shall wear a film badge and a pocket dosimeter (0-200 mR) while in the room. At least one of each two individuals working in the room shall wear a "chirpee" type of instrument. The two individuals shall stay together if only one of them is wearing a "chirpee".

c. At least one out of each group of four or less of visitors in the Exposure Room at one time shall wear a personnel dosimeter. The members of such a group shall stay close to each other so that any exposure indicated by the dosimeter will be representative of each member of the group.

d. The Supervisor of Radiation Facilities, the Radiation Protection Officer or one of their designated representatives, or the approved operator in charge of the facility at the time may require the use of additional personnel dosimeters and/or radiation detectors.

11. General Safety Precautions:

a. Individuals wishing to visit the Underground Vault Area, to have material irradiated, or to enter the area for some other reason (other than

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for emergency reasons) should schedule the visit so that advance preparations can be made. Contact the Supervisor of Radiation Facilities or his assistant (X65683) to make reservations.

b. Individuals shall sign in and be issued personnel dosimeters, radiation detection and measuring devices before entering the restricted portion of Bldg. 401. These steps are carried out in the Bldg. 401 office nearest the entrance to the building.

c. All individuals going to the Console Room shall be accompanied by an approved operator or his designated representative.

d. Only approved operators or their designated representatives will sign for the key to the Underground Area.

e. Only an approved operator may obtain the key for the switch lock that operates the solenoid air valves that control the positioning of the sources by air flow.

f. An approved operator and at least one other individual shall be in the Underground Vault Area while the door to the Exposure Room is open.

12. Source Storage:

a. The ( ) source will be kept in its storage container with the lead plug over the source and the ( ) source will be kept in its DOWN position (Since this source is attached to its lead safety plug, the source being DOWN also means the lead plug is DOWN) in its storage container if:

(1) The source is not in use.

(2) Individuals are in the Exposure Room.

(3) A leak test of the source indicates the source is leaking.

(4) Radioactive contamination is found in the Exposure Room.

b. The steps to follow in order to put the sources in their storage positions are listed in Item 14e below.

13. Emergencies:

a. No air pressure.

(1) If source capsules are in their lead storage containers they cannot be raised to exposure position until air pressure is supplied. A small emergency air compressor can be put into service by opening necessary valves.

E 2

(2) source capsule in exposure position. The source can be returned to the lead storage container by opening the switch to the magnetic clutch, which lowers the lead storage plug and pushes the source capsule into the lead storage container.

(3) The source in the exposure or UP position. The source can be returned to the lead storage container by inserting the key in the source control switch and turning the key counterclockwise. This exhausts the air and allows the source to lower.

b. Electrical Power Failure.

(1) The source capsules automatically return to the lead storage containers with any interruption of the electrical circuits.

(2) The emergency power generator automatically energizes if electrical power remains off for more than ten seconds. This emergency generator supplies electrical power to all components and supplies light to operate on during an emergency.

c. If the meter that indicates exposure rate at the source exhaust air vent reads above 3 mR/hour or if there are other indications of the sources leaking:

(1) Cut off the air supply valve to the source controls. This hand valve is located on the wall to the right of the console.

(2) Shut off the Console Room exhaust fan. The switch for this fan is located on the wall beside the electrical panel.

(3) Leave the Underground Vault Area. Close the door at the top of the stairs as you leave. Remove your shoes as you leave the area (they may be contaminated).

(4) Proceed to the Large Work Area of the building. If anyone is in the work area ask them to contact the Supervisor of Radiation Facilities or the Radiological Safety Office (X65292) and ask for assistance. If no one is in the area try to contact the Radiological Safety Office yourself. Two phones are in the large Work Area.

(5) Proceed to the nearest restroom, wash exposed portions of the body and remove outer garments. Remain in or near the restroom until you have checked for contamination.

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14. Sequence of Operations.

a. Pre-Entry Requirements.

(1) Obtain advanced approval of the Supervisor of Radiation Facilities or his designated representative.

(2) Register in office for film badge (if not permanently assigned) and personnel monitoring equipment (dosimeter, chirpee).

(3) Accompany approved operator (who has signed out for the Underground Vault Keys) to locked entrance of Vault Console Room.

b. Entry into Console Room. Upon entering the Console Room operator will:

(1) Activate equipment by turning on main electrical switch on wall panel.

(2) Open valve supplying air pressure to source controls.

(3) Open valve at bottom of filter to remove all water from air lines.

(4) Check readings of monitors for the console room and the one for the source exhaust air.

(a) If the Console Room Area monitor indicates that the exposure rate is over 2 mR/hour, notify the Supervisor of Radiation Facilities or the TSA Safety Office (X65292).

(b) If the exhaust air monitor reads over 3 mR/hour follow the instructions in Item 13c, "EMERGENCIES", above.

c. Entry into the Exposure Room.

(1) Make sure all entrants have required dosimeters and radiation instruments in addition to their film badges.

(2) Check and make sure both sources are down, in storage position and that the 660 Ci source storage plug is down.

(3) The operator will place the source control switch key in his pocket and keep it there.

(4) The first individual to enter the Exposure Room must take survey meter readings before and during entrance.

(5) Check survey meter at end of maze to insure that the source is in its safe position.

(6) When setting up equipment for exposures do not lean over source rise tubes.

d. Raising the Source.

(1) Make sure all equipment is secure and in correct position.

(2) Remove all excess cables and wires.

(3) Leave Exposure Room making sure to bring survey meter out.

(4) The operator in charge will check the Exposure Room to insure that everyone is out of the room before proceeding to (5) below.

(5) Close lead clad maze door to maze and the exposure room making sure interlock closes and green light shows on console.

(6) Check the level of solution in the zinc bromide window. Green light on console should be ON.

(7) To use Source 1 [ ] only.

(a) Open air valve for Source 1. Assure that air valve for Source 2 is closed.

(b) Check air pressure gauges. The pressure for the Source 1 UP gauge should be between 8 and 18 psi while the pressure on the DOWN gauge should be between 18 and 25 psi. The pressure on the Source 2 UP gauge should be 0. If the air pressure is beyond the ranges given, contact the Supervisor of Radiation Facilities before proceeding.

(c) Actuate the plug enable switch. This initiates a 10-second warning period, all during which an alarm bell sounds and a red warning light flashes.

(d) After the warning period is ended, actuate the plug raise switch. This initiates a 15-second period during which the lead storage plug is raised. A green light on the console indicates the end of this period.

(e) After the plug raising period has ended, insert the key in the source control switch and turn it clockwise. This will activate the air control, raising source 1 to the exposure position. The red lights on the console, the upper hallway, the outside of the building, and the earth mound will remain lit as long as the source is up.

(8) To use Source 2 [ ] only.

(a) Open air valve for Source 2. Assure that air valve for Source 1 is closed.

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(b) Check air pressure gauges. The pressure for the Source 2 UP gauge should be between 50 and 60 psi while the pressure on the DOWN gauge should be between 18 and 25 psi. The pressure on the Source 1 UP gauge should be 0 psi. If the air pressure is beyond the ranges given, contact the Supervisor of Radiation Facilities before proceeding.

(c) Insert the key in the source control switch. Turn the key clockwise. This will activate air control and raise Source 2 to the exposure position where it will be held by the air pressure. Red light on console will light as well as red lights in upper hallway and outside on building and earth mound. As long as source is in the UP position these lights will remain on.

(9) To use both Source 1 and Source 2 at the same time.

(a) Open air valve for Source 1 and air valve for Source 2.

(b) Check air pressure gauges. The pressure for the Source 1 UP gauge should be between 8 and 18 psi, the pressure for the Source 2 UP gauge should be between 50 and 60 psi and the pressure on the DOWN gauge should be between 18 and 25 psi. If the air pressure is beyond the ranges given, contact the Supervisor of Radiation Facilities before proceeding.

(c) Insert the key in the source control switch. Turn the key clockwise. This will activate air control and raise both sources to the exposure position. Red light on console will light as well as red lights in upper hallway and outside in building and earth mound. As long as source is in the UP position these lights will remain on.

(10) If overnight or weekend exposures are required, notify the Fire Department on X65432, also the security guards X65670.

e. Lowering the Sources.

(1) Insert key in source control switch and turn it counterclockwise. This lowers sources into storage containers as well as lowering the lead storage plug for source 1. All remote monitors should return to zero, red lights will go out and green light will appear on console.

(2) Close air valves for sources 1 and 2.

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(3) Lower lead shield covering window if it is in its UP position.

(4) Open lead shield door leading to exposure room.

(5) Turn on exhaust fan to remove ozone air due to exposure.

(6) Take survey meter and enter exposure room to remove equipment or make changes for further exposures.

f. Leaving Underground Vault.

(1) Make sure all excess equipment, cables, etc. are removed from exposure room.

(2) Make sure you have the keys to both the source switch and the door of the vault before leaving.

(3) Turn off air pressure valve to source controls.

(4) Turn off all radiation monitors.

(5) Turn off air vent blower.

(6) Pull main electrical switch.

(7) Make sure door to entrance of Underground Vault is locked.

