Ms-16
T5

DEPARTMENT OF THE ARMY
McALESTER ARMY AMMUNITION PLANT
McALESTER, OKLAHOMA 74501 -5000

REPLY TO
ATTENTION OF

November 18, 1985

SMCMC-QAM-M

Mr. C. L. Cain
Nuclear Materials Safety Section
U. S. Nuclear Regulatory Commission
Region IV
Parkway Central Plaza Building
611 Ryan Plaza Drive, Suite 1000
Arlington, Texas 76011

Dear Mr. Cain:

Reference your letter, 31 October 1985, Mail Control No. 18501, concerning our renewal application dated December 20, 1984.

In response to the specific items requested:

1. The individuals primarily responsible for the training program are MR. EDDIE D. FOWLER, Director for Quality Assurance, and MR. LEE MAXWELL, Safety Officer. Two copies of their qualifications (extracted from MCAAP Regulation 702-4) are attached. Also attached is a document verifying training accomplished in February 1985 by Captain Jeff Haeberlin, Fort Sill, Oklahoma.

2. Two copies of a 24-question examination (assistant radiographer) are attached.

3. Two copies of a 34-question examination (radiographer) are attached. This is given in conjunction with the 24-question examination mentioned above.

4. Two copies of our internal inspection program are attached (extracted from MCAAP Regulation 702-4, Section III).

5. Two copies of our daily utilization log are attached.

6. Two copies of the Figure 7 referenced in Appendix B, Section VI.2.c of our renewal application.

We believe the above items will satisfactorily complete our application; however, in addition, we are attaching one complete copy of MCAAP Regulation 702-4. This may be helpful if further information is required. Please note

418 501

that Mr. David Prescott, formerly chief of Management and Acceptance Division and Alternate Radiation Control Officer, passed away in August 1985. His replacement will be named in the regulation when a change is published sometime after January 1, 1986.

If there is further information required, we will be pleased to furnish it as quickly as possible. My phone number is 918-421-2557 (commercial).

Sincerely,

Randell L. Cook

Randell L. Cook
Chief, Management and Acceptance
Division

7 Enclosures

Appendix A

ANNEX 5

PERSONNEL QUALIFICATIONS

Personnel qualifications affecting active control over the radiography program at this installation are listed by office symbols and name as follows:

1. SMCMC-SF, L. V. MAXWELL (Radiation Protection Officer)

a. Formal Education:

(1) BS, Oklahoma State University

(2) Life Science Courses, US Navy

b. Experience:

(1) Seventeen years experience in ionization and non-ionization radiation equipment associated with depot production safety.

(2) Chief, Safety Office, McAlester Ammunition Facility, for 20 years, 1965 to present.

2. SMCMC-SF, John D. Watson (Alternate Radiation Protection Officer)

a. Education:

(1) Academic Graduate, McAlester High School

b. Experience:

(1) Ordnanceman, 66-69

(2) Foreman, Ordnanceman, 69-71

(3) Industrial Engineering Technician, 71-75

(4) Safety Specialist, 75 to present

c. Technical Training:

(1) Industrial Safety

(2) Munitions Safety

(3) Safety Program Management

(4) Hazardous Material Transport and Handling

(5) Occupational Safety and Health

(6) Accident Prevention

Encl 1

Appendix A

3. SMCMC-QA, E. D. FOWLER, QA Director (RCO)

a. Formal Education:

(1) BS (Math and Physics), East Central State College (OK), 1958.

(2) Masters Degree Candidate, Highlands University, Las Vegas, NM, 1960.

b. Experience:

(1) Secondary level teacher in Math, Physics, and Science, 58-62.

(2) Special Weapons Technician and Training Coordinator, Naval Ammunition Depot (NAD), McAlester, OK, 62-65.

(3) Quality Assurance Department Manager, NAD, McAlester, OK, 65-77.

(4) Director, Quality Assurance, McAlester Ammunition Facility, 77 to present.

c. Other Training:

(1) Special Weapons Cadre, Various Systems, DASA, Albuquerque, NM.

(2) Tritium monitoring, NAD, McAlester, OK.

