CURRICULUM OUTLINE

FOR

BASIC NUCLEAR-BIOLOGICAL-CHEMICAL DEFENSE

"BASIC NBC DEFENSE"

PREPARED BY

NAVAL TECHNICAL TRAINING CENTER
TREASURE ISLAND
SAN FRANCISCO, CALIFORNIA 94130

(A-495-0421)

PREPARED FOR

CHIEF OF NAVAL TECHNICAL TRAINING

JUNE 1980

UNIT 3.0 NUCLEAR DEFENSE

Estimated Contact Hours Allotted this Unit:

Classroom	Laboratory
15.0 Hours	4.0 Hours

TERMINAL OBJECTIVES:

Supported Entirely by this unit:

Upon completion of this course, the student will be able to:

6.0 IDENTIFY the basic terms, concepts, hazards, and procedures that are related to a nuclear accident or fallout situation, when given a multiple choice examination, with an accuracy of 70%.

7.0 DEMONSTRATE a working knowledge of the Navy's RADIAC instruments by using any one assigned by the instructor to detect and read the value of a radiation source, using standardized procedures without error.

8.0 DETECT, IDENTIFY, and DETERMINE the extent of a nuclear hazard, when given a simulated nuclear contamination situation, in accordance with NAVSEA Chapter 070 and NAVEDTRA 10899B, without procedural error.

9.0 EVALUATE the impact of radiation on personnel operating in a nuclear fallout situation, by calculating hazard effects, in accordance with NAVSEA Chapter 070, NAVEDTRA 10899B, and NWIP 50-3(A) with in an error range of ±5% from the instructor's predetermined calculations.

LESSON TOPIC 3.1 NUCLEAR TERMS & EFFECTS

Estimated Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
3.0 Hours	0.0 Hours

TERMINAL OBJECTIVES:

Supported partially by this lesson topic and partially by lesson topics 3.2 & 3.3.

Upon completion of this course, the student will be able to:

6.0 IDENTIFY the basic terms, concepts, hazards, and procedures that are related to a nuclear accident or fallout situation, when given a multiple choice examination, with an accuracy of 70%.

ENABLING OBJECTIVES:

Supported entirely by this lesson topic.

Upon completion of this lesson topic, the student will be able to:

3.1.1 DEFINE the basic nuclear defense terms listed below in accordance with NAVSEA Chapter 070 and COMNAVSURFPACINST 3541.4, by choosing the proper definition when given multiple questions. The terms to be define are: (PQS 3109.1 3109.2 2102.2 2102.3)

a. Dose
b. Dose Rate
c. Roentgen
d. Milliroentgen
e. Rad
f. Millirad
g. Radioactivity
h. Radiation
i. Contamination
j. Initial Radiation
k. Alpha
l. Beta
m. Gamma
n. Neutron
o. Base Surge
p. Fallout
q. Electromagnetic Pulse
r. Thermal Radiation
s. Maximum Permissible Exposure
t. Casualty Dose
u. Air Blast
v. Shockwave

3.1.2 SELECT statements concerning each type of nuclear detonation by its name, function and characteristics (to include ability to cause damage and personnel casualties), in accordance with NAVSEA Chapter 070 and NAVEDTRA 10899B, when given multiple choice questions. (PQS 3109.3 2102.1)

3.1.3 SELECT statements about the effects of ionizing radiation on personnel to include: personnel hazards of the four types of ionization and their penetrating potential; units of radiation and radiation dose measurement; cumulative nature of exposure; and radiation guides for peacetime and wartime, in accordance with NAVSEA Chapter 070, NAVEDTRA 10899B, TM 8-215, and NWIP 50-3(A), when given mutiple choice questions.

LESSON TOPIC 3.2 NUCLEAR DEFENSIVE COUNTERMEASURES

Estimated Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
2.0 Hours	0.0 Hours

TERMINAL OBJECTIVES:

Supported partially by this lesson topic and partially by lesson topics 3.1. & 3.3.

Upon completion of this course, the student will be able to:

6.0 DEFINE the basic terms, concepts, hazards, and procedures that are related to a nuclear accident or fallout situation, when given a multiple choice examination, with an accuracy of 70%.

ENABLING OBJECTIVES:

Supported entirely by this lesson topic.

Upon completion of this lesson topic, the student will be able to:

3.2.1 SELECT the personnel protective measure for protection from air blast, underwater shock, (to include the "secondary projectile" hazard from loose gear) and thermal radiation, in accordance with NWIP 50-3(A). NAVSEA Chapter 070, and NAVEDTRA 10899B, by choosing the proper responses on multiple choice questions. (PQS 2102.8)

3.2.2 SELECT NBC countermeasures available aboard ship to include examples of time, distance and shielding, in accordance with NWIP 50-3(A), NAVSEA Chapter 070, and NAVEDTRA 10899B, by choosing the proper responses on multiple choice questions. (PQS 2102.7)

LESSON TOPIC 3.3 NUCLEAR WEAPONS ACCIDENTS: HAZARDS & RESPONSES

Estimated Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
1.0 Hours	0.0 Hours

TERMINAL OBJECTIVES:

Supported partially by this lesson topic and partially by lesson topics 3.1 & 3.2.

Upon completion of this course, the student will be able to:

6.0 DEFINE the basic terms, concepts, hazards, and procedures that are related to a nuclear accident or fallout situation, when given a multiple choice examination, with an accuracy of 70%.

ENABLING OBJECTIVES:

Supported entirely by this lesson topic.

Upon completion of this lesson topic, the student will be able to:

3.3.1 SELECT the preliminary precautions to be observed and the hazards associated with nuclear weapons given a weapons handling and storage situation, when given multiple choice questions, in accordance with NAVSEA Chapter 070, NAVEDTRA 10899B FM 3-15, NWIP 50-3(A), and NAVMED P-5059.

3.3.2 DESCRIBE the procedures to be put into effect in the initial response to a nuclear weapon accident from the time of the accident to HE (high explosive) pick up, in accordance with NAVSEA Chapter 070, NAVEDTRA 10899B, FM 3-15, NWIP 50-3(A), and NAVMED P-5059, by answering written questions.

3.3.3 EXPLAIN the basic procedure for reporting a nuclear weapon accident to higher authority, in accordance with NAVSEA Chapter 070, NAVSEA 10899B, FM 3-15, NWIP 50-3(A), and NAVMED P-5059 by answering written questions.

3.3.4 SELECT the monitoring and decontamination procedural steps for spaces and personnel involved in a nuclear weapons accident, in accordance with NAVSEA Chapter 070, NAVEDTRA 10899B, FM 3-15, NWIP 50-3(A), and NAVMED P-5059, by answering written questions.

3.3.5 SELECT the proper method for disposing of radioactive material resulting from a nuclear accident (or fallout situation), in accordance with NAVEDTRA 10899B, when given multiple choice (PQS 3109.17) questions.

LESSON TOPIC 3.4 DOSE AND DOSE RATE INSTRUMENTS

Estimated Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
3.0 Hours	2.0 Hours

TERMINAL OBJECTIVES:

Supported entirely by this lesson topic.

Upon completion of this course, the student will be able to:

7.0 DEMONSTRATE a working knowledge of the Navy's RADIAC instruments by using any one assigned by the instructor to detect and read the value of a radiation source, using standardized procedures without error.

ENABLING OBJECTIVES:

Supported entirely by this lesson topic.

Upon completion of this lesson topic, the student will be able to:

3.5.1 LIST the functions and characteristics of the DT/60, IM (series) pocket dosimeter, AN/PDR-27, AN/PDR-43, AN/PDR-56, CP-95/PD, AN/PD-65, and PP-4276/PD radiac instruments and dosimetric devices, in accordance with NAVEDTRA 10899B, NAVSEA Chapter 070, and COMNAVSURFPACINST 3541.4, by answering multiple choice questions. (PQS 3218) 3219 3220 3221 3222 3223)

3.5.2 STATE the safety precautions to be observed when working with radioactive materials in a shipboard environment, in accordance with NAVMED P-5059, by responding to written questions, without error.

3.5.3 OPERATE the Navy standard RADIAC instruments to determine the extent and level of a hazard emitting measurable alpha or beta/gamma radiation in a controlled laboratory environment following all safety precautions, in accordance with NAVSEA Chapter 070, NAVEDTRA 10899B, FM 3-15, NWIP 50-3(A), and NAVMED P-5059, without procedural error.

NOTE: To ease scheduling for utilization of radiation source/facilities and extra instructor (safety monitor) personnel, the lab times for Lesson Topic 3.4 and 3.5 are scheduled to run consecutively; a total of 4 lab hours.

LESSON TOPIC 3.5 PERSONNEL MONITORING AND SHIPBOARD SURVEYS

Estimated Contact Hours Allotted this Lesson Topic.

Classroom	Laboratory
1.0 Hours	2.0 Hours

TERMINAL OBJECTIVES:

Supported entirely by this lesson topic.

Upon completion of this course, the student will be able to:

8.0 DETECT, IDENTIFY, and DETERMINE the extent of a nuclear hazard, when given a simulated nuclear contamination situation, in accordance with NAVSEA Chapter 070 and NAVEDTRA 10899B, without procedural error.

ENABLING OBJECTIVES:

Supported entirely by this lesson topic.

Upon completion of this lesson topic, the student will be able to:

3.4.1 SELECT the procedural steps for monitoring contaminated personnel and the safety precautions to be followed in accordance with NAVEDTRA 10899B, NAVSEA Chapter 070, and Principles of Radiation Contamination and Control (Volumes I and II), by selecting statements when given multiple choice questions.

3.4.2 MONITOR personnel for radiological contamination, using a simulated contaminated model (dummy) when given the necessary equipment and materials, in accordance with NAVEDTRA 10899B, NAVSEA Chapter 070, and Principles of Radiation Contamination and Control (Volumes I and II), to locate all hidden radioactive sources. (PQS 3305.110)

3.4.3 SELECT the major types of radiological surveys by name, function, characteristics, procedural steps, safety precautions, and documentation of results, in accordance with NAVEDTRA 10899B, NAVSEA Chapter 070, COMNAVSURFPACINST 3541.4, and NWIP 50-3(A) by selecting statements when given multiple choice questions. (PQS 3303.14A)

3.4.4 PERFORM a radiological survey using both gross and detailed procedures, when provided with the necessary equipment and materials, for a simulated nuclear fallout situation (using hidden radioactive sources), and following all safety precautions, in accordance with NAVEDTRA 10899B, NAVSEA Chapter 070, NWIP 50-3(A), and COMNAVSURFPACINST 3541.4 without procedural error. (PQS 3305.18 3305.19 3305.111)

LESSON TOPIC 3.6 RADIOLOGICAL CALCULATIONS

Estimated Contact Hours Allotted this Lesson Topic:

Classroom	Laboratory
5.0 Hours	0.0 Hours

TERMINAL OBJECTIVES:

Supported entirely by this lesson topic.

Upon completion of this course, the student will be able to:

9.0 EVALUATE the impact of radiation on personnel operating in a nuclear fallout situation, by calculating hazard effects, in accordance with NAVSEA Chapter 070, NAVEDTRA 10899B, and NWIP 50-3(A) within an error range of ±5% from the instructor's predetermined calculations.

ENABLING OBJECTIVES:

Supported entirely by this lesson topic.

Upon completion of this lesson topic, the student will be able to:

3.6.1 CONSTRUCT a fallout plot to determine time of arrival and time of cessation, within a ±5% error, based upon data from a hypothetical nuclear fallout situation, in accordance with NAVSEA Chapter 070, NAVEDTRA 10899B, (PQS 3109.22) and NWIP 50-3(A).

3.6.2 DETERMINE the time of entry/time of stay based upon data from a hypothetical nuclear fallout situation, within an error factor of ±5%, in accordance with NAVSEA Chapter 070, NAVEDTRA 10899B, and NWIP 50-3(A). (PQS 3109.23)

3.6.3 DETERMINE the radiological hazard impact on personnel by calculating total dose exposurers, within an error factor of ±5%, based upon data from a hypothetical nuclear fallout situation, in accordance with NAVSEA Chapter 070, NAVEDTRA 10899B, and NWIP 50-3(A).