(8) Turn in all personnel monitors and sign out in office. (Bldg. 401)

15. Periodic Inspection and Maintenance Procedures.

There are four interlocks that prevent the sources from being raised.

a. The lead door to the exposure room has an interlock. If the door light on the control panel is red, this indicates the door is not closed far enough to close the interlock. If either source is up and the door is opened the action of the interlock will cause the source to be lowered into the storage container.

b. Zinc bromide level. There is a micro-switch on a float to check the level of the zinc bromide filled window. If the indication light is red the source will not go up. If the window liquid should leak out into the exposure room and not be apparent in the control room, a drop in the level of the zinc bromide liquid will cause the float to activate the micro-switch. If the source was in the exposure position it would activate the air valve, lowering the sources back into the storage containers making it safe to enter the control room.

c. Radiation monitors. There is a toggle switch on the control panel that turns the Victoreen area monitors off in case they need to be worked on. If this switch is in the off position the sources cannot be raised. The control room monitor is set at 3 mr/hr, and the exhaust air monitor is set at 3 mr/hr. When the control power is turned on, the needles go up to these settings and the warning bell comes on. Each meter has to be reset to release the warning bell interlock.

d. The plug enable switch must be in the on position or the sources will not raise. When this switch is turned on a warning bell will ring for 10 second: in the exposure room to give warning that the sources will be raised.

e. All of the interlocks work with air-electric valves. When the source is not in use, the air shut off valve is turned clockwise to the closed position. The air shut off valve must be turned counterclockwise to the open position before the sources can be raised. The sources cannot be raised to exposure position if there is no air pressure.

f. The following checks will be made every six months (March & Sept):

(1) Turn on main power to control panel and console containing monitoring system by closing knife switch located on electrical panel at the foot of the stairs.

(2) Check all lights on console and control panel. The following lights should be on.

(a) Control panel

Source switch (key) green

Plug enable - green

Door to exposure room - red (open) green (closed)
Window - green

Monitors - green

(b) Console

Alarm: Red light will show and alarm will ring until system equalizes. Green light will show, alarm will shut off.

Remote monitors: All meters should be lighted. All monitors should be to zero with red lights out. If red light shows on monitor - reset button must be pushed and held until light stays out. It takes time for monitors to reach equilibrium if the system has been off.

(3) Check interlock on lead door leading to exposure room. When door is closed red light on control panel should go out and green light should show.

(4) Check float level of zinc bromide window, green light should go out and red light activate when float is pushed lower in the solution.

(5) Check operation of lead shield cover for zinc bromide window by throwing switch located on the control panel up or down, to raise or lower. Check limit stop switches by running until windows stops automatically at both up and down positions.

(6) Check remote monitoring meters on console. If power transit has produced high reading(s) push reset button(s).

(7) Check plug enable light. Green light should go on after plug enable switch has been on for 10 seconds and alarm bell has rung.

(8) Turn on air valve, located on rear wall. This supplies air to the source operating system. Observe air gauges for up and down pressures. UP pressure for source 1 should be between 12-14 lbs, UP pressure for Source 2 should be between 50 and 55 lbs and DOWN pressure approximately 18 lbs. Adjust if necessary.

(9) Check each source operation as follows:

(a) Close lead door leading into source room, green light should show.

(b) Check window float level, green light should show.

(c) Check source key switch, green light should show.

(d) Raise lead safety plug for checking Source 1.

(e) Using source control key, turn switch clockwise, this activates air control valves and raises source to exposure position. Red light on source control switch should activate, green light should go out. Remote area monitor in source room and in maze should show indications of radiation. Red lights in upper-hallway, outside wall of vault and on mound should light.

(f) Source should remain in exposure position when key is returned to center position.

(10) Check each source safety operations as follows:

Source in exposure position.

(a) Turn switch key to counter-clockwise position, source should return to storage container and green light should come on.

(b) Open lead door leading to exposure room, source should immediately lower into storage container; red door light on control panel should show.

(c) Push up on back of float level for zinc bromide window forcing float lower in solution, source should automatically lower to storage containers, float level red light should come on.

(d) Check loss of power by opening knife switch on electrical panel controlling console power. With power off or interrupted, source should automatically return to its lead storage container, green source-light should activate.

(11) Emergency generator check.

Located in a shelter just outside Building 401. Unit consists of a standard Army power unit PU-26-A/U with engine starting controls and an automatic transfer switch. This unit has the capability of automatically starting if any of the three phases are out and shuts off automatically when normal service is restored. This unit supplies emergency power to the control panel and the console of the underground vault so that the source can be put into operation if necessary. A standby compressor to supply air pressure is also housed in the shelter to supply emergency air pressure if needed.

(12) To check for operation.

Just inside the door on the wall is a circuit break box. The three main circuit breakers are tied together on the box so that normal service can be cut off. To check put these circuit breakers in the off position. This will activate the automatic engine starting control and will crank the engine. If the engine does not start in 10 seconds there will be a pause of 10 seconds before it tries to start again. This cycle is repeated for 3 times. After the engine starts the automatic transfer switch throws the load on the generator, activating the control panel and console in the underground vault. An emergency light is also connected to this circuit to give light in the vault.

Throwing the circuit breaker back to the on position causes the transfer switch to put the load on normal service and the engine shuts off automatically.

(13) Calibration and Check of Remote Monitoring System

This system provides separate readout, in the control room, of the dose rate at each of the five remote sensing units. The units have logarithmic meter readout covering three decades. Three of the units have 1 to 1000 mR/hr ranges. The fourth unit covers 100 to 100,000 mR/hr and the fifth 0.1-100 R/hr. Radiation levels in excess of pre-set alarm conditions are indicated by a red alarm light for each unit. The system operates on 115V, 60 hertz supply.

The following detailed procedure may be followed to recalibrate any suitable combination of remote radiation sensing unit and plug-in station unit:

(a) Turn on the remote area monitoring system and allow it to warm up for 10 minutes. Remove the small cover plate on the front of the plug-in station unit, thus exposing the three screw-driver adjust potentiometers: Track, Span and FIL current adjust as well as the filament current measuring jack.

(b) Measure the filament current by plugging into the filament current measuring jack (J-201) a 0.25 V millivoltmeter. Adjust the FIL current adjust potentiometer until the meter reads 0.25V. A model 630 Simpson multimeter switched to the 100 micro-ampere DC range can conveniently be used as a 0.25V millivoltmeter. The proper plug for J-201 is a Switchcraft No. 480 (JAN PJ-068 or WE 39) plug. Changing the filament current shifts the static level of electrometer tube plate current without appreciable changing the charge in plate current per decade change in signal or ion current. Moving the FIL adjust potentiometer, therefore, has the same affect as moving the RANGE potentiometer, without affecting the proper setting of the SPAN potentiometer. Measurement of the filament current is desirable primarily to establish that the resistor string, of which the filament is a part, has the proper current and that the zener diode is operating properly.

(c) Irradiate the remote radiation sensing unit connected to the plug-in station unit in question with a gamma radiation field of the intensity indicated on the left end of the meter scale. Adjust the RANGE potentiometer (R-203) on the front panel of the plug-in station unit until the meter reads correctly.

(d) Irradiate the remote radiation sensing unit with the second gamma radiation intensity preferably at least a decade higher than that used in step 3. Without changing the position of the RANGE control, adjust the SPAN control (R-205) until the indicating meter again reads correctly.

(e) In the event that either step (c) or step (d) cannot be accomplished properly, change the position of the FIL current adjust potentiometer to provide a different filament current and repeat steps (c) and (d).

(f) In the event that it is inconvenient to irradiate the remote radiation sensing unit with an intensity equivalent to the left end meter scale reading (the lowest measurable radiation intensity), any two known on-scale radiation intensities may be utilized for calibration. However, it will be necessary to arrive at successive approximations for the proper adjustment of the SPAN and RANGE controls by performing steps (c) and (d) two or three times, since the SPAN and RANGE controls are not independent of each other for radiation intensities other than that indicated in the previous steps.

(g) Tighten all locks on the screw driver potentiometers and replace the cover plate on the plug-in station unit.

The RANGE control may be adjusted at any time through the use of the built-in calibration device. This RANGE control is provided on the front panel to permit adjustment to compensate for minor long term drifts in the instrument. Its position will not affect the proper SPAN setting or the change in meter reading per decade change in signal or ion current.

g. In addition to the checks described in f the following are performed at the interval indicated.

(1) Sources are leak tested every six months.

(2) Source 1 head holding mechanism is checked for wear and adjustment every 3 months.

(3) Micro-switch on holding heads are inspected and tested for radiation damage every 3 months.

(4) Wooden platform in source room is checked yearly and replacement made if any radiation damage is present.

(5) Mercury vapor lamps in exposure room are checked every 3 months, and replaced or repaired if necessary.

(6) Air system is inspected for leaks every 3 months.

(7) Filter in air line is drained and purged every month to remove water collected from the air.

(8) Safety back-up system is checked every 3 months.

(9) Remote monitoring systems are checked and calibrated every 6 months.

(10) Air compressor is oiled and checked every month.

(11) Emergency power generator and switching mechanism is checked weekly.

(12) Battery for power generator is checked and maintained monthly.

(13) Air vent blower is checked and oiled every 3 months.

(14) Dehumidifiers are checked and oiled every 6 months.