4. SMCMC-QAM-T, JIMMY L. HOLMAN

a. Formal Education:

(1) A/A (Management), Eastern Oklahoma State College

(2) 30 hours (Business Management), SE Oklahoma State University

b. Experience:

(1) Advanced Weaponsman, 63-67

(2) Inspector, Gages C, 67-72

(3) Quality Assurance Specialist, 72-83

(4) Supvr Quality Assurance Specialist, Test and Acceptance Branch, Mar 84 to present.

b. Technical Training:

(1) 310 hours, DASA (Navy GMT Nuclear Weapons Course)

DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is TAGO.

REFERENCE OR OFFICE SYMBOL	SUBJECT
SMCMC-QAM	FY 85 Refresher Training for Radiographers

TO SMCMC-QA FROM SMCMC-QAM DATE 4 Mar 85 CMT 1

Mr. Prescott/ncp/2557

1. Reference MCAAPR 702-4, Appendix A, Annex 2.

2. CPT Jeff Haeberlin, RPO, Fort Sill, OK, conducted training on 28 February 1985 in Radiation and Radiation Protection. Also discussed were worker rights and responsibilities, radiation protection standards, radiation definitions and sources, natural radiation, medical radiation, and consumer products radiation.

3. The following personnel were present:

D. L. Prescott
Jimmy L. Holman
Ronnie L. Smith
Wallace R. Allen
Lee V. Maxwell
John D. Watson
Harold E. Washington
Dorothy A. Malone
Don Weiher

D. L. PRESCOTT
Chief, Management and Acceptance Division

CF:
SMCMC-SF
SMCMC-QAM-T
SMCMC-PTR (T)
1 Ea Indiv

DA FORM AUG 80 2496 PREVIOUS EDITIONS WILL BE USED

Appendix A

ANNEX 5

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a. Education:

(1) Academic Graduate, McAlester High School

b. Experience:

(1) Ordnanceman, 66-69

(2) Foreman, Ordnanceman, 69-71

(3) Industrial Engineering Technician, 71-75

(4) Safety Specialist, 75 to present

c. Technical Training:

(1) Industrial Safety

(2) Munitions Safety

(3) Safety Program Management

(4) Hazardous Material Transport and Handling

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(6) Accident Prevention

Encl 12

Appendix A

3. SMCMC-QA, E. D. FOWLER, QA Director (RCO)

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(2) Inspector, Gages C, 67-72

(3) Quality Assurance Specialist, 72-83

(4) Supvr Quality Assurance Specialist, Test and Acceptance Branch, Mar 84 to present.

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TO SMCMC-QA FROM SMCMC-QAM DATE 4 Mar 85 CMT 1

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2. CPT Jeff Haeberlin, RPO, Fort Sill, OK, conducted training on 28 February 1985 in Radiation and Radiation Protection. Also discussed were worker rights and responsibilities, radiation protection standards, radiation definitions and sources, natural radiation, medical radiation, and consumer products radiation.

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D. L. PRESCOTT
Chief, Management and Acceptance Division

CF:
SMCMC-SF
SMCMC-QAM-T
SMCMC-PTR (T)
1 Ea Indiv

DA FORM AUG 80 2496 PREVIOUS EDITIONS WILL BE USED

Appendix A

ANNEX 3

RADIATION SAFETY COURSE

SAMPLE TEST _____ FOR PHASE I TRAINING

NAME_____ GRADE_____

BADGE NO._____ PASSED_____ FAILED_____

DATE_____ GRADED BY_____

(Representative Sample Test in Support of Annex 1, Appendix B)

_____ 1. Pocket dosimeters depend upon a _____ for their indication.

a. G-M tube
b. battery to provide electrical power
c. Quartz film electroscope
d. theory that like charges attract and dislike charges repel.