3.6.4 DETERMINE exposure rate and dose by calculating time, distance, and shielding data, within an error factor of ±5%, based upon data from a hypothetical nuclear fallout situation, in accordance with NAVSEA Chapter 070 and NAVEDTRA 10899B.

The following is a list of required reading for completion of the Radiation Worker Training Program. This will aid you in your preparation for the written rad worker exam. You may be asked oral questions at any time by the Radiation Safety Officer and Assisant Radiation Safety Officer. Be prepared.

10 CFR

All of Part 19

Part 20: 20.1, 20.3, 20.4, 20.5, 20.101, 20.102, 20.104, 20.105, 20.106, 20.201, 20.202, 20.203, 20.206, 20.301, 20.302, 20.401, 20.402, 20.403, 20.405.

Part 21: 21.6, 21.21, 21.31, 21.41, 21.51, 21.61.

Part 30: Be familar with this section and remember to re-read NDCTC license.

Part 34: 34.21, 34.22, 34.23, 34.24*, 34.24*, 34.26, 34.27*, 34.28, 34.31**, 34.51 Appendix A**

Part 71: Be familar with contents

NAVMED P-5055

Read Chapter 1

Read Chapter 2, pages 2-6 to 2-11

All of Chapters 4, 5, and 6.

Read Chapter 7, pages 7-1 to 7-3

* Denotes that the material is very important / pay special attention.

** Denotes that the material is imperative to you as a rad worker.

ENCLOSURE(3)

RADIATION WORKER TRAINING

NDCTC, PHILADELPHIA

I. INTRODUCTION (70 minutes)

A. Basic Components of the Atom (Atomic Structure)
B. Stability of Atoms and Isotopes
C. Fission and Fusion

II. RADIOACTIVITY (3.0 hours)

A. Units of Measurement

1. Activity
2. Intensity
3. Dose

B. Ionizing Radiation

1. Types

a. alpha
b. beta
c. gamma
d. neutron

C. Half-Life

D. Contamination

III. RADIATION SAFETY (2.9 hours)

A. Radiation Worker

B. Radiation Area

C. Controlling/Limiting Dose Levels

D. Personnel Dosimetry

E. Hazards of Low-Level Ionizing Radiation

IV. REGULATIONS (70 minutes)

A. Federal

1. Title 10, Code of Federal Regulations
2. Nuclear Regulatory Commission

B. Navy

1. NAVMED P-5055, Radiation Health Protection Manual

V. LICENSING (60 minutes)

A. Application/Amendments - Details of NDCTC, PHILA License No. 37-05293-01

I. Introduction to Ionizing Radiation

II. RADIOACTIVITY

A. Units of Measurement

1. Activity: Unstable atoms disintergrate or decay, and as they do, they release energy. This released energy is labled natural radiation; and like everything else, we like to measure this energy. When we are measuring the natural radiation of a particular element, it is said to be the Activity of that element. Activity is further broken down to the following units:

a. Curie (Ci): the basic unit of activity

b. Practions of the Ci in common usage:

(1) MiliCurie (mCi): one thousandth of one Curie; 1 mCi - 1Ci/1,000 or 1,000 mCi = 1 Ci

(2) MicroCurie (uCi): one millionth of one Curie; 1 uCi - 1, 000,000 Ci or 1,000,000 uCi = 1 Ci

2. Intensity (I): a certain amount of radioactive material (let's say, 1 gram) has a certain activity (1 Ci). At different distances, the intensity (I) will vary. Intensity is measured in the following units:

a. Roentgen (R): this unit was adopted in 1937 as a standard for expressing quantities of X-ray and gama radiation. Intensity is always expressed in an amount (R) per unit time (hour); or as we abbreviate, R/hr = Roentgen per hour.

b. Rad (r): a new unit, the rad is a measure of the absorbed energy of any type of ionizing radiation in any medium. It is, however, more nearly equivalent to the Roentgen in mixed body tissue (hard and soft) and it is thus applicable to human exposure. So although no exactly equal, they are close enough for us to consider the relationship 1 to 1, or 1R = 1 rad.

3. Dose: if an individual were to stay in any spot where there was radiation of a known intensity during a certain time period (stay time), we could estimate the effect of that radiation on his body. This effect is labled DOSE, and is always determined by the product of the Intensity (I) of a radiation multiplied by the length (time) of stay in the area.

Example: I = 100 R/hr - 100 r/hr
Stay time: 30 minutes = 0.5hr

Dose (D) = I x T = 100 r/hr x 0.5 hr
= 100r x 0.5 = 50r
D = 50r

a. Relative Biological Effectiveness (RBE): the biological effectiveness of ionizing radiation can not be measured exactly, since it varies with the part of the body irradiated, the type of radiation, and many other factors such as the age and sex fo the individual. However, by use of a Relative Biological Effectiveness factor (RBE), a close approximation is possible.

II. RADIOACTIVITY

A. Units of Measurement

3. Dose

b. REM (rem): the rem is designed to compensate for the differences in ionization, energy transfer, etc. of the wide variety of radiations that are encountered in research and in the application of atomic power. It is the quantity of radiation (any type) which produces the same biological effect in man as those resulting from the absorbtion of 1 Roentgen of X-ray or gamma radiation. For whole body irradiation of gamma radiation the RBE is considered to be a factor of one. So rem = rad x RBE; or rem = rad x 1 for whole body irradiation of gamma radiation.

c. Other examples of RBE are as follows:

Energy and Type of Radiation	RBE
X-ray	1
Gamma	1
1.0 MEV* Beta Particle	1
0.1 MEV Beta Particle	1.08
Thermal Neutron (MEV)	2 to 5
1.0 MEV Proton	8.5
0.1 MEV Proton	10
Fast Neutron (1 to 10 MEV)	10
5 MEV Alpha	15
1 MEV Alpha	20

*MEV = million electron volts

B. Ionizing Radiation

1. Refer to Rad Worker Information Binder

C. Half-Life

1. Refer to Rad Worker Information Binder

D. Contamination

1. Refer to 10 CFR and NAVMED P-5055

III. RADIATION SAFETY

A. Radiation Worker

1. Read definition, article 19.3, Part 19, Title 10 Code of Federal Regulations (10 CFR)

2. Essentially, any individual working in or frequenting any portion of a designated radiation area where they will be exposed to ionizing radiation shall be designated a Radiation Worker.

III. RADIATION SAFETY

A. Radiation Worker

3. Radiation Workers shall be instructed in accordance with Title 10, Code of Federal Regulations.

a. Read:

(1) Part 19, 10 CFR

(2) Part 20, 10 CFR, art. 20.206 (page 196)

B. Radiation Areas

1. Read articles 20.202 and 20.203; Part 20, 10 CFR

C. Controlling/Limiting Dose Levels

1. Read articles 20.1 through 20.108; Part 20, 10 CFR

2. Methods:

a. Time: one of the easiest ways of limiting radiation exposure is tightly control the time in which individuals are exposed to sources of ionizing radiation.

b. Distance: as mentioned in lesson II, intensity decreases the further you are from the source of radiation. More specifically, we use the Inverse Square Law to determine intensities at given distances from a known source.

I_1 = initial Intensity

d_1 = initial distance

$I_2 = I_1(d_1/d_2)^2$

I_2 = desired Intensity

d_2 = desired distance

#1 Example: we have a 1Ci source of Co^{60} which has an intensity of 10 r/hr at a distance of 1 meter (1m). What will be the intensity at 5m?

I_1 = 10r/hr $\quad d_1$ = 1m

I_2 = ? $\quad d_2$ = 5m

$I_2 = I_1 (d_1/d_2)^2$

I_2 = 10 r/hr x $(1m/5m)^2$ = 10 r/hr x $(1/5)^2$ = 10 r/hr x 0.04

I_2 = 10 r/hr x 0.04 = 0.4 r/hr

III. RADIATION SAFETY

C. Controlling/Limiting Dose Levels

2. Methods:

b. Distance:

#2 Example: we have the same data as #1, with 10r/hr at 1m. But what happens if we move closer? What will be the intesity at 0.25m.

I_1 - 10r/hr $\quad d_1$ = 1m $\quad I_2 = I_1 \times (d_1/d_2)^2$

I_2 = ? $\quad d_2$ = 0.25m $\quad = 10r/hr \times (1m/0.25m)^2$

$= 10r/hr \times (1/0.25m)^2 = 10r/hr \times 16$

$I_2 = 160r/hr$

See how quickly the intensity jumps as you move closer to the source? This is the reason you must be aware of the hazard of working close to radioactive sources when you are a Radiation Worker.

c. Shielding

(1) Refer to Rad Worker Information Binder, Section 2

d. Reduce Amount of Radiation:

(1) Why expose individuals to a 1 Ci source, when a lesser, 0.5 Ci or even a 250 mCi source, would perform just as well, with much less risk.

e. In summary, methods of controlling dose levels are: (1) minimize time of exposure; (2) maximize distance; (3) use maximum amount of shielding; and (4) minimize the activity of the source with which you are working.

D. Personnel Dosimetry

1. Read articles 20.405-20.409; Part 20, 10 CFR

2. Read Chapters 4, 5, and 6 in NAVMED P-5055, Radiation Health Protection Manual

3. In summary of the above readings the types of personnel monitors used at NDCTC, PHILA are LiF TLD, Pocket Dosimeter, PDR/1B, and Film Badges. These monitors are used to measure the radiation dose which personnel have received from exposure to our radioactive sources. All students and visitors are required to wear film badges when entering the radiation area. These badges are collected monthly, or when a person is no longer likely to be exposed to ionizing radiation, and are sent to Bethesda, Maryland for processing. Radiation Workers will be required to wear LiF TLD during normal working hours on the compound and on base. Required dosimetry during radiation exercises, inspections, surveys, and leak tests are specified in NDCTC INST 5100.1E. A report is returned, listing the dose in rem which each individual received during the month. Each individual will then have his dose recorded on a DD Form 1141, which is maintained in the individual's health record.

III. RADIATION SAFETY

D. Personnel Dosimetry

3. Cont'd:

The use of personnel monitors is required by the Nuclear Regulatory Commission, and there are two main reasons for recording personnel dose. The first of these reasons is to assure that personnel do not receive any doses greater than those established by the NRC. If an overdose is received, corrective actions must be taken ranging from investigation of circumstances that caused the overdose to the medical treatment of the person that caused the overdose to the medical treatment of the person who received the overdose. The second reason is simply to document personnel doses. This is important because it is sometimes necessary to know a person's history of radiation exposure.

E. Hazards of Low-Level Ionizing Radiation

1. Studies on the long term effect of low-level ionizing radiation are incomplete. However, it may be safe to assume that radiation in any form and any level is not good for you. It appears to be a cause or at the very least increases the risk of leukemia and other cancers.

2. Although very high doses are necessary for sterility, there are some real dangers to exposing pregnant women to ionizing radiation. Extreme care must be taken for the safety of the woman and the fetus when exposing them to any radiation. At this command, pregnant women will not enter or participate in any radiation exercise or drill.

3. This is why we attempt to tightly control dose levels to radiation workers (lesson III, C). With these stringent requirements, we minimize the dangers from exposure.