DISPOSITION FORM

For use of this form, see ...R 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
DELSD-SF	Radiation Protection, Combined Directive

TO All Elements of
TSA
CSTAL
ETDL
EWL

FROM Cmdr TSA
Cmdr CSTAL
Dir ETDL
Dir EWL

DATE 29 Jun 78 CMT 1
Mr. Potter/rb/65292

1. POLICY.

a. It is the policy of the Commander/Directors that radiation sources be used in a fashion which will protect personnel from unwarranted radiation exposure.

b. Radiation sources will be used with the understanding that their procurement and utilization shall be in accordance with Radiation Safety Procedures (copy attached). Any questions concerning the interpretation of procedures will be brought to th attention of the Radiological Protection Officer (RPO) for assistance and guidance.

2. DISCUSSION.

a. These procedures apply to all addressee organizational units and individuals who procure, possess, use, store, transfer, or dispose of radiation sources, i.e., radioactive material with an activity of one microcurie or greater, and ionizing radiation producing devices.

b. Responsibilities and procedures governing the radiation protection program are described in the inclosure.

3. REFERENCES.

a. Code of Federal Regulations, Title 10.

b. AR 40-14.

c. AR 700-52.

d. DARCOM-R 385-25.

e. DARCOM-R 385-29.

E. L. Bowman
E. L. BOWMAN
Cdr, TSA

WINSTON EVANS
Cdr, CSTAL

~~CLYDE HARDIN~~
Dir, EWL
MAX ADLER

~~CLARE THORNTON~~
Dir, ETDL
S. E. DANKO
Deputy Director, US Army Electron
Technology and Devices Lab

RADIOLOGICAL SAFETY PROCEDURES

RESPONSIBILITIES AND PROCEDURES GOVERNING THE RADIATION PROTECTION PROGRAM ARE DESCRIBED HEREIN. ANY QUESTIONS CONCERNING THE INTERPRETATION OF PROCEDURES SHOULD BE BROUGHT TO THE ATTENTION OF THE RADIOLOGICAL PROTECTION OFFICER (RPO), TELEPHONE EXTENSION 65292.

CONTENTS

CHAPTER 1

Responsibilities

1. The Commander of TSA is responsible for establishing an effective Radiation Protection Program in coordination with laboratory directors. For this purpose he will appoint a Radiation Protection Officer to assist him and act in an advisory capacity and coordinate safety policies and procedures among various users of radiation sources.

2. The Radiation Protection Officer is responsible for:

a. Staff supervision of the Radiation Protection Program including authority to order temporary suspension of hazardous operations.

b. Advising the Commander TSA and Laboratory Directors on the degree of hazards associated with ionizing radiation and the effectiveness of measures to control these hazards.

c. Performing inspections to insure compliance with provisions of NRC licenses and applicable Army regulations.

d. Maintaining the inventory of radiation sources and radioactive materials, including both materials licensed by NRC and those requiring DA authority.

e. Coordinating purchases of radioactive material to assure compliance with NRC licenses or DA authority.

f. Representing ERADCOM on the Ionizing Radiation Control Committee.

g. Coordinating submittal of applications for renewal or amendment of NRC licenses and DA authorization and for issuing local permits to use radiation sources.

h. Maintaining a library of current regulations pertinent to the Radiation Protection Program which will be furnished on request to persons covered by this regulation.

3. The Industrial Safety Officer is responsible for providing assistance and advice on general safety matters in relation to the radiological safety programs.

4. The Chief, Logistics Management Division, TSA, is responsible for assuring that all purchases for items containing radioactive material, X-rays, lasers, or other radiation sources have been cleared through the Radiation Protection Officer.

5. The Chief, Logistics Mangement Division, TSA, is also responsible for prompt notification of the Radiation Protection Officer when radiation sources are received. Items will be picked up by the user after check by the Radiation Protection Officer.

6. Supervisors in areas where radiation sources are used are responsible for:

a. Insuring that local permits are obtained before any work with radiation sources begins.

b. Insuring that the purchase or use of radiation sources are coordinated with the Radiation Protection Officer.

c. Insuring that all requisitions or contracts requiring radioactive material or other sources of radiation are clearly marked as "documents for procurement of radiation sources" and that these requisitions are coordinated with the Radiation Protection Officer.

d. Providing training of new employees in the safe handling of radiation sources.

7. Workers in areas where radiation sources are used are responsible for strict compliance with procedures approved for the specific application. These procedures and limitations will be contained in the application for a local permit.

8. Any person who notices a situation where an ionizing radiation safety hazard might exist will report that situation to the Radiological Protection Officer, Mr. Stanley Potter, telephone 65292, or his alternate, SP 5, Michael Davison, at the same number. In the event that these persons cannot be contacted the report will be made to Dr. Walter McAfee, telephone 54131.

CHAPTER 2

Definitions

Accelerator	A device for imparting kinetic energy to charged particles, such as electrons, protons, deuterons and helium ions.
Airborne radioactive material	Any radioactive material dispersed in the air in the form of dusts, fumes, mists, vapors or gases.
Bioassay	The determination of kinds, amounts or concentrations, and locations of radioactive materials in the human body, whether by in vivo counting (whole-body counting, selected organ counting, etc.) or by analysis and evaluation of materials excreted or removed from the human body.
Byproduct materials	Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the process of producing or utilizing special nuclear material.
Contamination (Radioactive)	Deposition of radioactive material in any place where it is not desired, and particularly in any place where its presence can be harmful. The harm may be in invalidating an experiment or a procedure, or in actually being a source of danger to persons.
Controlled area	A defined area in which the exposure of personnel to ionizing radiation is under the supervision of an individual in charge of radiation protection.
Decay, Radioactive	The disintegration of the nucleus of an unstable nuclide by the spontaneous emission of charged particles and/or photons.

Decontamination Factor	The ratio of the amount of undesired radioactive material initially present to the amount remaining after a suitable processing step has been completed. A factor referring to the reduction of the gross measurable radioactivity.
Dose (Dosage)	The radiation delivered to a specified area or volume or to the whole body. The dose may be specified in air, or the skin, or at some depth below the surface, but no statement of dose is complete without specification of location.
Dose Equivalent (DE)	This is the product of absorbed dose (D), quality factor (QF), and other factors needed to achieve the common exposure scale referred to under the definition of Quality Factor. It is commonly expressed in rems.
Dose Rate	Radiation dose delivered per unit time.
Dosimeter	An instrument used to detect and measure an accumulated dose of radiation.
Dpm	Disintegrations per minute.
Gamma Ray	Electromagnetic radiation emitted by a nucleus as a result of a transition between two nuclear energy levels. Gamma rays have high energies with correspondingly short wavelengths and their ability to penetrate matter is high.
Health Physics	A term in common use for that branch of radiological science dealing with the protection of personnel from harmful effects of ionizing radiation.
High radiation area	Any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose equivalent in excess of 100 millirem.

Ionizing Radiation	Any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter.
Ionizing Radiation Producing Devices	Electronic devices which are capable of generating ionizing radiation such as x-ray machines, linear accelerators, cyclotrons, radio frequency generators which use klystrons, magnetrons, or other tubes which produce x-rays, and electron microscopes.
Isotope	One or more nuclides having the same atomic number but a different mass. Isotopes of a substance have almost identical chemical properties.
Monitoring	Periodic or continuous determination of the amount of ionizing radiation or radioactive contamination present in an occupied region. Also called surveying.
MPC	Maximum permissible concentration(s).
mRad	Millirad
mRem	Millirem
Neutron	An elementary uncharged nuclear particle which has a mass equal to that of a hydrogen atom.
Photon	A quantity of electromagnetic energy whose value in ergs is the product of its frequency in hertz and Planck's constant.
Planck's Constant	A natural constant of proportionality (h) relating the frequency of a quantum of energy to the total energy of the quantum. $h=6.624 \times 10^{-34}$ joules-sec.
Positron	A particle equal in mass to the electron and having an equal but positive charge.

Quality Factor (QF)	This is the linear-energy-transfer-dependent factor by which absorbed doses are to be multiplied to obtain, for purposes of radiation protection, a quantity that expresses on a common scale for all ionizing radiations, the effectiveness of the absorbed dose
Radiation	Energy propagated through space. As used in this regulation, the term refers to two kinds of ionizing radiation: 1. Electromagnetic waves (x-rays, gamma rays) and 2. Corpuscular emissions from radioactive substances or other sources (alpha and beta particles). Ionizing radiation is any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter.
Radiation Absorbed Dose (Rad)	The amount of dose imparted to matter by ionizing radiation per unit mass of irradiated material. The unit of absorbed dose, the Rad, is equivalent to 10^{-5} Joules/gm.
Radiation Area	Any area accessible to personnel in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose equivalent in excess of 2 millirem or in any five consecutive days a dose equivalent in excess of 100 millirem.
Radiation Hazard	A condition under which persons might receive radiation in excess of the applicable maximum permissible dose, or where radiation damage might be caused to materials or personnel.
Radiation Sources	Materials or devices which generate or are capable of generating ionizing radiation, including naturally occurring radioactive material, by-product materials, source materials, special nuclear materials, fission products, materials containing induced or deposited radioactivity, radiographic and fluoroscopic equipment, particle generators and accelerators, and

	electronic equipment which utilizes klystrons, magnetrons, or other electron tubes which produce x-rays.
Radiation Work Permit	A locally developed form which is completed prior to the start of any work that is to be performed in a controlled area and describes the potential radiation hazards and protective equipment requirements for a given job. It should also provide a running record of radiation exposures received during a given job.
Radioactivity	Process whereby certain nuclides undergo spontaneous disintegration, liberating energy through the emission of alpha or beta particles or gamma photons or a combination of these.
Radiological Survey	Evaluation of the radiation hazard incident to the production, use, or existence of radioactive materials or other sources of radiation under a specific set of conditions.
Radiological Protection Officer (RPO)	An individual designated by the commander to provide consultation and advice on the degree of hazards associated with radiation and the effectiveness of measures to control these hazards. In addition, he is tasked with the supervision of the Radiation Protection Program. This individual will be technically qualified by virtue of education, training, and professional experience, to assure a capability commensurate with the assignment. (The term "Radiological Protection Officer" is not intended to denote a commissioned status.)
Restricted area	Any area to which access is controlled for purposes of protection of individuals from exposure to radiation and radioactive materials.