_____ 2. The formula for the inverse square law is:

a. $\frac{I_2}{\overline{I_1}} = \frac{D_1^2}{\overline{D_2^2}}$

b. $\frac{I_1^2}{\overline{I_2^2}} = \frac{D_1^2}{\overline{D_1^2}}$

c. $\frac{I_1}{\overline{I_2}} = \frac{D_2}{\overline{D_1}}$

d. $\frac{I_1}{\overline{I_2}} = \frac{D_2^2}{\overline{D_1^2}}$

_____ 3. Biological half life is:

a. The time it takes 1/2 of the atom of a radioisotope to disintegrate.

b. The time it takes 1/2 of a radioactive material to be passed from the body as waste material.

c. The time it takes to rid the body of 1/2 of a radioactive material by a combination of biological elimination and radioactive decay.

_____ 4. Radiation intensity at a certain point is 20 r/hr. How many HVL are required to reduce the intensity to 5 r/hr?

Encl 2

Appendix A

_____ 5. Radioactive half-life is:

a. The time it takes one-half of the atom of a radioisotope to disintegrate.
b. The time it takes one-half of a radioactive material to be passed from the body as waste material.
c. The time needed to rid the body of one-half of a radioactive material by a combination of biological elimination and radioactive decay.

_____ 6. Gamma and x-radiation damage human body tissue by a process known as _____.

_____ 7. The HVL of lead for CO-60 is 0.49 inch. At a certain distance from the CO-60 source, radiation is 600 mr/hr. What thickness of lead is required to reduce the intensity to 75 mr/hr?

_____ 8. The whole body radiation dose must normally be limited to a dose of:

a. 1-1/4 rems/qtr
b. 18-3/4 rems/qtr
c. 7-1/2 rems/qtr
d. 5 rems/qtr

_____ 9. Portable instruments used to monitor radiation areas are called:

a. film badges
b. survey meters
c. personnel monitoring devices
d. environmental badges

_____ 10. The unit that compares the biologists' effectiveness of the different types of radiation is the:

a. rem
b. RAD
c. RBE
d. roentgen

_____ 11. A given radiation dose will cause less damage if it is received over a very short period of time than if it is received over a long period of time.

a. True
b. False

_____ 12. The term RAD stands for:

_____ 13. In most radiographic operations, the ionization chamber survey meter is more desirable than the G-M counter.

a. True
b. False

_____ 14. The intensity at 1 foot from a 10 curie source of IR-192 is 59 r/hr. The standard dose rate for 1 curie at 1 foot for IR-192 is _____.

Appendix A

_____ 15. The time rate at which a radiation dose is received is called:

_____ - _____

_____ 16. The most penetrating radiation from radioisotopes is:

a. Beta particles
b. Alpha particles
c. Gamma rays
d. X-rays

_____ 17. At 10 feet from an isotope, radiation intensity is 150 mr/hr. The intensity at 1 foot would be _____.
(Show your work.)

_____ 18. Radiation intensity at 6 feet from an isotope is 40 r/hr. At what distance would the intensity be reduced to 10 r/hr.
(Show your work.)

_____ 19. Two types of personnel monitoring devices are:

a. _____

b. _____

_____ 20. The physical effects of radiation on the body of the individual receiving the radiation are called:

a. Somatic effects
b. Latent effects
c. Genetic effects
d. Radiosensitive effects

_____ 21. The permissible accumulated dose for a person who is 37 years old is _____.

_____ 22. The primary hazard in radiography comes from:

a. internal radiation
b. gamma rays and alpha particles
c. beta particles
d. external radiation

_____ 23. Materials exposed to gamma rays and x-rays become radioactive and dangerous to handle.

a. True
b. False

Appendix A

_____ 24. An x-ray machine presents an internal hazard.

a. True
b. False

Appendix A

ANNEX 3

RADIATION SAFETY COURSE

SAMPLE TEST _____ FOR PHASE I TRAINING

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DATE_____ GRADED BY_____

(Representative Sample Test in Support of Annex 1, Appendix B)

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a. $\frac{I_2}{\overline{I_1}} = \frac{D_1^2}{\overline{D_2^2}}$

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c. The time it takes to rid the body of 1/2 of a radioactive material by a comoination of biological elimination and radioactive decay.

_____ 4. Radiation intensity at a certain point is 20 r/hr. How many HVL are required to reduce the intensity to 5 r/hr?

Encl 2

Appendix A

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a. The time it takes one-half of the atom of a radioisotope to disintegrate.
b. The time it takes one-half of a radioactive material to be passed from the body as waste material.
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Appendix A

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_____ _____

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(Show your work.)