IV. REGULATIONS

1. Nuclear Regularoty Commission (NRC)

a. Read Part 1, 10 CFR; pages 25 - 27

2. Code of Federal Regulations (CFR)

a. Read pages V and VI, 10 CFR

3. U. S. Navy

a. Radiation Health Protection Manual, NAVMED P-5055

(1) Read Chapter 1, NAVMED P-5055

V. LICENSING OF RADIOACTIVE SOURCES

A. Application for / Amendments to

1. Read Chapter 1, Part 2, subpart A, 10 CFR, pages 41 - 52

V. LICENSING OF RADIOACTIVE SOURCES

A. Application for / Amendments to

2. Be familiar with information of all handouts for this training

B. Naval Damage Control Training Center License

1. Read NDCTC License No. 37-05293-01

2. Read NDCTC INST 5100.1E

RADIATION WORKER

NAME _____
Last First Middle Initial

Rate/Rank _____ Department _____

Check off list:

10 CFR _____

P-5055 _____

Rad. info. binder _____

Date of exam _____

Grade _____

Signature _____ Date _____

RSO Signature _____ Date _____

FINAL EXAM

FOR

RADIATION WORKERS

1. The energy which holds the nucleus of an atom together is called:

   a. Electrostatic energy
   b. Heat energy
   c. Binding energy

2. The Splitting of Large Unstable Atoms into Smaller Fragments with a Release of Energy is:

   a. Fission
   b. Fusion
   c. A chain reaction
   d. Ionization

3. The Form of Nuclear Radiation with the Longest Range is:

   a. Alpha Particle
   b. Beta particle
   c. Gamma rays

4. The Transmission Factor of a Certain Shield is .25. If 100 R/hr strikes the Shield, how much radiation do you receive?

   a. 400 R/hr
   b. 100 R/hr
   c. 25 R/hr
   d. 2.5 R/hr

5. Steel, Concrete, Lead and Wood all Act as Radiation Shields. Which of the Following is the Proper Arrangement from Best to Worst Shield:

   a. Lead, concrete, steel, wood
   b. Lead, Steel, concrete, wood
   c. Lead, steel, wood, concrete
   d. Lead, concrete, wood, steel

Match the Following:

6.	Activity_____	A.	Rem
7.	Dose_____	B.	Roentgen
8.	Exposure_____	C.	Curie

9. Film Badge Readings are measured in

   a. Rem
   b. Roentgen
   c. Curie

10. There are _____ Millicuries in One Curie

   a. 10
   b. 100
   c. 1,000
   d. 1,000,000

11. An AN/PDR 27 Measures

a. Activity
b. Dose
c. Exposure

12. Three Ways to Reduce Exposure are:

a. Minimize time, maximize distance, maximize shielding
b. Maximize time, maximize distance, minimize shielding
c. Minimize time, minimize distance, maximize shielding
d. Minimize time, maximize distance, minimize shielding

For 13-16 choose A if statement applies to film badges and B if it applies to pocket dosimeters.

_____13. Cannot be read on the spot
_____14. Collected monthly
_____15. More prone to error due to mechanical shock
_____16. Rechargeable

17. Leukemia and Lung Cancer are_____effects of Radiation

a. Acute
b. Somatic
c. Genetic

18. A Large Dose of Radiation Delivered Instantaneously will cause_____ Effects

a. Acute
b. Somatic
c. Genetic

19. Which of the following Documents must be either posted or available to Radiation Workers for Examination

a. NRC license
b. Regulations of parts 19 & 20, title 10 CFR
c. Operating procedures
d. All of the above

20. The Maximum Permissible Dose to the Whole Body for a Radiation Worker is:

a. 5 millirem per year
b. 5 rem per year
c. 5 rem per quarter
d. 1 rem per month

21. True or False - Personnel Monitors (Film Badges or Pocket Dosimeters) are not required, but are suggested for use in high Radiation Areas.

22. The missing Z number in the following decay equation is

$$ {}^{15}_{8} \qquad {}^{15}_{\_\_\_}N \qquad {}^{0}_{+1}\beta $$

a. 6
b. 7
c. 8
d. 9

23. Except for radiography programs, most Navy Radiac survey instruments are required to be calibrated every

a. 3 months.
b. 6 months.
c. 12 months.
d. 18 months.

24. Personnel exposures are maintained in the military Health Records on form:

a. NAVMED 6470-1
b. DD 1141
c. NRC-4
d. OPNAV 5101

25. List the three sources we have on board by name of isotope:

__________________, ________________, ________________.

26. What are the specific activities of each of the sources that NDCTC is licensed to hold:

____

____

____

27. A Swipe Test or Leak Test must be performed:

a. Annually
b. Semi-Annually
c. Monthly
d. When necessary

28. NBC Staff, while conducting Radiation Drills, must wear:

a. LiF TLD
b. Pocket Dosimeter
c. Either a or b
d. Both a and b

Checklist for Practical Examination of individual User Candidates (Radiation Safety Officer observes rad worker running an exercise.)

_____ 1. Does he handle material only by string, 10" plyers, or other remote device?

_____ 2. Does he keep sources away from body while handling them?

_____ 3. Does he work as fast as possible while still handling the source carefully?

_____ 4. Does he replace sources in stowage safe as soon as is practical upon completion of drill?

_____ 5. Does he assure that time of student exposure to radiation is kept to a minimum consistent with requirements of the drill?

_____ 6. Does he assure that all persons entering the radiation area are wearing film badges or required dosimetry?

_____ 7. Does he assure that the radiation area is locked whenever an instructor is not present?

_____ 8. Does he demonstrate confidence in handling the sources?

ENCLOSURE(5)

DEPARTMENT OF THE NAVY
NAVAL DAMAGE CONTROL TRAINING CENTER
NAVAL BASE
PHILADELPHIA, PENNSYLVANIA 19112

NDCTCINST 5100.1E
N5/LJP:cc
9 MAY 1983

NAVDAMCONTRACEN INSTRUCTION 5100.1E

To: Distribution

Subj: Radioactive Materials; Promulgation of safety and operating procedures for

Ref: (a) Radiation Health Protection Manual, NAVMED P-5055
(b) Title 10, Code of Federal Regulations, Part 20
(c) NRC By-product Material License, No. 37-05293-01
(d) NAVSUP Instruction 5101.9B
(e) BUMEDINST 6470.10
(f) OPNAVINST 6470.1
(g) NAVELEXINST 9673.9A
(h) NAVELEXINST 9673.5D

Encl: (1) Radiological Safety Requirements and Procedures for Use of Radioactive Sealed Sources at Naval Damage Control Training Center, Philadelphia, Pennsylvania 19112
(2) Diagram of Naval Damage Control Training Center, Philadelphia, Pennsylvania 19112

1. Purpose. The purpose of this Instruction is to establish procedures to be followed in the event of accidents or incidents involving radioactive materials and to implement regulations, policy, and operating instructions for the use of radioactive sources as outlined in enclosure (1).

2. Background. Radioactive sealed sources are presently employed by the NBC Branch in compliance with reference (c).

3. Cancellation. This Instruction supersedes Naval Damage Control Training Center Instruction 5100.1D of 4 June 1979.

4. Policy. The policy of the commanding officer for radiation exposure to personnel shall be as follows:

a. Any female who is or suspects she is pregnant will not be permitted into the radiation area or participate in any radiation evolutions without medical evaluation. This shall be strictly observed in accordance with reference (f).

b. Radiation exposure shall be held at the minimum level consistent with the achievement of training objectives and in accordance with reference (b).

c. The level of exposure shall in no case exceed the Maximum Permissible Exposure (MPE) as prescribed in reference (b).

d. Visitors will not be permitted access to the NBC areas during drills and exercises. Definite limitations shall be imposed during these times by restricting entry

ENCLOSURE (2)

of unnecessary personnel into the restricted areas of building 740. For the purpose of this instruction, "unnecessary personnel" shall include all personnel with the exception of:

(1) NBC Branch radiation workers participating in the exercises.
(2) Students participating in the exercise.
(3) The RSO and designated source handlers.
(4) In the event of an emergency at any time, controlled access shall be permitted for essential Source Recovery Team Members only.

5. General Information. Radioactive materials are employed by the NBC Branch to simulate small fallout fields and to demonstrate the principles of radiological monitoring and shielding. The radioactive materials are sealed sources, primarily Gamma Emitters, and are Cesium 137 (one source) and Cobalt 60 (two sources). The radioactive materials are located and used in the following areas:

a. Radiation Monitoring Exercise Area. This is an area in Building 740 containing mock-ups of ships' compartments. It is surrounded by masonry and poured concrete shielding walls. The facility is used for training students in the use of high and low range radiac instruments. The facility is designated and posted as "Radiation Area".

b. Radioactive Stowage. The place of stowage is a locally manufactured stowage safe. Shielding is provided by ½ inch poured lead sandwiched between two 3/8 inch thick steel plates and 8 inches of masonry and poured concrete surrounding the safe. The safe is secured with a Sargent and Greenleaf Locking System and is located within the Radiation Monitoring Exercise Area (see enclosure (2)). When sources are secured and radiation area is not in use, it will be posted as "Radioactive Storage Area."

6. Duties and Responsibilities. NDCTC will have appointed a Radiation Review Committee (RRC). The RRC committee will consist of the Executive Officer, Radiation Safety Officer (RSO), Assistant Radiation Safety Officer (ARSO), and Photodosimetry Coordinator who shall be a qualified hospital corpsman. The committee will ensure the implementation of this instruction at the working level and meet at least annually to review the radiation program prior to inspections. A Source Recovery Team (SRT) will consist of all appointed radiation workers, with the RSO and ARSO having cognizant authority during any emergency situation. It will be the NDCTC Command Duty Officer responsibility to adhere to procedures as outlined in this Instruction. The duties of the members of the RRC, SRT and CDO are as follows:

a. Commanding Officer. The commanding officer shall have ultimate responsibility for the safe and efficient operation of the command.

(1) He shall maintain an effective radiation control program in accordance with this Instruction.

(a) Establish and implement a radiation safety program.
(b) Appoint a qualified Radiation Safety Officer (RSO).
(c) Ensure effective coordination among the RSO, radiation workers, Base Fire and Police Forces and appropriate medical personnel.

b. Executive Officer

(1) Conduct meetings when required: review license and amendments, changes to procedures and qualification of radioactive materials handlers and radiation workers in charge of monitoring evolutions.

(2) Ensure that regular inspections of the facilities and operations are conducted.

(3) Coordinate the establishment of maximum permissible exposures for qualified staff personnel as set forth by the commanding officer in compliance with reference (b).

(4) With the assistance of the RSO, formulate a radiation protection program.

c. Radiation Safety Officer (RSO). A qualified member of the NDCTC staff who has had training and experience in Radiation Safety shall be appointed as Radiation Safety Officer for the command. If a person so qualified is not available, a suitable candidate shall be chosen and sent to the Radiation Safety Officer Course (A-4J-0016) given by Naval Energy and Environmental Support Activity (NEESA), Port Hueneme, CA. Upon completion of this course the individual shall be appointed as Radiation Safety Officer. His/her duties shall be as follows:

(1) Report directly to the commanding officer via the executive officer for all matters relating to radiation safety and advise him of all laws, regulations and directives, promulgated by higher authority, governing the use of radioactive materials.

(2) As necessary, prepare the Nuclear Regulatory Commission (NRC) license, license renewal application, and applications for amendment for the commanding officer's signature.

(3) Assist the executive officer in formulating the command radiation safety program which shall include:

(a) Conducting or designating ARSO to conduct an annual refresher training in safe handling procedures, which shall include observation of all handlers of radioactive material in the course of their duties and give a written exam.

(4) Conduct occasional inspections of spaces containing radioactive sources, observe exercises conducted in them and certify to the commanding officer that all drills, exercises and procedures are acceptable from the viewpoint of radiation health.

(5) Evaluate and sign all NAVMED 6470/1 forms (Report of Personnel Exposure to Ionizing Radiation), that may be necessary. In addition, ensure that all DD1141 forms are prepared properly.

(6) Conduct periodic inspections at least semi-annually of sources, conduct or supervise the semi-annual leak tests of sources, maintain a permanent file of the results and institute disposition procedures for sources exceeding the maximum permissible surface contamination allowed by reference (b).

(7) Assume responsibility for the qualified staff use of all radioactive materials in drills and exercises. (It shall be his/her decision to terminate an exercise or drill due to any violations or hazards which endanger personnel involved. He shall immediately inform the commanding officer, executive officer and HT"A" Department Head of such action.).

(8) Require that all students in a "Radiation Area" be under supervision of a qualified radiation worker at all times.

(9) Maintain custody of the keys to radiation areas and of the keys to the sealed sources safe or designate this responsibility to the ARSO.

(10) Ensure that all official observers and visitors comply with the provisions set forth in reference (b).

(11) Check and evaluate the control films located throughout the command to ensure that monthly background readings are within prescribed limits.

(12) Ensure that all radiac instruments are in operational order and are in accordance with reference (g) and (h).

d. Assistant Radiation Safety Officer (ARSO)

(1) Be responsible for the safe and efficient employment of radioactive sources within the command.

(2) Maintain a current radiation source log-book/inventory, knowing the exact location of each source and assuring the sources are secured against unauthorized use.

(3) Recommend detailed administrative, operating and emergency instructions and procedures for the use of radioactive materials within the command.