Roentgen	The quantity of X or gamma radiation such that the associated corpuscular emission per 0.001293 gram of air (1cc of dry air at standard conditions) produces, in air, ions carrying one electrostatic unit or quantity of electricity of either sign. This is the special unit of exposure.
Roentgen Equivalent Man (REM)	This is the unit of dose equivalent (DE) and is commonly referred to as the roentgen equivalent mammal.
Special Work Permit	A permit to assure that no work will commence in areas where radiation is greater than 20 mrem/hr until each job has been properly evaluated from a radiological standpoint and has been approved by Health Physics personnel.
User	An individual assigned to an activity, section, division, or other organizational unit which has been delegated the responsibility for the use, operation, or storage of radiation sources.
X-ray	Penetrating electromagnetic radiation having wavelengths shorter than those of visible light. X-rays are similar to gamma rays, but are originating in the extra-nuclear origin.

CHAPTER 3

EXPOSURE GUIDES

1. Regulations. Requirements as set forth in Title 10, Parts 19 and 20, Code of Federal Regulations, and AR 40-14 for the Control of Occupational Exposure to Ionizing Radiation, will be followed. Recommendations in the National Bureau of Standards Handbooks on Radiation will be used in addition.

2. Exposure of individuals in controlled areas. a. A controlled area is any area in which the exposure of personnel to radiation or radioactive materials is under the supervision of a radiation protection officer. Every effort will be made to maintain radiation doses as low as possible. Avoid all unnecessary exposure to ionizing radiation. Radiation protection standards for the control of occupational exposures to ionizing radiations include the following:

(1) The accumulated dose of radiation to the whole body, head and trunk, active blood-forming organs, gonads, or lens of the eye shall not exceed:

(a) 1.25 rem in any calendar quarter, nor

(b) 5 rem in any one calendar year, nor

(c) 5(N-18) rem total lifetime dose, where N equals the present age in years.

(2) The accumulated dose of radiation to the skin of the whole body, forearms, or the cornea of the eye shall not exceed:

(a) 7.5 rem in any calendar quarter, nor

(b) 30 rem in any calendar year.

(3) The accumulated dose of radiation to the hands and wrists or the feet and ankles shall not exceed:

(a) 18.75 rem in any calendar quarter, nor

(b) 75 rem in any calendar year.

b. Personnel not occupationally exposed, and persons who are less than 19 years of age will not be exposed in any calendar quarter in excess of 0.125 rem or in excess of 0.50 rem in any calendar year. Pregnant women will not be exposed to occupational doses or ionizing radiation. When a female employee becomes aware of her pregnancy, she will request that her duties be changed to eliminate all occupational exposure to ionizing radiation.

c. Occupational exposure to radioactive concentrations in air or water may not exceed the limits set forth in Title 10, Part 20 of the Code of Federal Regulations.

3. Exposure of individuals in uncontrolled areas. Radioactive materials and other sources of ionizing radiation will not be possessed, used, or transferred in such a manner as to create in an uncontrolled area radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of 0.5 rem in one calendar year.

4. Limits for contamination. When hands, body surfaces, clothing or shoes become unavoidably contaminated, steps will be taken as soon as possible to remove loose contamination. Decontaminate hands and body surfaces until no detectable activity above background is observed. Some degree of fixed contamination in certain cases cannot be avoided and the following maximum limits are recommended for personal clothing and shoes (see Chapter 6, Table 1):

Alpha activity - 200 disintegrations per minute per 100 square centimeters of area.

Beta-gamma activity - 0.2 millirad per hour at one centimeter.

5. Concentrations of radioactive contamination surfaces. a. Loose contamination on exposed surfaces such as bench tops and floors will be removed as soon as possible. Small amounts of fixed contamination will be unavoidable at times, but the degree of such contamination should be kept as low as practicable. Maximum limits of fixed contamination of 1000 dpm per 100 cm^2 of alpha and 2 mrad/hr at 1 cm of beta-gamma are recommended for controlled areas. Amounts of contamination in excess of the above limits will not be permitted to remain on exposed surfaces without approval of the RPO. Higher levels of contamination may be permitted for restricted surfaces, that is in areas where entry or access is controlled by procedures or special work instructions. The same standards of contamination control shall apply to tools and equipment. In all cases, signs and controls for contaminated surfaces, areas, or equipment will be instituted to the extent necessary to prevent the occurrence of a health hazard or the spread of contamination. In no case will the levels result in exposure to individuals in excess of the established limits. Any material or equipment so contaminated will be properly labeled with a contamination tag giving:

(1) Type and level of radiation (mrad/hr) at a specified distance.

(2) Extent of contamination on surfaces.

b. No contaminated equipment or material may be removed from any area without prior notification and approval of the RPO. Any equipment or material to be maintained or handled in a clear area must be decontaminated according to the requirements set forth in Chapter 6, paragraph 6, Table 1.

6. Radiation protection controls governing beta-gamma exposure. The following limits will be observed:

a. No individual without a special work permit will be permitted to work in a radiation control area where exposure levels are greater than 20 mrem/hr.

b. Any radiation area where exposure levels are greater than 100 mrem/hr shall be classified as a high-radiation area. An accurate exposure record will be maintained for each individual required to work in a high-radiation area. Based on pencil dosimeter reading, the record will contain the total cumulative exposure of the individual during the life of the special work permit.

c. The time during which any individual is exposed will be controlled so that exposure limits will not be exceeded.

7. Radiation protection controls governing alpha exposure. External exposure to alpha radiation is negligible, since the range of the alpha particles is less than the thickness of the layer of dead skin. Fume hoods will be used in conjunction with the long-lived alpha-emitting substances or other substances presenting a similar health hazard. In handling an unsealed alpha source, gloves or forceps afford adequate protection. Sealed alpha-neutron sources must be carefully handled to protect the integrity of the seal and prevent the spread of contamination. The prime hazard to consider is personnel contamination and the danger of ingestion or inhalation of airborne contamination. Fume hoods should have an absolute filter. The linear flow rate should be at least 100 ft/min. Airborne contamination levels will be determined as set forth in Chapter 6, paragraph 6.

CHAPTER 4

Local Permits

1. Local permits for the use of radiation sources are required. Applications for permission to use or store radioactive materials or sources of ionizing radiation will be submitted to the Radiation Protection Officer, DELSD-SF.

2. Radioactive sources. Local permits for the use of radioactive materials will be issued only when an approved NRC license or DA authorization is available. Contractors will be issued a local permit based on an approved DA permit.

3. Application for local permits. The local permit must be obtained before procurement of the particular item(s). Each organization desiring to use a radiation source will apply for a permit. Application will be on DF addressed to Radiation Protection Officer, DELSD-SF, and will include the following information:

   a. Organization.

   b. User personnel and qualifications (include training and experience).

   c. Type of radiation source.

   d. Physical form of the radioactive material.

   e. Number of sources required.

   f. Quantity of radioactive material or power of radiation source.

   g. Planned use of radiation source.

   h. Radiation protection equipment.

   i. Facilities where radiation source will be used.

   j. Radiation protection program (SOP).

Special Work Permit

An application for a special work permit must be submitted to the RPO before working in any area with radiation levels greater than 20 mrem/hr when authorization has not been otherwise obtained.

Radiation Work Permit (RWP)

Upon request from radiation area supervisors, a radiation work permit will be issued by health physics personnel for work when unusual working conditions are required as prescribed by the RPO. (See Incl 1 for sample RWP.)

CHAPTER 5

Procuring, Shipping and Receiving of Radiation Sources

1. Procurement. All requisitions or contracts for items that contain radioactive materials will be coordinated with the Radiation Protection Officer. Each request for radiation sources will include a covering DF stating the need for the material and citing the local radiation permit where the sources will be used. Procurement of radioactive materials will not be initiated until proper coverage under an NRC license or DA authorization is issued.

2. Shipping.

a. The user is responsible for the proper packaging and labeling of radioactive materials for shipping. The user will initiate DA Form 2791-R which will then be completed by the Radiation Protection Officer.

b. The user will provide the Radiation Protection Officer with the NRC license or DA authorization of the person who will receive the radioactive material.

3. Receiving.

a. The Radiation Protection Officer will check all radioactive material when it arrives. He will complete all necessary shipping paperwork, then notify the user to pick up the radioactive material. Radioactive materials will only be transported in privately owned vehicles in emergency cases, and only with specific approval of the RPO.

b. Upon receipt of radioactive material, the Radiation Protection Officer will perform a leak test, when required, and notify the user of the results of the leak test.