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b. gamma rays and alpha particles
c. beta particles
d. external radiation

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a. True
b. False

Appendix A

_____ 24. An x-ray machine presents an internal hazard.

a. True
b. False

Appendix A

FINAL EXAMINATION
SAMPLE TEST

NAME_____ GRADE_____

BADGE NO._____ PASSED_____ FAILED_____

DATE_____ GRADED BY_____

_____ 1. The standard dose rate of a radioisotope is expressed in:

a. Roentgens per hour per curie at any standardized distance not exceeding 75 feet.
b. Roentgens per hour per curie per foot.
c. Roentgens per hour per curie at a distance of one foot.
d. None of the above.

_____ 2. When a body tissue cell is damaged by radiation:

a. The cell may lose its ability to reproduce.
b. The cell may die.
c. Damage is caused by knocking an electron out of the orbit of its parent atom.
d. All of the above.

_____ 3. The pocket dosimeter has the advantage of:
a. Being more accurate than the film badge.
b. Providing an immediate indication of radiation exposure.
c. Providing a permanent record of radiation exposure.
d. All of the above.

_____ 4. There are five variables which influence the effect that radiation doses have on individuals. List three of these variables.

a. _____

b. _____

c. _____

_____ 5. The most serious radiation exposure is to the:

a. Whole body
b. Feet and ankles
c. Skin
d. Hands and forearms

Encl 3'

Appendix A

_____ 6. Radiation intensity at 6 feet from an isotope is 40 r/hr. What distance would the intensity be reduced to 10 r/hr?

_____ 7. When reading low levels of radiation, the _____ (G-M counter or ion chamber meter) is more effective.

_____ 8. A person who becomes contaminated with radioactive material can spread contamination to other persons.

a. True
b. False

_____ 9. Effective half-life is:

a. The time it takes one-half of the atoms of a radioisotope to disintegrate.
b. The time it takes one-half of a radioactive material to be passed from the body as waste material.
c. The time needed to rid the body of one-half of a radioactive material by a combination of biological elimination and radioactive decay.

_____ 10. Pocket dosimeters depend upon a _____ (fill in from below) for their indication.

a. G-M tube.
b. Battery to provide electrical power.
c. Quartz fiber electroscope.
d. Theory that like charges attract and unlike charges repel.

_____ 11. Two types of survey meters are _____ and _____.

_____ 12. The normal operating range of a pocket dosimeter is:

a. 0 to 200 mr.
b. 50 to 500 mr.
c. 0 to 75 r/hr.
d. 25 to 250 r.

_____ 13. At 10 feet from an isotope, radiation intensity is 150 mr/hr. The intensity at 1 foot would be _____.

Appendix A

_____ 14. The term "RBE" stands for _____.

_____ 15. Devices attached to the clothing of people working in radiation areas for measurement of radiation are called:

a. Survey instruments.
b. G-M counters.
c. Personnel monitoring devices.
d. Portable rate meters.

_____ 16. The standard dose rate at 1 foot for CO-60 is 14.5 r/hr/curie. What is the intensity at 1 foot for a 7 curie source of CO-60?

a. 14.5 r/hr
b. 75 r/hr
c. 145 r/hr
d. 101.5 r/hr

_____ 17. For each year a person is past age 18, how many rems are deposited in his radiation bank account for whole-body exposure?

a. 18-3/4 rems
b. 12 rems
c. 1-1/4 rems
d. 5 rems

_____ 18. The formula for finding permissible accumulated dose is:

a. 12 (N-18)
b. 18 (5+N)
c. 5 (N-18)
d. 12 (N+18)

_____ 19. The inverse square law as applied to radiation protection states that:

a. Radiation intensity varies inversely as the square of the time spent near the source.
b. Radiation intensity varies proportionally with distance from the source.
c. Radiation intensity varies inversely as the square of the distance from the source.