(4) Supervise and enforce such administrative, operating and emergency procedures as are approved by the commanding officer.

(5) Report to the RSO any incident, personnel injury, suspected overexposure, contamination, or internal deposition involving radiation sources as soon as possible.

(6) Designate subordinates to assist him in the discharge of these duties.

(7) Post appropriate warning signs and notices.

e. Photodosimetry Coordinator. The executive officer will arrange for the CO, NRMC, Philadelphia, to designate a qualified hospital corpsman to act as the Photodosimetry Coordinator for the command. He/she shall be under the direct supervision of the RSO and perform the duties listed below. In the event a Photodosimetry Coordinator cannot be designated, the RSO will assume the duties until such time.

(1) Maintain records of exposure and all pertinent medical records required by reference (a).

(2) Ensure radiation workers have radiation physicals in accordance with reference (a).

(3) Ensure that a record of exposure of all personnel is forwarded to the individual's next duty station or to the command maintaining his/her health record. In the case of an exposure in excess of the permissible limits, he shall:

(a) Notify the RSO who will take appropriate action

(b) One of the appointed radiation workers will assist in preparing NAVMED 6470/1, Report of Personnel Overexposure to Ionizing Radiation, in accordance with reference (a) and (b).

(4) Be responsible for documentation and the forwarding of all film badges. This shall be done on a monthly basis. The film shall be forwarded for processing to the BUMED Dosimetry Center, Radiological Safety Department, Bethesda, Maryland 20814.

(5) One of the appointed radiation workers will assist in preparing DD1141's Radiation Exposure History Report, for inclusion in all medical records.

(6) One of the appointed radiation workers will assist in preparing the annual NAVMED 6470/1, Report of Personnel Exposure to Ionizing Radiation, for each class of students exposed to radiation. He shall prepare and send annual and situational reports for all staff personnel in accordance with reference (a) and (b).

f. Radiation Workers. All radiation workers shall be trained and held responsible for:

(1) Knowing and following radiation safety procedures, rules and special instructions.

(2) Ensuring that students have received thorough instructions prior to using or being exposed to radiation.

(3) Being present at all times during a class radiation exercise or drill.

(4) Using safety equipment properly.

(5) Reporting to the ARSO any incident, personnel injury, suspected overexposure, contamination, or internal deposition involving radiation sources as soon as possible.

(6) Reporting to the ARSO any hazardous or potentially hazardous working conditions.

(7) Assisting the Photodosimetry Coordinator in preparing all radiation reports for medical records and all radiation exposure reports.

g. Source Recovery Team (SRT). All appointed radiation workers will be considered the SRT. In the event of an emergency situation involving radioactive materials, they shall be held responsible for:

(1) Ensuring that appropriate protective clothing is worn.

(2) Assisting the RSO and ARSO as directed.

(3) Ensuring that non-SRT personnel are not in the designated radiation area.

(4) Posting appropriate warning signs and tags as required and immediately roping off the area.

h. NDCTC Command Duty Officer

(1) Be familiar with the contents of this instruction, emergency situation procedures and safety procedures used in conjunction with radioactive materials.

(2) In the event of an emergency or incident involving radioactive material, carry out the procedures listed in paragraph 7. c. of this Instruction.

(3) Notify Base Fire and Police Forces to be on hand in any emergency situation.

7. Standard Operating Procedures. All applicable requirements and procedures of reference (a), (b) and (c) shall be strictly adhered to.

a. Radiation Dosage Control

(1) Maximum Permissible Exposures. These have been established in accordance with references (a) and (b).

(a) Staff and Students

1 Radiation workers shall not exceed limits as specified in reference (a) unless given verbal or written approval by the CO, RSO or ARSO.

2 Students shall be limited to the minimum exposure possible.

(b) Official Observers

1 Official personnel observing radiological exercises or drills shall adhere to and be certified in accordance with reference (a) and (b).

2 Those personnel not qualified in accordance with reference (a) and (b) shall attain written permission from the RSO, ARSO, or CO for entry into the radiation area.

(2) Permissible Levels of Radiaiton in "Unrestricted Areas". An "unrestricted area" is one which does not have controlled access for purposes of protection of personnel from exposure to radiation. Radiation levels for these areas shall not exceed the prescribed limits set forth in reference (a).

(3) Wearing a Dose Measuring Device

(a) All students and visitors authorized to enter an area where radioactive material is present will wear fillm badges and such badges will be logged and processed in compliance with reference (a).

(b) Qualified rad working personnel performing required evolutions and tests will wear pocket dosimeters, Lithium Flouride Thermoluminescent (LiF TLD) badges and the PDR/1B.

(c) Personnel permanently assigned to the NBC Branch who are radiation workers will wear the LiF TLD's at all times during working hours.

b. Physical Security. Security measures will be observed in the Radiation Monitoring Exercise area in building 740. The buildings and grounds are divided into area security (external) and building security (internal). The security measures for the sealed source safe have been delineated in paragraph 5 of this Instruction and the security measures for building 740 are delineated in enclosure (1). During working hours, any violations of command policies shall be promptly reported to the RSO, ARSO, or CO. After working hours, violations are to be reported to the NDCTC Command Duty Officer.

c. Emergency Procedures

(1) Notify the RSO, ARSO, CO, XO and SRT of any emergency situation involving radiation materials or spaces.

(2) In the event of a theft or loss of any radioactive materials the following action shall be initiated: a report shall be made by telephone and message to the manager of the nearest NRC Operations Office. This report shall be made as soon as the theft or loss is discovered by the commanding officer or his designated representative. The Regional NRC Operations Office, Region One is located at 631 Park Ave., King of Prussia, PA 19406, Phone (215) 337-5000.

(3) Isolate the area to prevent any unnecessary exposure to personnel and/or further spread of contamination. Close the main gate to NDCTC. Allow no persons to leave the compound until the RSO or ARSO are on scene.

(4) If a personnel casualty exists, the RSO or ARSO shall determine the extent of injuries and decontaminate the individual if necessary before removing him/her for medical treatment. If a situation exists where speed is essential to saving life or limb, wrap the individual in blankets or polyethylene bags to contain as much of the contamination as possible and immediately contact the Naval Regional Medical Center, Philadelphia, Pennsylvania for further instructions. Inform the hospital that the individual is contaminated and give the circumstances surrounding the incident.

d. Reports. In compliance with references (a) and (b), the following reports will be submitted, if applicable, by the commanding officer or his designated representative following notification of an emergency or incident:

(1) Immediate Notification. Notify the manager of the nearest NRC Operations Office (see paragraph 7.c. (2) of this Instruction) by telephone and message of any incident which may have caused or threatens to cause:

(a) Exposure of the whole body to 15 rem or more, exposure of the skin of the whole body to 150 rem or more, or exposure of the feet, ankles, hands or forearms to 375 rem or more of radiation.

(b) A loss of one working week or more of the operations of any facility affected.

(c) Damage to property in excess of $200,000.00.

In addition, notify the Chief of Naval Tchnical Training, the Bureau of Medicine and Surgery (Code 3C2) by priority message. A detailed NAVMED 6470/1, Personnel Overexposure to Ionizing Radiation, Report Symbol 6470-2, furnishing all information available on the overexposure, reasons for the overexposure, general status of the health and physical condition of the individual and a summary of the treatment rendered or recommended shall be forwarded to BUMED (Code 3C2) as soon as possible with copies to CNTECHTRA.

(2) Twenty-four Hour Notification. Notify the manager of the nearest NRC Operations Office (see paragraph 7. c. (2) of this Instruction) by telephone and message and submit a report to the Bureau of Medicine and Surgery (Code 3C2) with copy to CNTECHTRA of any incident which may have caused or threatens to cause:

(a) Exposure of the whole body to 5 rem or more, the skin of the whole body to 30 rem or more, or exposure of the feet, ankles, hands or forearms to 75 rem or more of radiation.

(b) The loss of one working day or more of the operation of any facility affected.

(c) Damage to property in excess of $2,000.00.

(3) In addition to any notification required above, the Commanding Officer, NDCTC, will make a report in writing within thrity days to the Director of Regulatory Operations, NRC Washington, DC 20545, with copy to CNTECHTRA in the following situations:

(a) Exposure of any individual to radiation or concentrations of radioactive material in excess of any applicable limit set forth in references (a) and (b).

(b) Levels of radiation in unrestricted areas in excess of ten (10) times any applicable limit specified in reference (b).

(4) In addition to the regular and/or routine reports listed previously in this Instruction, and those emergency reports outlined in paragraph 7. c. of this Instruction, the following reports and/or logs shall be made:

(a) Receipt and Transfer. Licensed materials received by this Command shall be receipted for and a copy shall be maintained of the invoice which has been signed by the Radiation Safety Officer certifying receipt and date of receipt. Records shall also be maintained for radiological materials permanently transferred to another facility for disposition by requiring the receiving facility to return a signed copy of the invoice certifying receipt. Final disposal will be in accordance with reference (d).

(b) Use of Sources. Records shall be maintained indicating the usage of licensed radioactive materials for purposes other than regular drills and exercises. Only the Radiation Safety Officer may authorize the use of radioactive materials for other than regular drills and exercises.

8. Effective Date. This Instruction is effective upon receipt.

J. L. CONNELL

Distribution:
CNTT
NRMC, PHILA (Chief of X-ray)
List I, Case 1
CO
RSO
CDO
NDT Code 138.1

RADIOLOGICAL SAFETY REQUIREMENTS AND PROCEDURES FOR USE OF RADIOACTIVE SEALED SOURCES AT NAVAL DAMAGE CONTROL TRAINING CENTER, PHILADELPHIA, PA 19112

1. Exercise Area Procedures

a. The instructor in charge of the drill will ensure that only authorized personnel are permitted in the area and proper radiation markings are posted at all entrances. All personnel involved in the drill will wear film badges. Pocket dosimeters (IM Series and PDR/1B) worn by qualified staff personnel will be checked periodically to ensure that the prescribed dose limit is being observed. Any person receiving an overexposure will be removed from the area immediately and the occurance reported to the Radiation Safety Officer (RSO).

b. Radiation Monitoring Exercise Area (Building 740, First Deck)

(1) Radiation workers will enter required information into radiation log book.

(2) The radiation worker/instructor in charge of the drill will unlock the safe and remove the storage vessels and sources using one of the following means: pliers (minimum length of ten inches), or a metal tag attached to the source by a 12 inch string. At no time are the sources (once removed from the cases) to be touched or carried unless using one of the above means.

(3) Prior to placing the sources in position for the drill, the radiation worker/instructor in charge of the drill will ensure that all tags are securely attached and bear the following information: "DANGER - RADIOACTIVE MATERIAL - DO NOT HANDLE - NOTIFY MILITARY AUTHORITIES IF FOUND." During the course of the drill the Radiation Safety Officer, Assistant Radiation Safety Officer or instructor in charge of the drill will spotcheck the sources to ensure that no one had moved or tampered with them.

(4) Upon securing the exercise, the RSO, ARSO or instructor in charge of the drill will collect the sources one at a time, using 10 inch pliers, or metal tag attached to a 12 inch string, ensuring that each source is tagged. He/she will insert the sources into the storage vessel and lock the safe. Sources will not be removed from the Radiation Area except by permission of the RSO or Commanding Officer.

c. Routine use of protective clothing or masks is not deemed essential as the sources offer no internal hazard through contamination.

2. Leak Testing Procedures. In compliance with reference (c) and (e), sealed sources will be tested for leakage and/or contamination at intervals not to exceed six months. Testing will be done by the RSO, ARSO, or designated radiation worker in the "Radiation Area". A Lif TLD, PDR/1B and pocket dosimeter will be worn during the test operation.

a. Equipment and Materials

(1) A shielding enclosure of 4 x 8 x 2 inches lead bricks to protect the body.

(2) Pliers (minimum length of ten inches) or metal tag (minimum length of a 12 inch string).

(3) Filter paper or cotton swabs moistened with alcohol or water.

(4) Containers properly labeled, one for each source and one for each source container.

(5) Surgical rubber gloves.

(6) Polyethelene sheets.

(7) High and low survey instruments.

b. Preparing the Samples

(1) Remove one source from its case and place it inside the shielding enclosure.