CHAPTER 6

Prevention of Radiation Hazards

1. Method. a. This chapter contains information on the prevention of radiation hazards and special precautions necessary to safety work with radioactive materials. The three methods of radiation hazard prevention are: Mechanical and chemical, medical, and monitoring. All personnel required to work in radiation hazard areas will be informed as to the function and use of each method.

b. Some methods of radiation hazard prevention involve the proper use of fire extenguishers, roping off and posting of areas, permanent and portable shielding, and the use of area-monitoring instrumentation.

c. Another method of radiation hazard prevention includes the protection of personnel by wearing some or all of the following items, depending on the type of work: Disposable clothing, coveralls, plastic aprons, gloves, plastic shoe covers, and/or boots.

d. Decontamination materials include such things as the chemicals used to decontaminate personnel and laboratory equipment, waste containers, swabs or Kemwipes, and paper - both absorptive and non-absorptive.

e. Prevention of radiation hazards is effected by the establishment of restricted areas, time limits for stay in danger zones, and the requirements to comply with exposure limits and other rules.

2. Procedures. a. Mechanical and chemical. (1) Film badge service will be initiated or discontinued by request to the RPO. An adequate supply of film badges will always be available for immediate use. Staff members who escort visitors to radiation areas are responsible for signing badges in and out for their visitors.

(2) Each person assigned a film badge will wear only the particular badge number assigned to him. Under no circumstances will badges be exchanged with another person. Film packs should never be removed from the badge or tampered with in any way.

(3) Personnel working in radiation areas must wear badges at all times while they are in such areas. These badges may be worn comfortably on the belt line or chest but they must never be covered by any other clothing or carried in pockets.

(4) All film badges will be kept in the assigned badge rack at the end of the work period. They will not be taken out of the building unless the outside specific duty or travel will be associated with an exposure to radiation.

(5) Film badges will be collected for exchange of film each month on the day specified on the assigned badge rack.

(6) Pocket dosimeters will be recharged as required. Additional pocket dosimeter will be maintained for visitors or persons whose routine does not require a permanently assigned film badge. These dosimeters will be sigged for in a log, the dose will be recorded, and a notation will be made that the person wearing it was a visitor.

(7) All persons entering radiation areas will wear a dosimeter. People who are unfamiliar with the facility will be accompanied by responsible personnel acquainted with the facility.

(8) Fire extinguishers will be placed in conspicuous places in radiation areas and clearly marked. They will be periodically checked and maintained by the Area Fire Captain. Any extinguisher that is used will not be returned to its rack but will be reported to the Fire Captain as soon as possible. All personnel will familiarize themselves with the location and use of these extinguishers throughout the building so that in the event of an emergency they will be brought into use as soon as possible.

(9) Radiation signs and tags are posted for the safety of every employee and must be respected. The Radiological Protection Officer will post and remove radiation warning signs. When radiation levels exceed permissible levels, the area will be posted with appropriate signs. These signs will indicate the nature of the radiation and/or contamination, the date of posting, the radiation level at a specified distance, and any other appropriate data.

b. Medical. (1) Each person working with radiation will be required to undergo a complete medical examination at the start of employment and at one-year intervals thereafter. This initial examination will include a complete medical history and physical examination. The history will include a notation of previous work with ionizing radiation. A copy of each medical record will be kept on file by the preventative-medicine facility. The entering examination will include a complete blood count, urinalysis, and a chest x-ray.

(2) Special checkups will be made at any time as determined necessary by the Radiation Protection Officer and/or Preventive Medicine Officer.

c. Monitoring. (1) Personnel monitoring will be accomplished by the use of film badges and dosimeters with resulting data recorded. Special monitoring due to exposure or contamination may be required. Cases of overexposure or contamination may require a special medical checkup.

(2) When an individual has received a dose of ionizing radiation in an amount exceeding 1.25 rem per calendar quarter, he will be removed from duties involving occupational exposure to ionizing radiation until subsequent exposure limitations are established in consultation with competent medical authority. When an individual has received an accumulated dose of ionizing radiation in excess of 5(N-18) rem, he will be removed from duties involving occupational exposure to ionizing radiation until his exposure record has been evaluated by the Surgeon General of the Army and subsequent exposure limitations are established as necessary.

(3) The frequency of area monitoring will depend upon the radiation levels of the usual work in the area, the frequency of the use of the area and other conditions specific for each area. The radiation area supervisor will assure radiation levels are determined prior to working in a radiation control area, on a daily basis.

(4) The general radiation background in the area will be first recorded. Successive readings in representative work areas will be taken and noted. If any locations are noted where the dose rate is greater than the maximum permissible, the area will be posted immediately. Where additional shielding will correct the situation, this will be done as soon as possible.

(5) As each area is surveyed, a check will be made to detect any existing or potential hazard and to rectify it.

(6) Special surveys will be made by the RPO at any time upon specific request of an individual or before unrestricted entry is permitted to a previously contaminated area.

(7) Sufficient instrumentation is available to the RPO to properly support all special radiation surveys. All instrumentation used for radiation protection will be calibrated at least every three (3) months, and after each maintenance or battery change. Dosimeters will be calibrated at least every six (6) months.

3. Periodic checkups. a. From time to time, inspections will be made to insure that personnel are complying with procedures in radiation areas. Periodic checks will also insure that any modifications to the basic operating procedures are being followed correctly so as to minimize radiation hazards.

b. Constant inspections are necessary to avoid a dulled alertness on the part of personnel. It cannot be overemphasized that while working with radiation can be safe, mistakes may be very dangerous and possibly fatal. The checkups are for the safety of personnel.

c. The efficiency of all warning devices will be determined at intervals not greater than one month; this is in addition to the complete maintenance check which will be made at any time on all locks, etc. If at any time there is a failure in any remote monitors, work will be halted immediately and the approval of the Radiation Protection Officer will be required before normal operating procedure is resumed.

4. Access to radiation areas. a. Access to areas where there is a potential radiation hazard will be limited to minimum personnel required to safely, efficiently, and most readily carry out the required procedures. All persons entering an area classified as a Radiation Control Area or a High Radiation Area must wear a film badge. A pocket dosimeter may also be required in certain areas. All visitors to radiation areas are required to be accompanied by personnel assigned to the area. A "visitor" is considered to be anyone not directly connected with the work being conducted.

b. Anyone discovering an area of hazardous radiation will evacuate the area and call the RPO who will accurately survey the area and post it. Only the RPO has the authority to remove any signs once they are posted.

5. Radiation hazard signs. These signs are in the form of labels, tags, and signs for posting areas and equipment and identifying radiation areas and items which may be radioactive or contaminated. They incorporate the standard magenta and yellow color, the three bladed radiation symbol, and appropriate wording, such as "Caution," "Danger," "Contamination," "Radiation Area," and "High Radiation Area." Where such signs and tags are used, additional information may be added to them by the RPO to further identify the nature of the hazard. The information will contain the nature of the substance causing the hazard, its dose rate at a specified distance, the date, and other pertinent information.

6. Decontamination and waste disposal. a. In order to prevent the possibility of contamination, the following regulations will be observed:

(1) There will be no smoking, drinking, or eating in radiation control areas.

(2) In cases of skin contamination, no eating, smoking or application of cosmetics will be permitted until all removable radioactivity has been taken from the skin and the person is released by the RPO.

(3) Organic solvents, highly alkaline soaps, or abrasives should not be used for decontamination at any time, since they increase the possibility of skin injury and serious contamination. Levels of radiation beyond which areas are considered to be contaminated radiation areas are outlined in Chapter 3. Any incident or accident which causes an area to be contaminated must be reported immediately to the RPO. The use of any decontaminates other than mild soap and water should only be done under the supervision of medical personnel.

b. The RPO will be responsible for establishing procedures controlling the spread of contamination. These procedures will include emergency ventilation control, controlled step-off areas, controlled passageways, personnel monitoring, decontamination procedures, etc.

c. All persons selected by the RPO to work on monitoring and decontamination will be equipped with protective clothing, suitable gloves and other equipment required by the level of work.

d. In the event of airborne contamination the RPO will determine through the use of fixed or portable air sampling monitors the extent of the contamination. The RPO will specify the maximum levels for personnel access to airborne contamination areas. These limits will not exceed:

For Personnel Wearing	Alpha Concentrations	Beta Concentrations
No respiratory protection	< 1 MPC*	< 1 MPC*
M-17 Full face respirator	50 MPC*	50 MPC*
Supplied air or self-contained air supply with full face mask	50 MPC*	50 MPC*

*Maximum permissible concentration

e. When there is a possibility of contamination or radiation hazard, all ducts and vents leading from the building, whether they are for water, air, gas, or electrical conduit, will be marked so that maintenance or repairmen will be aware of the potential hazard. Where these tags exist, the RPO will be notified to survey the area before any work is started. If the need for shielding is indicated by monitoring procedures, the supervisor or the project leader will provide the shields before work in this area can resume.

f. Personnel decontamination methods depend upon the nature of the contaminating material and the size of contaminated skin area. No detectable contamination level above background is allowed to remain on hands or skin after decontamination. The following procedures will be used immediately:

(1) First notify the RPO. All materials needed for decontamination will be furnished by the RPO and will be located where they will be most convenient for use.

(2) Thorough washing with soap and water and rinsing with large quantities of water is the best general decontamination method for the hands and other parts of the body, regardless of the nature of the radioactive contaminant. If, however, the contamination is well localized,

it is recommended that the area be cleaned immediately with small swabs and later, if necessary, by a general washing. Spread of contamination to other skin areas is thus avoided.

g. If the contamination is widespread, a general washing or shower should be taken and other more specific measures outlined below should be followed under medical supervision and the RPO.