_____ 20. The basic unit of measure used to express gamma or X-radiation exposure is the:

a. rem
b. rad
c. roentgen
d. RBE

Appendix A

_____ 21. The radiation effects which can be passed on to the offspring or to a later generation of a person receiving radiation are called:

a. Future effects
b. Genetic effects
c. Somatic effects
d. Radiosensitive effects

_____ 22. The unit that expresses the biological dose produced in humans by any type of radiation is the:

a. rem
b. rad
c. roentgen
d. RBE

_____ 23. Radiation intensity at a certain point is 20 r/hr. How many HVL are required to reduce the intensity to 5 r/hr?

_____ 24. In relation to radiation effects, MLD stands for?

_____ 25. List concrete, lead, and steel in order of their effectiveness in providing shielding against radiation.

a._____

b._____

c._____

_____ 26. We have a 1 Ci source of F^{17} ($T_{\frac{1}{2}}$=66.6 sec.) whose original activity was 128 Ci. How much time has passed?

_____ 27. Ten years ago 60 Ci of CO-60 was purchased. With a half-life of 5.28 years, what is its activity in Ci now?

_____ 28. If sand has a density of 100 lbs/ft^3 and concrete a density of 150 lbs/ft^3, it takes 3/4 as much sand as concrete to give the same shielding effect.

a. True
b. False

Appendix A

_____ 29. It is necessary for an occupationally exposed individual (radiation workers) to perform most of his duties 5 meters away from a 25 Ci. source of Sodium-22 (radiation level for 1 Ci. at 1 meter is 1.2 r/hr). What is the dose rate of the radiation field he must work in if no shielding is provided?

_____ 30. Using the answer to problem 29, how many half thicknesses of shielding must be provided to reduce the dose rate to less than 2 mR/hr?

Appendix A

ANSWER SHEET

Corresponding answers to Radiation Safety Course Phase I and Final Examination.

Phase I (Sample Test)

1. Quartz film (fiber) electroscope
2. d
3. b
4. 2
5. a
6. Ionization
7. 1.47
8. a
9. b
10. c
11. b
12. Radiation Absorbed Dose
13. a
14. 5.9
15. Exposure/Dose Rate
16. c
17. I_z = 15 r/hr
18. D_z = 12 ft
19. Film Badges and Pocket Dosimeters
20. a
21. 95
22. d
23. b
24. b

Final Examination (Sample Test)

1. c
2. d
3. b
4. Area of Body Exposure
   Real time of exposure
   Chronological age
   Body part
   Biological aspect of individual
5. a
6. 12 ft
7. GM counter
8. a
9. c
10. c
11. Ionization Chamber/G-M Counter
12. a
13. 15 R/hr
14. Relative Biological Effectiveness
15. c
16. d
17. d
18. 5(N-18)
19. c
20. c
21. b
22. a
23. 2
24. Median Lethal Dose
25. Lead, steel, concrete
26. 466.2 Sec (7 half-life)
27. 16.585 curies
28. b
29. 1.2 R/hr
30. 10 HVL

Appendix A

FINAL EXAMINATION
SAMPLE TEST

NAME_____ GRADE_____

BADGE NO._____ PASSED_____ FAILED_____

DATE_____ GRADED BY_____

_____ 1. The standard dose rate of a radioisotope is expressed in:

a. Roentgens per hour per curie at any standardized distance not exceeding 75 feet.
b. Roentgens per hour per curie per foot.
c. Roentgens per hour per curie at a distance of one foot.
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_____ 2. When a body tissue cell is damaged by radiation:

a. The cell may lose its ability to reproduce.
b. The cell may die.
c. Damage is caused by knocking an electron out of the orbit of its parent atom.
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_____ 3. The pocket dosimeter has the advantage of:
a. Being more accurate than the film badge.
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d. All of the above.

_____ 4. There are five variables which influence the effect that radiation doses have on individuals. List three of these variables.

a. _____

b. _____

c. _____

_____ 5. The most serious radiation exposure is to the:

a. Whole body
b. Feet and ankles
c. Skin
d. Hands and forearms

Encl 3[2]

Appendix A

_____ 6. Radiation intensity at 6 feet from an isotope is 40 r/hr. What distance would the intensity be reduced to 10 r/hr?