(2) While holding the source with pliers or metal tag string, wipe one of the sources with the filter paper or cotton. Then rotating the source ninety degrees each time, make three additional wipes of the source.

(3) Place the sample in the properly labeled container and seal.

(4) Using a second piece of filter paper or cotton, wipe the inside of the source case, place and seal in the proper container as above.

c. Deliver the samples to the following activity below:

(1) Radiac Repair Facility
U. S. Naval Shipyard
Philadelphia, PA 19112

Instrumentation used will be capable of detecting 0.005 microcurie of radioactive material on test sample.

d. Results. The sample will be tested to reveal the presence of removable contamination. If the test reveals the presence of 0.005 microcuries or more of removable contamination, the source(s) will be immediately withdrawn from use. The source(s) will then be disposed of in compliance with reference (b) and (d). In such cases, a report will be filed within five days of the test with the Director, Division of Licensing and Regulations, NRC, Washington, D. C. 10015, describing the

equipment involved, the test results, and the corrective action taken. A copy of this report will be sent to the Manager of the nearest NRC Operations Office (see paragraph 7. c. (2) of NDCTCINST 5100.1E).

3. Procedures for Emergency Situations

a. During most emergency or disaster situations the NDCTC safe is the safest place in this area for the stowage of radioactive material. In the event of destruction of the safe, severe fire, flooding or other emergencies, the source materials will be transferred to the Industrial Shipyard, Non-Destructive Testing Code 138.1, U. S. Naval Shipyard, Philadelphia, PA. In the event that this transfer cannot be accomplished, the source materials will be transferred to the Navy Regional Medical Center, Philadelphia, PA as another emergency location.

b. In the event that an emergency transfer of source material is required, the following procedures will be adhered to:

(1) For transfer to:
Non-Destructive Testing Code 138.1
Industrial Shipyard, Bldg. 20
Naval Shipyard
Philadelphia, PA 19112

During normal working hours the RSO will call the Safety Manager in the Naval Shipyard, Bldg. 20 (Ext. 3620) and inform him that radioactive material is being delivered for emergency storage. He/she will then call the Base Fire/Police Departments, U. S. Naval Base, Philadelphia, PA and notify the Fire Chief/Police Chief or Senior Fire/Police Officer that radiological material is being transferred across Naval Base property to Bldg. 20. The message to the Fire/Police Departments shall include the following information:

(a) The radiological material are sealed sources Cobalt and Cesium, which emit Gamma radiation.

(b) Material is to be stowed in the vault in Bldg. 20.

(c) In the event of fire it is not expected that this material would present any additional health hazards.

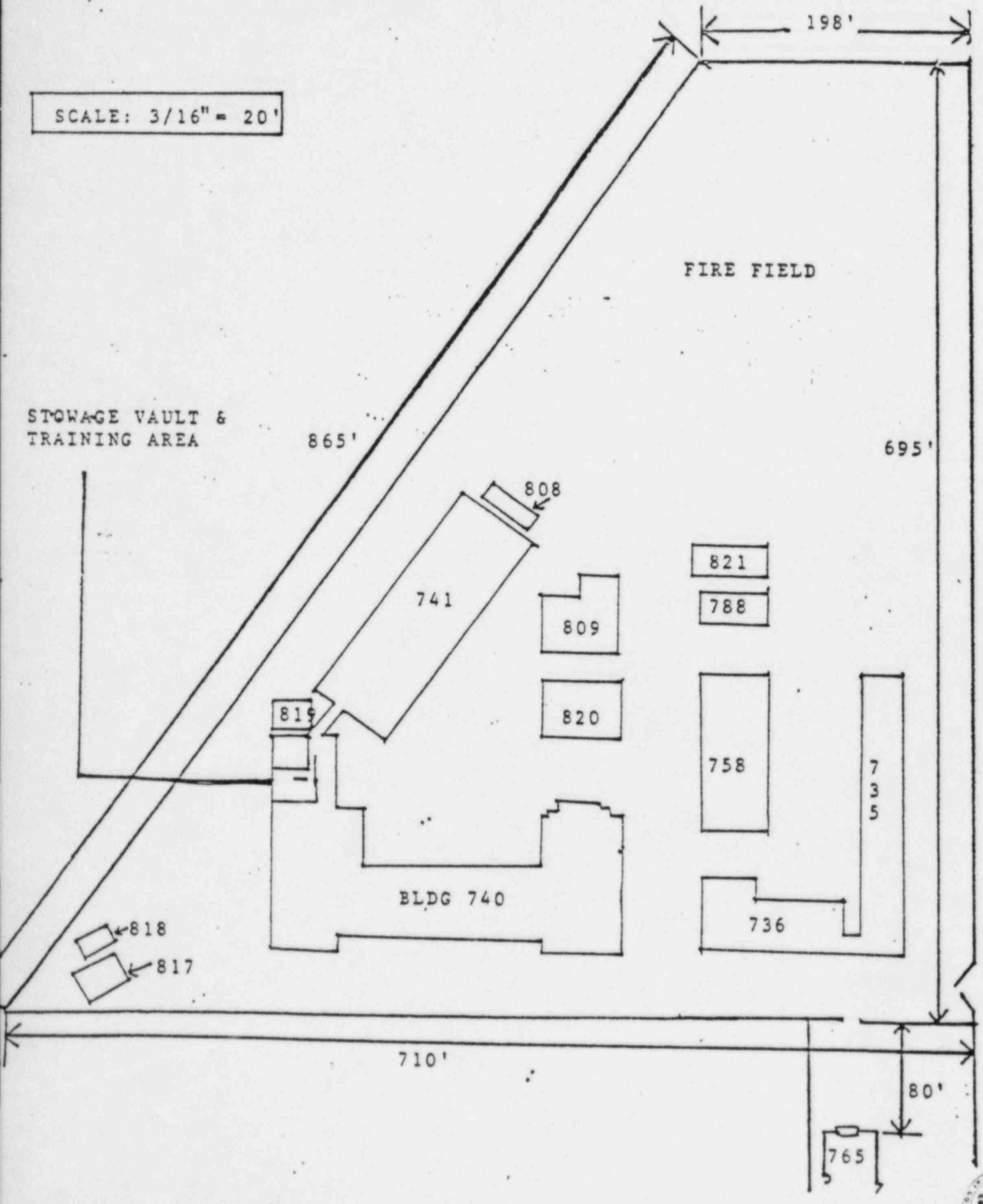
The RSO along with the ARSO will then transport the material to Bldg. 20 in the same manner as indicated above. He/she will then turn the material over to the person in charge of the vault and obtain a receipt. During other than normal working hours this area will not be available for transfer of radiological material.

(2) For transfer to:
Nuclear Medicine Department, Bldg. 62
17th and Pattison
Naval Shipyard
Philadelphia, PA 19112

During normal working hours the Radiation Safety Officer will call the Chief of Radiology and inform him/her that radioactive material is being delivered by NDCTC for emergency stowage. The RSO and ARSO will then transfer the material in their lead cases and in a vehicle plainly marked with the signs available to the Chief of Radiology or his designated representative. A receipt will be obtained. During other than normal working hours, the NDCTC Duty Officer will contact the RSO, ARSO, and the Commanding Officer. The RSO or ARSO will contact the Duty Officer at the Hospital and inform him/her that radioactive material is being transferred for storage. The RSO and/or ARSO will then transfer the radioactive material to the hospital in the same manner as stated above. He/she will also obtain a receipt.

c. All personnel handling radiological material or who must be in the radiation area shall wear dosimetry devices. Since it may be necessary for these individuals to exceed the Maximum Permissable Exposures listed in paragraph 7. a. (1) of this Instruction, these individuals shall not be reexposed to additional radiation until they meet the criteria for exposure limits set forth in reference (a).

U.S. NAVAL DAMAGE CONTROL TRAINING CENTER



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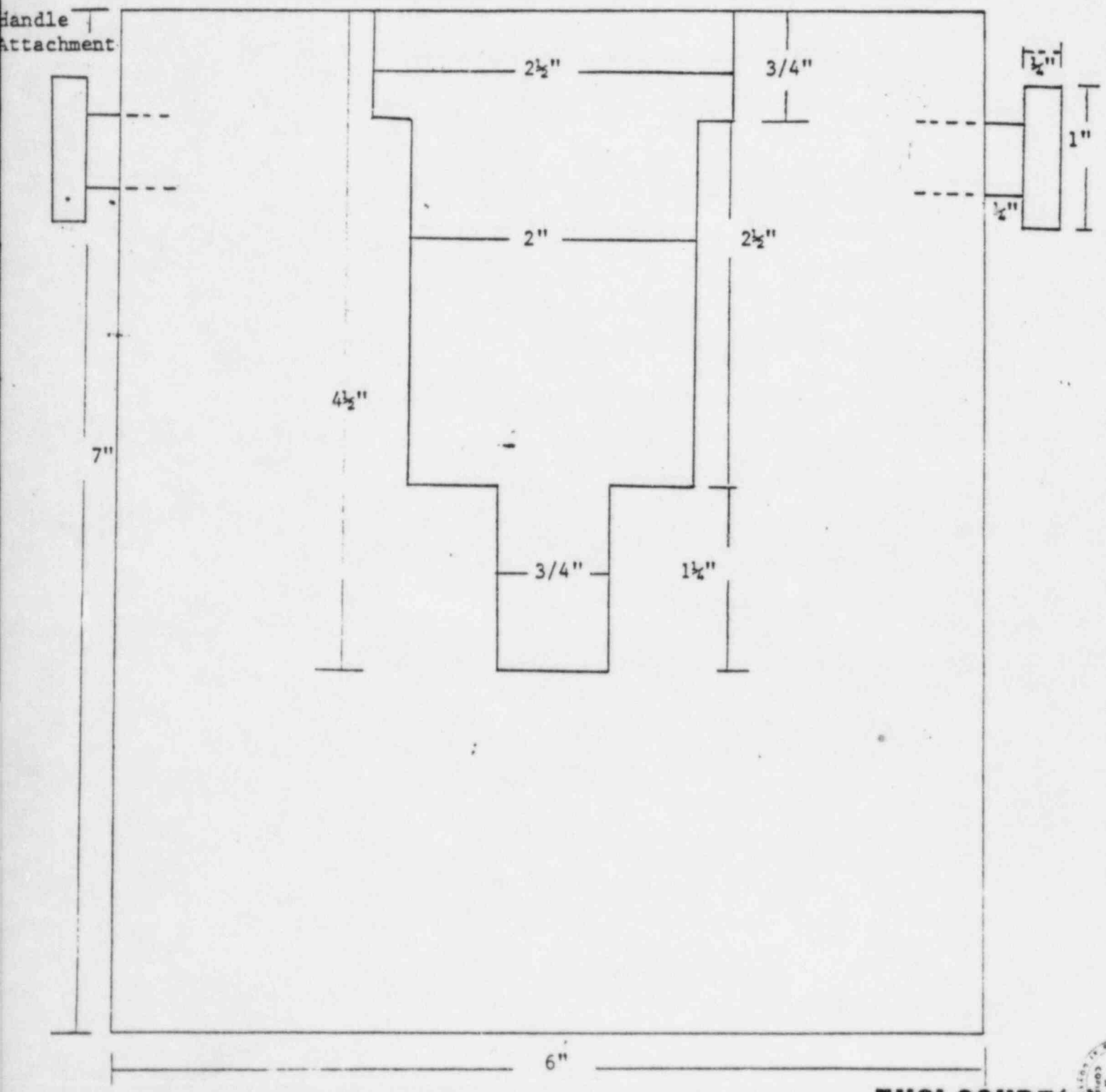