(1) For general washing: Wash the hands for two to three minutes in tepid water using a mild soap, with special attention to finger folds, outer edges of the hands and fingernails. Rinse thoroughly and repeat a maximum of four times. If the required degree of decontamination is not reached, proceed with step (2).

(2) Using a soft brush, wash and rinse contaminated areas three times in eight minutes of which no less than six minutes are spent in scrubbing. Use pressure light enough not to abrade the skin. Rinse thoroughly and monitor. If the desired level is not reached after several trials, chemical decontamination may be attempted as outlined in step (3).

(3) Apply a paste of titanium dioxide liberally and work it in over the contaminated areas for a minimum of two minutes. Use water sparingly, only enough to keep the paste moist. Rinse with warm water and follow with soap, brush and water, being extremely cautious to remove all paste about the nails. Monitor. Repeat process if necessary. If three successive trials fail to remove all contamination to the prescribed level, follow step (4). Note: Do not use near face or other body openings.

(4) Daub over the contaminated area a saturated solution of potassium permanganate for not more than two minutes. Wash with soap and water and rinse. Next, apply a solution of sodium bisulfite to remove the dark permanganate stain. The procedure may be repeated but since the permanganate is caustic to the skin, care should be taken to follow the prescribed times closely. Hand cream should be used as a final step to prevent chapping. Note: Do not use near face or other body openings.

h. Persons with cuts or wounds will not be permitted to work in a contaminated area or radioisotope laboratory unless specific approval is obtained from the RPO. Any wounds, cuts or abrasions received while working with, in, or near radioactive materials should be flushed with water immediately. Any such accidents should be referred to the RPO immediately so that specific measures can be taken.

i. The RPO will assist in and monitor the decontamination of materials and equipment. He will supervise the disposal of radioactive waste and other work connected with radiation hazards.

j. In the event of contaminated clothing, the contaminated articles will be removed immediately. Skin areas underneath the clothing will be cleansed as soon as possible and the contaminated clothing placed in plastic bag so that it may be properly laundered and recovered.

k. In order to prevent the gross contamination of laundered items, two separate laundry systems are employed. All contaminated laundry generated in radiation areas is laundered in a specially equipped laundry.

l. Contaminated materials will be disposed of in suitable dry active waste or liquid active waste containers. At no time should dry active and liquid active wastes be mixed. When containers for radioactive wastes are full, the RPO will supervise the removal. All radioactive waste containers will be stored in the radioactive storage vault.

m. The RPO will aid in the problem of evaluating contaminated equipment. If it is not practical to decontaminate the equipment, it will be handled as dry active waste. In some cases, it may be possible to store such equipment for future use when radiation levels have decayed to acceptable levels. Equipment properly marked and shielded will be stored in the radiation storage vault.

n. The following methods can be used to decontaminate equipment; the decision as to the actual and most practical method will be determined by the RPO.

(1) Equipment may be washed with a hot, strong detergent solution, rinsed, and procedure repeated until the desired decontamination is reached. Chemicals that may be used include chromic acid, nitric acid, ammonium citrate, trisodium phosphate, and ammonium bifluoride. In selecting decontamination materials, the nature of the surface and extent of contamination must be considered. For all practical purposes, decontamination effectiveness of a solution is considered complete at the end of the second repetition of any one process. If the desired level is not reached at this time, other methods should be considered.

(2) Before any decontaminated equipment or articles can be moved or transported to a "clean area" the RPO will determine the extent of contamination of the particular item. Limits of contamination for items to be admitted to a clean area on the basis of 100 cm^2 area are as follows:

Loose contamination detectable by smear

Alpha (DPM)	50
Beta-Gamma (DPM)	100

Maximum fixed contamination

Alpha (DPM)	200
Beta-Gamma (m Rad/hr)	0.25

In the case of area contamination, the method of decontamination will depend upon the nature of the surface. These methods are vacuuming, physical removal of surfaces, covering of short-lived materials with impervious materials, detergents, and chemicals. When practical, areas which are contaminated will be isolated until radioactive decay permits safe entry.

o. All areas which are contaminated by accidents or spills will be evacuated immediately. If certain safety precautions can be instituted (such as placing absorbent paper on a spill to prevent spread of the contaminant) without endangering one's safety before leaving, it should be done. The RPO will monitor the contaminated area and determine the most practical methods of decontamination.

p. Maximum permissible contamination levels are listed in Table 1.

Table 1. Maximum permissible contamination on inanimate objects.

Item and Corrective Action	Fixed (F) or Removable (R)	CONTAMINATION LEVEL: Alpha, dpm/100 cm^2 Instrument	Alpha, dpm/100 cm^2 Smear	Beta-Gamma, mrad/hr at 1 in.	Beta-Gamma, dpm/100 cm^2
1. Personal clothing, including shoes. Replace, decontaminate or store for decay, if above:	F	200		0.2	
	R		None		None
2. Protective clothing, incl. choes.					
a. General. Should be replaced or decontaminated, if above:	F	1,000		0.5	
	R		200		1,000
b. Laundry. Do not release to public laundry, if above:	F	200		0.4	
	R		50		200
c. Respirators	F	200		0.06	
	R		None		None
3. Laboratories and work areas:					
a. Uncontrolled areas. Require controls and posting or decontaminate, if above:	F	200		0.25	
	R		30		100
b. Controlled areas. Decontaminate, or if impossible, fix with periodic check on fixation, if above:	F	1,000		2.0	
	R		200		1,000
4. Vehicles:					
a. Use in controlled areas. Decontaminate or if impossible, fix, if above:	F	1,000		2.0	
	R		300		1,000
b. Use in uncontrolled areas. Decontaminate, if above:	F	500		0.4	
	R		30		500
5. Tools, equipment and containers. Prior to non-radioactive use, decon if above:	F	200		0.25	
	R		50		100
6. Shipping containers, outside surfaces, decon if above:	F	500		0.25	
	R		None		None

CHAPTER 7

Emergency Procedures for Radiation Accidents

1. Emergency procedures will be instituted at the time of a radiation accident or contamination event or whenever safe levels prescribed in Chapter 3 are exceeded.

2. Emergency procedures in case of contamination. a. An individual's first responsibility is for his own safety and for the safety of other individuals in the immediate area. Loss or damage of materials and equipment under emergency conditions is a secondary consideration. Immediate measures for the prevention of spread of contamination, such as dropping absorbent material on spilled liquids, should be carried out only if they can be completed safely. Once an individual has left an emergency area, he may not return without permission from and under the supervision of the RPO.

b. The room or area will be vacated immediately. Where radioactive materials are released, persons in the area should hold their breaths to avoid inhalation of the materials.

c. The contaminated area will be isolated as quickly as possible and each entrance or exit to the area marked with a warning sign indicating the hazard.

d. If any material comes in contact with the clothes or body:

(1) Clothing will be discarded in a suitable container. Under no circumstances should the clothing be so carelessly handled as to spread the contamination further.

(2) Contaminated skin areas will be decontaminated as quickly as possible using methods outlined in chapter 6, paragraph 6. Any contaminated cuts or abrasions should be flushed immediately with huge quantities of water.

(3) All other persons who were working in the vicinity of a contaminated area will be monitored by the RPO.

e. The RPO and the area supervisor will be notified immediately and no area decontamination procedures should be started until the situation is evaluated by the RPO.

3. Fires and other major emergencies. a. The first person to discover the emergency will:

(1) Notify all persons not directly involved with the incident who are in the area.

(2) Notify the fire department and other emergency personnel.

(3) Attempt extinguishment of fires using readily available first-aid type extinguishers if a radiation hazard is not immediately present. Efforts should be made to prevent water or fire fighting chemicals from coming in contact with the radiation source. Attempt to control runoff, preventing it from entering sewers or drainage systems until it has been monitored.

(4) Notify the RPO.

b. the RPO will:

(1) Advise and assist the emergency personnel.

(2) Following the emergency, monitor the area and determine the protective devices necessary for safe decontamination.

(3) Supervise decontamination.

(4) Monitor all persons who were in the emergency area and those who were involved in combating the emergency.

(5) Monitor downwind, delineate all contaminated areas, and restrict access as necessary.

RADIATION WORK PERMIT

RWP Serial Number_______________

Date:_________Page_____of_____Pages

Location:_______________

____

Time Approved:_______________

Time Started Work:_______________

Description of Job:_______________

____

____

____

Survey Measurements:_______________

____

____

Contamination Control Point_____Yes_____No

Approval to Start Work:

Area Supervisor:_______________

Health Physics:_______________

Protective Equipment Required

Lab Coat	
Overalls	
Rubbers	
Booties	
Rubber Gloves	
Hoods	
Surgeons Cap	
Eye Protection	
Assualt Mask	
Fresh Air Mask	
Other	

Monitoring Required:_______________

____

____

Duration of RWP

____

Permit Terminated By:_______________
(Signature) (Date) (Time)

Reason: Completion ( ) Cancellation ( )
Changed Conditions ( )

TIME RECORD

*Name	Film Badge Number	Dosimeter Number	Reading In/Out	Time In/Out	Total Time	Dosage Rec'd M/R

*Indicates understanding and compliance.

Incl 1

INCLOSURE 9

EMERGENCY PROCEDURES

EMERGENCY PROCEDURES

1. Attached as attachment 1 is the text of a sign which is conspicuously posted in the control room of the irradiation facility.

2. Attached as attachment 2 is a copy of emergency procedures for the First Aid Squad.

3. Attached as attachments 3 and 4 are copies of emergency procedures of Patterson Army Hospital which is the primary medical facility which will be used in the event of an emergency at the irradiator facility. This Hospital is located about 30 minutes from the facility. Attached as attachment 5 is chap 7 of TM 8-215 which is a reference of attachment 3.

4. In addition to Patterson Army Hospital a secondary medical facility, Jersey Shore Medical Center, is located about 10 minutes from the irradiator facility. In the event of an emergency where a few minutes delay might be vital, a verbal agreement has been made with Jersey Shore Medical Center that they will accept patients, even if radiologically contaminated. They will perform any emergency procedures that might be called for and will either accept the patient for check-in, or will transport the patient to Patterson Army Hospital by helicopter, whichever would benefit the patient more. This agreement supplements emergency procedures of Patterson Army Hospital.

In the event of suspected or known Radiation overexposure of personnel the following procedures are to be carried out.

1. The vault will be evacuated immediately.

2. The First Aid Squad will be called. (65416)

3. The Radiological Protection Officer will be notified. (65292)

Attachment 1

FIRST AID SQUAD

EMERGENCY PROCEDURES

In responding to suspected or known radiation overexposure of personnel the following procedures are to be carried out.

1. Until there is positive assurance to the contrary it will be assumed that the patient is radiologically contaminated and appropriate procedures will be implemented to keep the contamination from being spread.

2. The patient will be taken to Patterson Army Hospital by ambulance and will be checked in for treatment and/or observation.

3. In the event of accompanying injury where a few minutes delay in hospitalization might be vital, the patient will be taken to Jersey Shore Medical Center.

Attachment 2

AHDD-HE

Observation and Treatment of Persons Overexposed to Radiation

xx THRU XO, MEDDAC
CDR, MEDDAC

C, HEV Actv
MEDDAC

4 May 78

sl/22579

TO Emergency Room Personnel

1. As a result of personnel working with radioactive materials and sources at Fort Monmouth, an accident may occur where an individual(s) may receive a significant overexposure to radiation. If such an individual(s) is presented to the Patterson Army Hospital Emergency Room, the individual(s) should be kept for an appropriate observation time as determined by medical authorities. If this is not possible, the individual(s) should be transferred to a medical facility capable of providing this service. Emergency treatment may also be rendered in accordance with appropriate medical directives.

2. The above instructions apply specifically to patients who have been overexposed to radiation but are not contaminated with radioactive material. For any individual(s) who are contaminated with radioactive material, Annex L of the MEDDAC Emergency Preparedness Plan should be followed in the handling of these persons.

Original signed by

CHARLES C. BOGER, JR.
CPT, MSC
C, Health & Environment Activity

ANNEX L (HANDLING OF RADIOACTIVE CONTAMINATED PATIENTS) EMERGENCY PREPAREDNESS PLAN

1. PURPOSE. The purpose of the plan is to set forth the procedures to be followed in case of radiation accidents.

2. SCOPE. This plan is applicable to the Emergency Room personnel, the Administrative Officer of the Day, the Adjutant and Radiation Protection Officer.

3. RESPONSIBILITIES:

a. Persons receiving call.

(1) In addition to the routine information sought, the person receiving the call should inquire about the type of the radioactive contaminant and level of contamination remaining after initial contamination at the scene of the accident.

b. Emergency Room Personnel should notify:

(1) Adjutant (21043) during duty hours
AOD after duty hours

(2) MOD

(3) Radiation Protection Officer (Environment Scien[illegible] Officer).

c. Emergency Room Personnel:

(1) The guidelines set forth in TM 8-215, Chapter 7 in particular, should be followed as appropriate.

(2) Contaminated patients will be brought in the entrance to the immediate left of the emergency entrance and placed in the holding area at the rear of the emergency room area.

(3) All patients, personnel and material leaving this area must be checked for contamination by the Radiation Protection Officer or his assistant.

(4) Access to the patient treatment area will be limited to the personnel necessary to provide treatment.

(5) All waste and contaminated material will be held for disposal by Medical Supply.

(6) Lifesaving measures will take precedence over patient decontamination.

(7) Pregnant personnel will not be assigned to radiation injury patients.

d. It will be the responsibility of the Radiation Protectio Officer to perform the necessary monitoring of radiation.

e. Ambulance and Emergency Room personnel sent to the scene of a nuclear accident will:

(1) Report to the Nuclear Accident/Incident Control Officer (NAICO) or on-scene commander to receive the situation briefing as to the presence of casualties, the type of accident and whether the accident has a potential for creating a radioactive contamination hazard.

(2) Ascertain from the NAICO or on-scene commander the requirements for individual protective measures to be taken by rescue and medical personnel against potential hazards from high explosives and radioactive or other hazardous materials.

(3) Prepare casualties for early evacuation. Take simple and feasible but not unreasonable time-consuming decontamination measures (e.g., removal of shoes, external clothing, etc., weather permitting) to minimize the spread of contamination to transport vehicles or treatment facilities.

f. Mass Casualty Recall should be initiated by the AOD if the number of casualties is too great for the staff on hand to manage.

4. <u>REFERENCE</u>:

a. TM 8-215

CHAPTER 7

MEDICAL MANAGEMENT OF PATIENTS IN NUCLEAR WARFARE

32. General

The successful early management of patients depends upon the exercise of sound judgment in the following basic areas:

a. Medical sorting of patients (Triage).

b. Treatment. This should be directed toward providing maximum benefit to the greatest number under the circumstances while avoiding any procedure which would unwarrantably reduce the patient's ability to care for himself.

c. Utilization of medical service personnel. Medically trained individuals must be used efficiently and should not be diverted to first aid, rescue, transportation, or nonmedical labor functions.

d. Flexibility of the supporting medical facility to respond and adapt to rapidly changing circumstances.

e. Rigorous supply conservation.

f. Evacuation of casualties.

g. Planning and training. Preparation for the management of patients in nuclear warfare must be based on a knowledge of nuclear weapons effects and sound medical practices. Training must be practical rather than theoretical.

33. Medical Sorting

a. Medical sorting or triage is the key to the effective management of large numbers of sick and wounded. It includes the immediate classification of patients according to type and seriousness of injury and likelihood of survival, and the establishment of priorities for treatment and evacuation to assure medical care of the greatest benefit to the largest number. Sorting permits the orderly, timely, and efficient utilization of available medical means. It is a continuous process, carried out at each echelon of medical care as patients are evacuated rearward. The critical importance of sorting demands that medical officers assigned this responsibility be selected on the basis of mature professional judgment.

b. Criteria for the classification of patients will vary with the military situation, the patient load, and the capability of the medical unit involved. The following is a classification of patients according to their need for medical care and chance for survival:

(1) *Patients requiring **Minimal** treatment:* Those who may be returned to duty include those who have: 1) small lacerations or contusions, 2) simple fractures of small bones, 3) second-degree burns of less than 10 percent extent but not involving face or hands, or who have received, 4) short term body ionizing radiation doses of 100 to 150 rads. The second group includes non-effective persons who need minimal nursing care for: 1) disabling minor fractures; 2) burns of the face or hands which interfere with the person's ability to care for himself; 3) moderate neuropsychiatric disorders, or, 4) early symptoms of nausea and vomiting due to short term whole-body ionizing radiation doses of 150 rads or less. These patients truly have no priority for treatment but in practice would receive some treatment when first seen. Ordinarily, their wounds and diseases would be such that the treatment they receive while being sorted is all the treatment they would require, and they could then be returned to duty or sent to a facility for minimal nursing care. This group could constitute up to 40 percent of the total injured.

(2) *Patients requiring **Immediate** Care.* Included as patients requiring immediate care are those with: 1) hemorrhage from an easily accessible site, 2) rapidly correctible mechanical respiratory defects, 3) severe crushing wounds of the extremities, 4) incomplete amputations, 5) severe lacerations with open fractures of major bones, and 6) severe burns of the face and upper respiratory tract necessitating tracheotomy. The patients in group 2 will be given the highest priority for surgical treatment because a relatively short procedure could save life or limb. More definitive surgery would be delayed to a later date. An increased rate of complications and permanent disability would have to be accepted. This group is expected to comprise about 20 percent of the total injured.

(3) *Patients whose surgical treatment may*

be Delayed. Persons whose surgical treatment can be delayed without immediate jeopardy to life include those with 1) simple closed fractures of major bones, 2) moderate lacerations without extensive bleeding, 3) second-degree burns of 10 percent to 25 percent and third-degree burns of 10 percent to 15 percent of the body surface (after body fluid levels have been stabilized), and 4) noncritical central-nervous-system injuries. This group is composed of patients for whom a delay in treatment might lead to complications but whose lives would not be unduly jeopardized by delay. The amount of delay between wounding and surgery for this group depends on the total number of patients with higher priorities who need treatment and the medical facilities available. This group may comprise about 20 percent of all injured.