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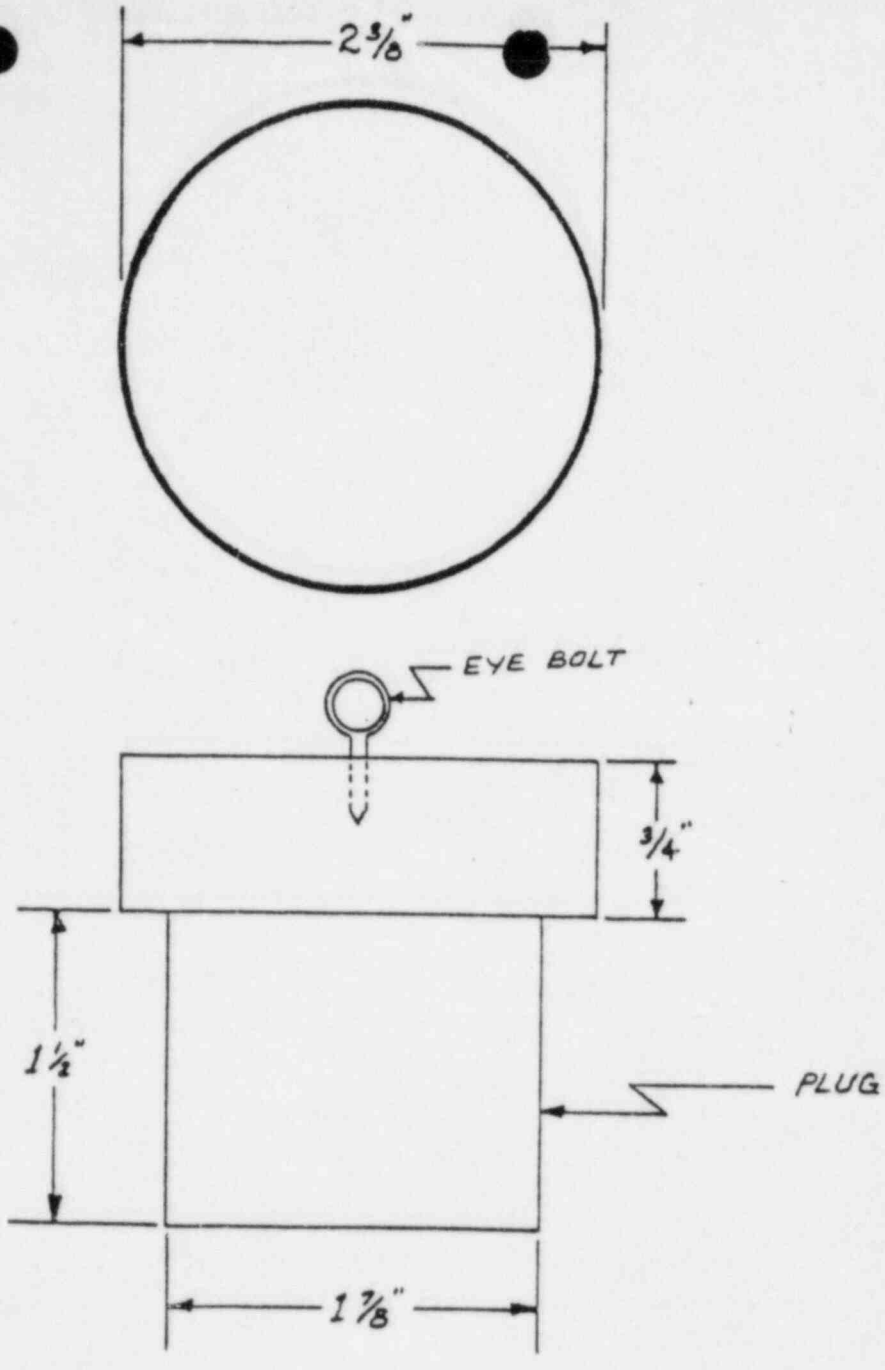
ENCLOSURE(8)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1 1/2"
PLUG
1 7/8"

HT1 WALSH, Richard C.

Type of Training

	Where Trained	Duration Training	On the Job	Formal Course
a. Principles and practices of radiation protection	NBC Practical Phila., PA	1 wk.		X
	NDCTC Phila, PA	1 wk.	X	Refresher
b. Radioactivity measurement standardization and monitoring techniques and instruments.	NBC Practical Phila., PA	1 wk.		X
	NDCTC Phila, PA	1 wk.	X	Refresher
c. Mathematics and calculations basic to the use and measurement of radioactivity	NBC Practical Phila., PA	1 wk.		X
	NDCTC Phila,PA	1 wk.	X	Refresher
d. Biological effects of radiation	NBC Practical Phila., PA	1 wk.		X
	NDCTC Phila,PA	1 wk.	X	Refresher

9. Experience with Radiation

ISOTOPE	MAX. AMOUNT	WHERE EXPERIENCE GAINED	DURATION EXPERIENCE	TYPE OF USE
Cesium 137	100 millicuries	NDCTC Phila., PA	Since 15DEC82	Training personnel in use of radia instruments.
Cobalt 60	50 millicuries	NDCTC Phila., PA		
Cobalt 60	50 millicuries	NDCTC Phila., PA		

HTC WILLIAMSON, Robert D,

Type of Training

	Where Trained	Duration Training	On the Job	Formal Course
a. Principles and practices of radiation protection	NBC Practical Phila., PA	1 wk.		X
	NDCTC Phila, PA	1 wk.	X	Refresher
b. Radioactivity measurement standardization and monitoring techniques and instruments.	NBC Practical Phila, PA	1 wk.		X
	NDCTC Phila, PA	1 wk.	X	Refresher
c. Mathematics and calculations basic to the use and measurement of radioactivity	NBC Practical Phila, PA	1 wk.		X
	NDCTC Phila,PA	1 wk.	X	Refresher
d. Biological effects of radiation	NBC Practical Phila., PA	1 wk.		X
	NDCTC Phila, PA	1 wk.	X	Refresher

9. Experience with Radiation

ISOTOPE	MAX. AMOUNT	WHERE EXPERIENCE GAINED	DURATION EXPERIENCE	TYPE OF USE
Cesium 137	100 millicuries	NDCTC Phila., PA	Since 14FEB83	Training personnel in use of radiac instruments.
Cobalt 60	50 millicuries	NDCTC Phila., PA		
Cobalt 60	50 millicuries	NDCTC Phila., PA		

HT1 GORSE, Dennis L.

Type of Training

16.

	Where Trained	Duration Training	On the Job	Formal Course
a. Principles and practices of radiation protection	SFF N London	2 wks.	24 mos.	X
	NDCTC, Phila, PA	1 wk.	X	Refresh
b. Radioactivity measurement standardization and monitoring techniques and instruments.	SFF N London	2 wks.	24 mos.	X
	NDCTC, Phila, PA	1 wk.	X	Refresh
c. Mathematics and calculations basic to the use and measurement of radioactivity	SFF N London	2 wks.	24 mos.	X
	NDCTC, Phila, PA	1 wk.	X	Refresh
d. Biological effects of radiation	SFF N London	2 wks.	24 mos.	X
	NDCTC, Phila, PA	1 wk.	X	Refresher

17. Experience with Radiation

ISOTOPE	MAX. AMOUNT	WHERE EXPERIENCE GAINED	DURATION EXPERIENCE	TYPE OF US
Cesium 137	100 millicuries	NDCTC Phila., PA	Since tour of duty March 1982	Training personnel i use of radi instruments
Cobalt 60	50 millicuries	NDCTC Phila., PA		
Cobalt 60	50 millicuries	NDCTC Phila., PA		

HTC HULL, Darrell D.

Type of Training

16.

	Where Trained	Duration Training	On the Job	Formal Course
a. Principles and practices of radiation protection	Sub Base N London	2 wk./upgrade qtly	X	X
	USS Orion(AS-18)	"	X	X
	~~NDCTC Phila PA~~	~~1 wk.~~	~~X~~	~~Refresher~~
b. Radioactivity measurement standardization and monitoring techniques and instruments.	Sub Base N London	2wk./upgrade qtly	X	X
	USS Orion(AS-18)	"	X	X
	NDCTC Phila PA	1 wk.	X	Refresher
c. Mathematics and calculations basic to the use and measurement of radioactivity	Sub Base N London	2 wk./upgrade qtly	X	X
	USS Orion(AS-18)	"	X	X
	NDCTC Phila PA	1 wk.	X	Refresher
d. Biological effects of radiation	Sub Base N London	2wk./upgrade qtly	X	X
	USS Orion(AS-18)	"	X	X
	NDCTC Phila PA	1 wk.	X	Refresher

17. Experience with Radiation

ISOTOPE	MAX. AMOUNT	WHERE EXPERIENCE GAINED	DURATION EXPERIENCE	TYPE OF USE
unknown	unknown	Sub Base, New London	2 years	Rad worker
unknown	unknown	USS Orion(AS-18) and various SSN's	2 years	Rad worker
Cesium 137	100 millicuries	NDCTC Phila., PA	Since tour of duty August 1982	Training personnel in use of radi instruments
Cobalt 60	50 millicuries	NDCTC Phila., PA		
Cobalt 60	50 millicuries	NDCTC Phila., PA		

ENSIGN PFEIL, Lola J.

Type of Training

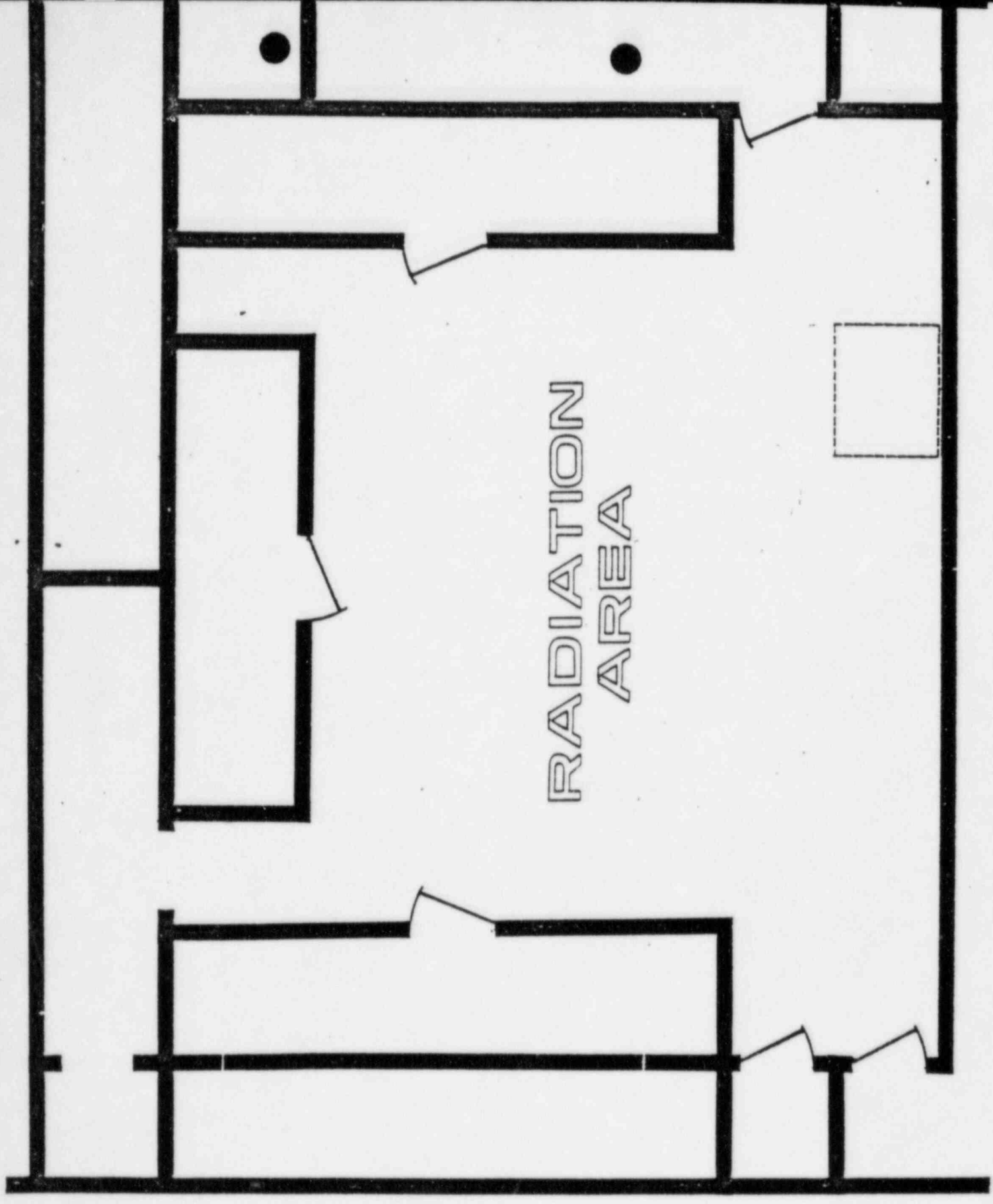
16.