(4) *Patients whose treatment would be on an extended delayed basis (Expectant).* These patients include those with: 1) critical injuries of the central nervous system or respiratory system, 2) penetrating abdominal wounds, 3) multiple severe injuries, 4) severe burns of large areas (30 percent or above), or 5) known lethal or supralethal doses of total body radiation. The treatment for group 4 patients would consist of that resuscitation and emergency medical treatment which the available facilities, total supplies, and number of professional personnel permit. They would have the lowest priority for surgery because the operative procedures required would be time consuming and technically complicated, so that an operation on one of these patients would theoretically jeopardize the lives of several in other higher priority groups. The more rapidly patients in other treatment categories are treated and moved, the sooner more definitive treatment could be started on the injured in category 4. It is anticipated that this group will comprise about 20 percent of all injured.

c. The percentages noted above for each classification may vary considerably in a specific instance during nuclear warfare, depending on a multitude of factors including the physical environment, orientation of the personnel, weapon employment, time of day, presence or absence of fallout, and many other variables.

34. Handling the Radioactively Contaminated Patient

a. Patients who have been in fallout areas may have varying amounts of radioactive contamination on their skin and clothing. The contamination will be in the form of fission products which have become absorbed on the surfaces of dirt or dust particles of varying sizes. The patient himself will not be radioactive, but he will suffer radiation injury (beta burns) from the contamination unless it is removed early. In addition, as the patient is handled, much of the contamination will be scattered about, contaminating other people and the surroundings. The objective of proper decontamination is to control the removal of this hazardous material from patients, restricting it to defined areas. This will allow proper handling of contaminated equipment and clothing and will reduce the hazard to other personnel.

b. It is important to bear in mind the distinction between contaminated patients and radiation injured patients. Patients who have received substantial doses of radiation and who subsequently exhibit clinical manifestations of the acute radiation syndrome are not necessarily contaminated. Likewise, patients who are contaminated have not necessarily received substantial doses of radiation. Mere exposure to radiation does not result in a contaminated casualty. Only when substances emitting radiation are deposited upon, or become attached to, the patient or his clothing is the patient radiologically contaminated.

c. The presence of fallout contamination upon a patient represents by far a greater hazard to the patient himself than it does to the personnel caring for him. The duration of the exposure, the quantity of contact contamination, the distance between the source and those exposed, and the geometry of the radiation exposure all combine to maximize the danger to the patient while minimizing that to those around. Further, if the medical facility which receives the contaminated patients is itself in a fallout area, the high gamma environment and its threat to all patients and medical personnel would far outweigh any hazards from handling contaminated patients.

d. Fear that the gathering of large numbers of heavily contaminated patients in or around a medical facility is hazardous is unfounded. The only hazard from radioactive contamination which can cause injury at any distance in air is gamma radiation. It would be very difficult to get enough patients crowded together to constitute a significant gamma hazard. If all the radioactive contamination from many heavily contaminated patients was collected in one small area of a few square meters, a minor hazard could result, but the patients themselves will not present a gamma hazard.

e. The major hazard associated with handling contaminated patients is the possibility of beta burns caused by transfer of the radioactive material from the patients to the unprotected skin surfaces of other person. .. Though this hazard is not a lethal one, it could result in the incapacitation of medical personnel from the burns if the material is not removed from their skin.

f. In order to handle the radiologically contaminated patients properly, it is first necessary to detect contaminated patients. The only way to detect radioactive contamination is by proper monitoring with radiac instruments. Since the levels of radiation to be dealt with are rather low and the governing hazard is beta radiation, a Geiger-Mueller counter such as the AN/PDR-27 should be used to monitor incoming patients for contamination. As a general rule, if the reading is twice current background radiation or higher, the patient should be considered contaminated.

g. Incoming patients should be monitored at any time there is any reason to believe that contaminated patients are arriving at the medical facility. (Possible indications: reports from ambulance drivers, messages from another hospital or a headquarters, sighting of a nuclear burst or cloud.) Otherwise, patients may be "spot checked" every 15 minutes or every five or six patients. This monitoring need not be carried out at a great distance from the medical facility. It can be accomplished within or just outside the admission area. The only requirement is that it be done if at all possible prior to admission of the patient to the facility. Once it has been confirmed that the patient is contaminated, decontamination is easily accomplished. The simple removal of all outer clothing and a brief washing or brushing of the exposed skin surfaces will achieve a high degree of decontamination without subjecting the patient to the trauma of vigorous bathing and showering. These simple tasks can be accomplished prior to admission or later on the ward or elsewhere in the medical facility depending upon the condition of the patient. *The radiological contamination of the patient should not be allowed to interfere with immediate life saving treatment or the best possible medical care.* However, whenever decontamination of a patient is done, the material removed results in contamination of another area. If a patient is brushed or washed off, all the material removed must be collected and removed from the medical facility. Even though the quantities of radioactive material on one patient may be small, the uncontrolled removal of contamination from large numbers of patients could result in hazardous accumulations of materials in hospital facilities. Problems can arise as a result of trying to decontaminate seriously injured patients who require extensive resuscitative and surgical treatment without delay. It may be necessary to accept a certain amount of contamination in the treatment facilities, during the care of such patients. At intervals when possible, thorough cleaning of the areas will have to be done.

h. It is desirable for those handling patients before or during their decontamination to wear gloves. Any gloves will help, but rubber gloves are preferable. Monitors should supervise disposition of contaminated clothing and equipment, and all staff personnel must emphasize normal hygiene, such as washing hands and face.

i. Whenever a contaminated patient is admitted to the facility prior to complete decontamination, his records should be clearly marked to indicate that he is contaminated. Any suitable code word may be used, such as "RADCON," so long as personnel who come in contact with the patient understand its meaning. After incompletely decontaminated patients have been admitted, monitors should make followup rounds of clinics and wards. When the decontamination of the patient has been completed within the facility, and the monitor verifies this, the monitor should line out the code word and enter the word "clear" along with the date and his initials on the medical record. The patient need receive no special treatment or handling thereafter for reasons of radiological contamination.

j. The receipt of contaminated patients by a medical facility need not require the declaration of any alert or special "condition" throughout the facility. Only the few people who come in direct contact with the patient prior to decontamination need be concerned. Monitors who detect the contamination should notify those in the admission area and those in the supply section who may handle contaminated clothing and equipment. Others in the facility who come in contact with the patient prior to completion of decontamination will be alerted to the extent necessary by the coded entry on the patient's attached record. These are the only members of the staff who need be concerned about the situation (app B).

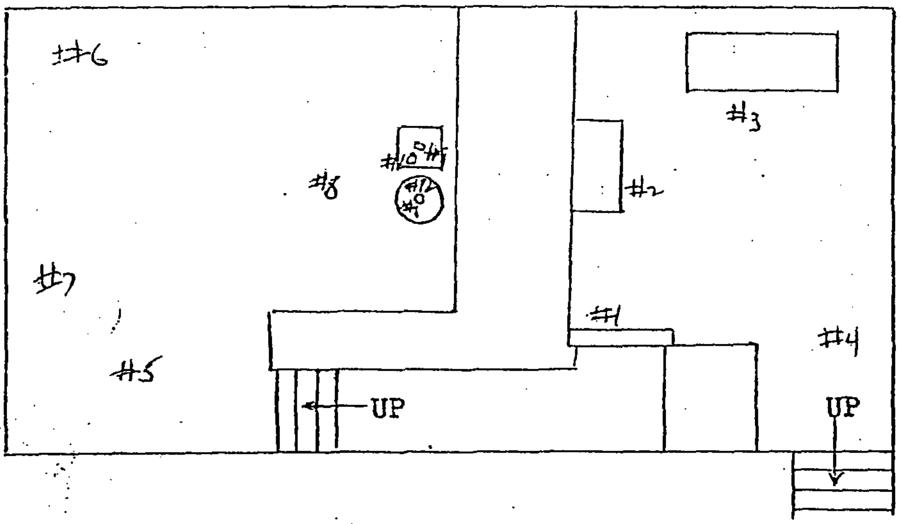
INCLOSURE #10

SURVEY OF FACILITY

HEALTH PHYSICS SURVEY WORK COPY		HP LOG # 11
PRINCIPAL USER: V. Bryan, Radiation Facility Supervisor	SURVEYOR: DAVISON	SAMPLE I.D.:
	SECTION: RAD SAFE OFFICE	METER USED: E-500 B

LOCATION:	AUTHORIZATION	PHONE:	TIME & DATE:
Irradiation Facility Bldg 401, Evans	29-01022-07	65292	0940 12 JUN 78

SAMPLE DESCRIPTION:



LABORATORY CHECK LIST

✓ Ventilation

✓ Storage Areas

✓ Labelling

✓ Monitoring Equipment

BACKGROUND: .02 mR/hr

SUSPECT ISOTOPE

ANALYSIS DESIRED

CHECK POINT	mR/hr	CHECK POINT	mR/hr	REMARKS
1	BKG	11	8.5	
2	BKG	12	3.5	
3	BKG	13		
4	BKG	14		
5	.05	15		
6	.065	16		
7	.08	17		
8	.6	18		
9	45	19		CENTER OF TUBE
10	180	20		BASE OF TUBE

REPORT OF ANALYSIS APPROVED BY:

TIME AND DATE OF COMPLETION:

ANALYSIS PERFORMED AT:
RD&E RadSafe Office
Room 150, Bldg 37D, Evans
Fort Monmouth, NJ 07703
Tel Ex 65292

10-1

Ex 2