	Where Trained	Duration Training	On the Job	Formal Course
a. Principles and practices of radiation protection	NEESA (RSO course) Port Hueneme, CA	2 wks.		X
	NDCTC Phila PA	1 wk.	X	X(refres
b. Radioactivity measurement standardization and monitoring techniques and instruments.	NEESA (RSO course) Port Hueneme, CA	2 wks.		X
	NDCTC Phila PA	1 wk.	X	X(refres
c. Mathematics and calculations basic to the use and measurement of radioactivity	NEESA (RSO course) Port Hueneme, CA	2wks.		X
	NDCTC Phila PA	1 wk.	X	X(refres
d. Biological effects of radiation	NEESA (RSO course) Port Hueneme, CA	2 wks.		X
	NDCTC Phila PA	1 wk.	X	X(refres

17. Experience with Radiation

ISOTOPE	MAX. AMOUNT	WHERE EXPERIENCE GAINED	DURATION EXPERIENCE	TYPE OF US
Cesium 137	100 millicuries	NDCTC Phila., PA	Since tour of duty January 1983	Training personnel i use of radi instruments
Cobalt 60	50 millicuries	NDCTC Phila., PA		
Cobalt 60	50 millicuries	NDCTC Phila., PA		

ENCLO



SCALE: 1/4"=1'-0"

ENCL (4)

HTC JOHNSON, Rodney D.

Type of Training

16.	Where Trained	Duration Training	On the Job	Formal Course
a. Principles and practices of radiation protection	NDCTC, PHILA., PA	3 WKS	X	X
b. Radioactivity measurement standardization and monitoring techniques and instruments	NDCTC, PHILA., PA	3 WKS	X	X
c. Mathematics and calculations basic to the use and measurement of radioactivity	NDCTC, PHILA., PA	3 WKS	X	X
d. Biological effects of radiation	NDCTC, PHILA., PA	3 WKS	X	X

17. Experience with Radiation

ISOTOPE	MAX. AMOUNT	WHERE EXPERIENCE GAINED	DURATION EXPERIENCE	TYPE OF USE
		NONE		

HTC THOMPSON, Joseph T.

Type of Training

16.

	Where Trained	Duration Training	On the Job	Formal Course
a. Principles and practices of radiation protection	NDCTC PHILA., PA	3 WKS	X	X
b. Radioactivity measurement standardization and monitoring techniques and instruments	NDCTC, PHILA., PA	3 WKS	X	X
c. Mathematics and calculations basic to the use and measurement of radioactivity	NDCTC, PHILA., PA	3 WKS	X	X
d. Biological effects of radiation	NDCTC, PHILA., PA	3 WKS	X	X

17. Experience with Radiation

ISOTOPE	MAX. AMOUNT	WHERE EXPERIENCE GAINED	DURATION EXPERIENCE	TYPE OF USE
COBALT-60	?	USS EMORY S. LAND (AS-39)	2½ YRS.	N.D.T.
TRICIUM	?	USS EMORY S. LAND (AS-39)	2½ YRS.	N.D.T.
CESIUM-137	100 millicuries	NDCTC, PHILA., PA	JAN. 84 TO PRESENT	Training personnel in use of radiac instruments
COBALT-60	50 millicuries	NDCTC, PHILA., PA		
COBALT-60	50 millicuries	NDCTC, PHILA., PA		

HTCS RIVERS, Earl E.

Type of Training

16.

	Where Trained	Duration Training	On the Job	Formal Course
a. Principles and practices of radiation protection	NAVAL DIVING SCHOOL, PEARL HARBOR	2 WKS	X	
	NDCTC, PHILA., PA	1 WK	X	X
b. Radioactivity measurement standardization and monitoring techniques and instruments	NDS, PEARL HARBOR	2 WKS	X	
	NDCTC, PHILA., PA	1 WK	X	X
c. Mathematics and calculations basic to the use and measurement of radioactivity	NDS, PEARL HARBOR	2 WKS	X	
	NDCTC, PHILA., PA	1 WK	X	X
d. Biological effects of radiation	NDS, PEARL HARBOR	2 WKS	X	
	NDCTC, PHILA., PA	1 WK		X

17. Experience with Radiation

ISOTOPE	MAX. AMOUNT	WHERE EXPERIENCE GAINED	DURATION EXPERIENCE	TYPE OF USE
		NDS, PEARL HARBOR DURING SPECIAL DIVING EXERCISES 1982-1983		
CESIUM-137	100 millicuries	NDCTC, PHILA., PA	NOV 84 to PRESENT	Training personnel in use of radiac instruments
COBALT-60	50 millicuries	NDCTC, PHILA., PA		
COBALT-60	50 millicuries	NDCTC, PHILA., PA		

HTCM OPEL, Joseph E.

Type of Training

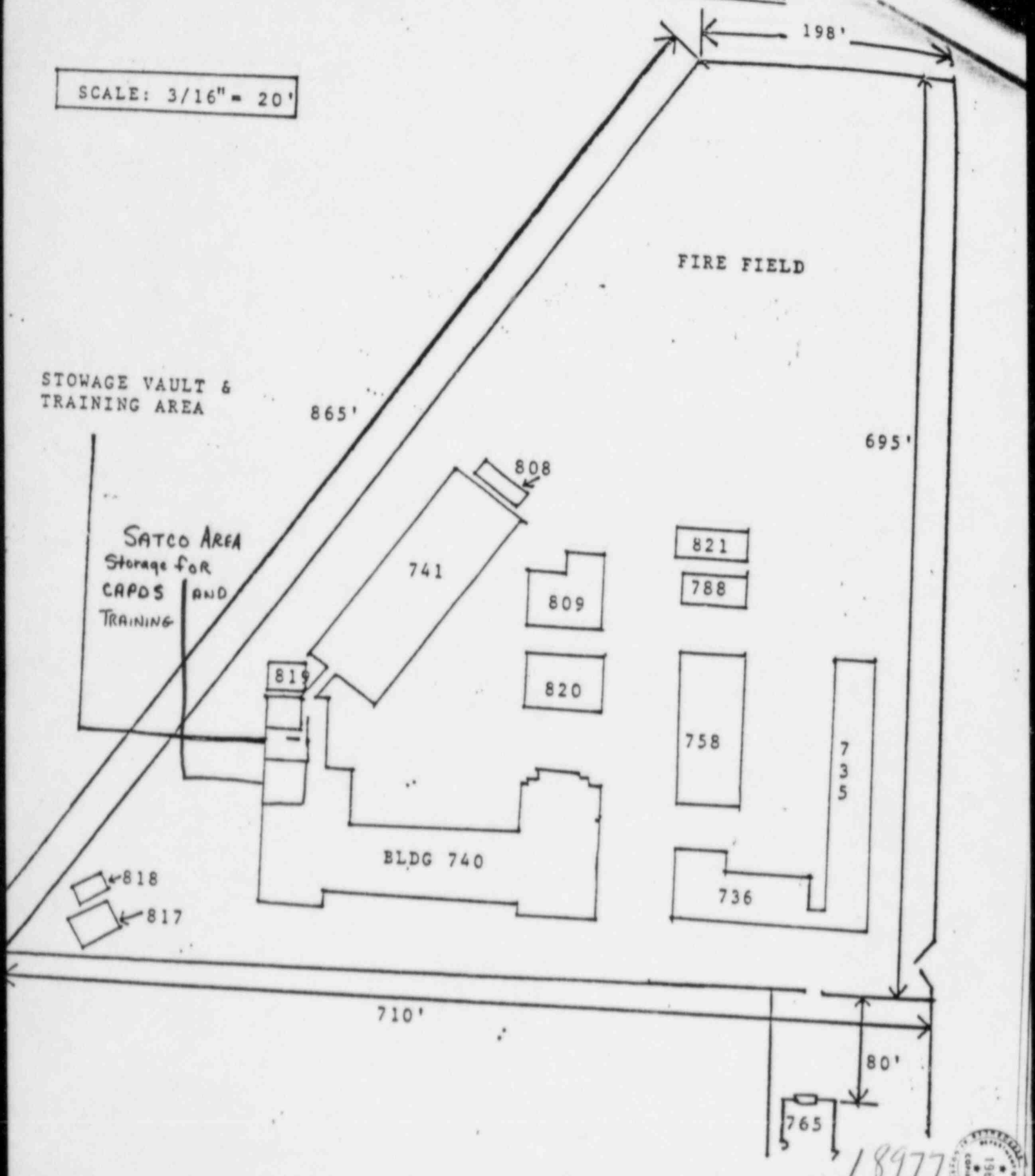
16.	Where Trained	Duration Training	On the Job	Formal Course
a. Principles and practices of radiation protection	AS-33 USS SIMON LAKE	2 WKS	X	X
	USS L.Y. SPEAR	1 WK		X
	NDCTC, PHILA., PA	1 WK	X	X
b. Radioactivity measurement standardization and monitoring techniques and instruments	USS SIMON LAKE	2 WKS	X	X
	USS L.Y. SPEAR	1 WK		X
	NDCTC, PHILA., PA	1 WK	X	X
c. Mathematics and calculations basic to the use and measurement of radioactivity	USS SIMON LAKE	2 WKS	X	X
	NDCTC, PHILA., PA	1 WK	X	X
d. Biological effects of radiation	USS SIMON LAKE	2 WKS		X
	USS L.Y. SPEAR	1 WK		X
	NDCTC, PHILA., PA	1 WK		X

17. Experience with Radiation

ISOTOPE	MAX. AMOUNT	WHERE EXPERIENCE GAINED	DURATION EXPERIENCE	TYPE OF USE
		USS SIMON LAKE	DEC 72-APR 78	Reactor Wroker
		USS L.Y. SPEAR	JAN 82-JAN 84	Fire Marshal
		NAVDAMCONTRACEN PHILA., PA	APR 84-PRESENT	Training on Radiac
Cesium-137	100 millicuries	NDCTC PHILA., PA	APR 84-PRESENT	Training Personnel in use of radiac instruments
Cobalt-60	50 millicuries	NDCTC PHILA., PA		
Cobalt-60	50 millicuries	NDCTC PHILA., PA		

SIMON LAKE duty involved pipefitting, brazing, freeze seal, glove bag work.
L. Y. SPEAR duty involved training fire parties proper procedures involved with casualty in space.

U.S. NAVAL DAMAGE CONTROL TRAINING CENTER



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Enclosure (6)

DEPARTMENT OF THE ARMY
HEADQUARTERS, EDGEWOOD ARSENAL
ABERDEEN PROVING GROUND, MARYLAND 21010

SAREA-SA

6 MAR 1975

SUBJECT: Radiological Hygiene Special Study No. 43-090-74, Evaluation of Multiagent Detector System, Edgewood Arsenal, MD, 22 March 1974

Commander
US Army Armament Command
Attn: AMSAR-SC
Rock Island, IL 61201

1. Reference is made to FONECON 5 March 1975 between COL J. B. Bryant, your headquarters and Mr. P. M. Edwards, Edgewood Arsenal, subject as above. As mentioned, no response to the study was believed necessary as only an informational copy was received.

2. The study concerned a system being developed for the US Air Force. Edgewood Arsenal agrees with all recommendations contained in the study and will implement them in the technical data package to be furnished the Air Force. Procurement of the necessary NRC license is an Air Force responsibility.

3. The Army version of the system is now in the exploratory development phase. Recommendations of subject study will be implemented prior to type classification of the Army item.

FOR THE COMMANDER:

David A. Falck

DAVID A. FALCK
Chief, Safety Office

CF:
Cdr, ARMCOM (AMSAR-SF), Rock Island, IL 61201

SG-SC

AMCMM-E (18 Jun 74) 1st Ind S-16 Oct 1974
SUBJECT: Radiological Hygiene Special Study No. 43-090-74, Evaluation of Multiagent Detector System, Edgewood Arsenal, MD, 22 March 1974

HQ, US Army Materiel Command, Alexandria, VA 22333 16 July 1974

TO: Commander, US Army Armament Command, ATTN: AMSAR-SG, Rock Island, IL 612

1. Subject report has been reviewed by this office and is forwarded for information and necessary action.

2. Request the Office of the AMC Surgeon (AUTOVON 284-9024/5) be advised upon receipt of this correspondence. Further request a report of actions proposed/taken in regards to recommendations contained in para 8, subject report, be furnished this headquarters, ATTN: AMCMM, NLT 16 Oct 1974.

FOR THE COMMANDER:

for Ignacio Hernandez-Fragoso, MAJ, MSC
IGNACIO HERNANDEZ-FRAGOSO, M.D.
Colonel, MC
Surgeon

1 Incl
as

CF:
AMSTE-SF
AMXOS-ES
AMCSA-C
AMCSF-C
AMCSF-P

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010

USAEHA-RH

18 JUN 1974

SUBJECT: Radiological Hygiene Special Study No. 43-090-74, Evaluation of Multiagent Detector System, Edgewood Arsenal, MD, 22 March 1974

Commander
US Army Materiel Command
ATTN: AMCMM
5001 Eisenhower Avenue
Alexandria, VA 22333

1. REFERENCES.

a. AR 10-43, US Army Health Services Command, 27 June 1973.

b. AR 40-5, Preventive Medicine, 13 March 1969.

c. AR 700-64/AFM 67-8, Radioactive Commodities in the DOD Supply System, 20 December 1967.

d. Letter, SAREA-DE-DDR, Headquarters, Edgewood Arsenal, 21 November 1973, subject: Radiological Safety Aspects of Ionization Detector, with inclosure and indorsement thereto.

2. PURPOSE. At the request of the Commander, Edgewood Arsenal, Aberdeen Proving Ground, Maryland, the study was made to determine if there were any radiological health hazards associated with the use of the Multiagent Detector System.

3. GENERAL. The study was performed by Mr. Kenneth Lang, Analytical Chemist, Radiological and Biological Chemistry Division, and MAJ Gordon M. Lodde, MSC, Nuclear Medical Science Officer, Health Physics Division, this Agency.

4. BACKGROUND.

a. The Multiagent Detector System (A/E 23D-1 Alarm, Set, Chemical Agent, Automatic) employs three tritium foil-type (titanium tritide) radiation sources with an activity of one curie each. It is designed to constantly point sample its ambient atmosphere for the presence of any chemical warfare agents.

b. The activity of the source(s) is selected to provide an ionization current in the detector cell. The choice of the radionuclide is a function of the sensitivity desired and the "noise level" which can be tolerated.

c. A description of the system, including operating instructions, preventive maintenance, calibration and troubleshooting is contained in the technical manual prepared by Honeywell, Inc.

5. FINDINGS AND PROCEDURES.

a. One Multiagent Detector System, SN: 9, was provided for evaluation. Wipe tests were made at various locations inside the sensor module and power supply with Metricel®, GA-3 filter paper (see figure 1 and 2).

b. Wipe test samples were analyzed by liquid scintillation counting and the results are given in Table 1.

c. A review of the technical manual prepared by Honeywell, Inc. indicated that the manual did not include a description of the ionization detector cells and source(s) or procedures for radiation protection for the life-cycle of the Multiagent Detector System.

6. DISCUSSION.

a. Internal radiation hazards arise when radioactive material is liberated from the radioactive source(s). This may occur as a result of mechanical damage to the source(s) during cleaning or handling; emission of radioactive gas, such as, dissociation of titanium tritide; chemical damage to the source by the material being investigated or by a corrosive cleaning solvent; and damage to the source from excessive heat.

b. Tritium foils are normally prepared by absorbing tritium onto a layer of titanium bonded to a strip of copper. The tritium is loosely bound and evaporates at a rate dependent on temperature. A 300 millicurie foil will dissociate at a rate of approximately 5 microcuries (µCi) per day at 22°C and 50 µCi per day at 250°C. The Multiagent Detector System is designed so that the optimum operating temperature is about 64°C, therefore, the dissociation of the titanium tritide in the source(s) and the evolution of tritium gas will be minimal.

c. Cleaning the detector and sources will occasionally be necessary to remove deposits of organic substances which impair the operation of the detector by reducing its sensitivity. The cleaning solvent should not be corrosive or otherwise chemically attack the source(s). The cleaning solvent will become contaminated with radioactive material.

7. CONCLUSION. A review of the findings indicate that there is no significant radiological health hazard associated with the use and routine handling of the Multiagent Detector System; however, radioactive contamination will be found inside the sensor module and power supply. Recommendations are made concerning life-cycle control of the radioactive commodity.

8. RECOMMENDATIONS.

a. Prior to adopting the Multiagent Detector System as a standard item, the military services should process applications for AEC licenses in accordance with applicable service directives.

b. Insure that the detector cells, that contain tritium, are used in conjunction with a properly operating temperature control mechanism which prevents foil temperatures from exceeding 225°C.

c. Mark and label the detector cells containing tritium and the outer container in accordance with MIL-STD-1458.

d. Insure that the technical publication for the Multiagent Detector System includes a description of the ionization detector cell, radioactive source(s), and the radiation protection procedures which include controls for receipt, transportation, storage, use, transfer, maintenance, surveillance and disposal, as required by AR 700-64/AFM 67-8.

e. Insure that the ionization detector cell containing the tritium source is not opened for maintenance unless the facility has a laboratory hood meeting the requirements of the American National Standards Institute Standard N5.2-1963 (ISO R1710), and is authorized to perform such maintenance as described in the technical publication as required by TB MED 232, 22 September 1967 and TB 750-261, 31 May 1973. Maintenance personnel who are involved with disassembly of the ionization detector cell should be on a periodic radiobioassay program for tritium.

f. Physical handling of the source(s) should be minimized. If handling is necessary, rubber or plastic tipped tongs or forceps should be used to minimize abrasive damage to the source or possible radioactive contamination of the hands.

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SUBJECT: Radl Hygiene Sp Study No. 43-090-74, Evaluation of Multiagent Detector Sys, EA, MD, 22 Mar 74

g. Insure that the cleaning solvent which has become contaminated with radioactive material is disposed of as radioactive waste in accordance with AR 755-15, or applicable Air Force directives.

FOR THE COMMANDER:

for Lawrence L. Miller LTC MSC

3 Incl
as

WILLIAM W. YOUNG
COL, MSC
Director, Radiation and Environmental Sciences

CF:
Cdr, HSC (HSC-PA-H)
Cdr, EA (SAREA-DE-DDR)

APPENDIX A

TABLE 1

RESULTS OF WIPE TESTS

LOCATION OF WIPE TEST	MICROCURIES PER WIPE TEST SAMPLE AFTER VARIOUS PERIODS OF OPERATION			
	BEFORE	6 HOURS	24 HOURS	71 HOURS
Ionization Cell Block Assembly				
(1) Inlet (left side)	2.4×10^{-3}	8.3×10^{-3}	2.2×10^{-3}	1.8×10^{-3}
(2) Outlet (left side)	1.1×10^{-2}	9.1×10^{-3}	8.3×10^{-3}	3.3×10^{-3}
(3) Inlet (right side)	4.0×10^{-4}	5.6×10^{-4}	1.2×10^{-4}	6.0×10^{-5}
(4) Outlet (right side)	1.1×10^{-2}	1.3×10^{-2}	9.8×10^{-2}	6.1×10^{-2}
(5) Top and Bottom Edges of Complete Assembly	1.5×10^{-3}	1.9×10^{-3}	3.0×10^{-4}	6.0×10^{-4}
Effluent Filter (inlet)	8.3×10^{-3}	2.5×10^{-1}	7.7×10^{-1}	1.1×10^{-1}
Effluent Filter (outlet)	3.0×10^{-4}	2.8×10^{-3}	1.0×10^{-4}	4.0×10^{-4}
Area around Fuse	4.0×10^{-4}	1.0×10^{-4}	9.0×10^{-5}	4.0×10^{-5}
Exhaust Ports (in top box)	8.0×10^{-5}	1.0×10^{-4}	7.0×10^{-5}	1.0×10^{-4}
Exhaust Port (around screen)	1.6×10^{-4}	2.0×10^{-4}	4.0×10^{-5}	3.0×10^{-5}

USAEHA-RH
SUBJECT: Radiological Hygiene Special Study No. 43-090-74, Evaluation of Multiagent Detector System, Edgewood Arsenal, MD 22 March 1974

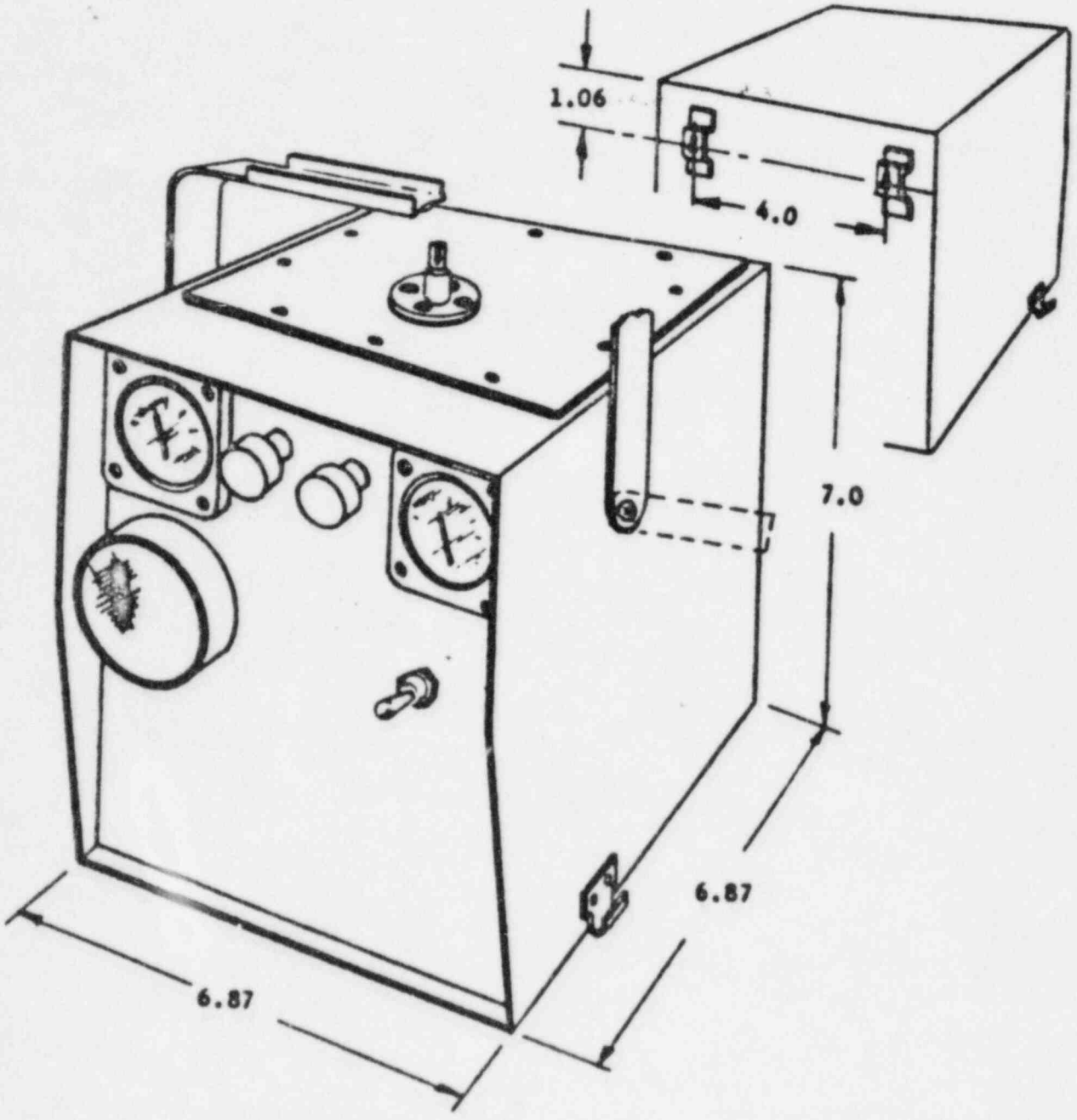

Figure 1

LG1049AA01

Sensor Module

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