_____ 7. When reading low levels of radiation, the _____ (G-M counter or ion chamber meter) is more effective.

_____ 8. A person who becomes contaminated with radioactive material can spread contamination to other persons.

a. True
b. False

_____ 9. Effective half-life is:

a. The time it takes one-half of the atoms of a radioisotope to disintegrate.
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_____ 19. The inverse square law as applied to radiation protection states that:

a. Radiation intensity varies inversely as the square of the time spent near the source.
b. Radiation intensity varies proportionally with distance from the source.
c. Radiation intensity varies inversely as the square of the distance from the source.

_____ 20. The basic unit of measure used to express gamma or X-radiation exposure is the:

a. rem
b. rad
c. roentgen
d. RBE

Appendix A

_____ 21. The radiation effects which can be passed on to the offspring or to a later generation of a person receiving radiation are called:

a. Future effects
b. Genetic effects
c. Somatic effects
d. Radiosensitive effects

_____ 22. The unit that expresses the biological dose produced in humans by any type of radiation is the:

a. rem
b. rad
c. roentgen
d. RBE

_____ 23. Radiation intensity at a certain point is 20 r/hr. How many HVL are required to reduce the intensity to 5 r/hr?

_____ 24. In relation to radiation effects, MLD stands for?

_____ 25. List concrete, lead, and steel in order of their effectiveness in providing shielding against radiation.

a._____

b._____

c._____

_____ 26. We have a 1 Ci source of F^{17} ($T_{\frac{1}{2}}$=66.6 sec.) whose original activity was 128 Ci. How much time has passed?

_____ 27. Ten years ago 60 Ci of CO-60 was purchased. With a half-life of 5.28 years, what is its activity in Ci now?

_____ 28. If sand has a density of 100 lbs/ft^3 and concrete a density of 150 lbs/ft^3, it takes 3/4 as much sand as concrete to give the same shielding effect.

a. True
b. False

Appendix A

_____ 29. It is necessary for an occupationally exposed individual (radiation workers) to perform most of his duties 5 meters away from a 25 Ci. source of Sodium-22 (radiation level for 1 Ci. at 1 meter is 1.2 r/hr). What is the dose rate of the radiation field he must work in if no shielding is provided?

_____ 30. Using the answer to problem 29, how many half thicknesses of shielding must be provided to reduce the dose rate to less than 2 mR/hr?

Appendix A

ANSWER SHEET

Corresponding answers to Radiation Safety Course Phase I and Final Examination.

Phase I (Sample Test)

1. Quartz film (fiber) electroscope
2. d
3. b
4. 2
5. a
6. Ionization
7. 1.47
8. a
9. b
10. c
11. b
12. Radiation Absorbed Dose
13. a
14. 5.9
15. Exposure/Dose Rate
16. c
17. I_z = 15 r/hr
18. D_z = 12 ft
19. Film Badges and Pocket Dosimeters
20. a
21. 95
22. d
23. b
24. b

Final Examination (Sample Test)

1. c
2. d
3. b
4. Area of Body Exposure
   Real time of exposure
   Chronological age
   Body part
   Biological aspect of individual
5. a
6. 12 ft
7. GM counter
8. a
9. c
10. c
11. Ionization Chamber/G-M Counter
12. a
13. 15 R/hr
14. Relative Biological Effectiveness
15. c
16. d
17. d
18. 5(N-18)
19. c
20. c
21. b
22. a
23. 2
24. Median Lethal Dose
25. Lead, steel, concrete
26. 466.2 Sec (7 half-life)
27. 16.585 curies
28. b
29. 1.2 R/hr
30. 10 HVL

Appendix A

SECTION III

INTERNAL INSPECTING (AUDITING) SYSTEM

1. Purpose: To verify that receipt, possession, and use of radioactive materials are continually controlled, audits shall be conducted internally at periodic intervals. Such audits will provide management with an objective evaluation of program problems and training needs. Formal internal audit personnel qualifications, responsibilities, and procedures are as follows:

a. Personnel Qualification: Each individual tasked to perform internal audits shall as a minimum have first-hand knowledge of operating and emergency procedures, use of the sealed source equipment, license conditions, NRC regulations (particularly CFR, Title 10, Parts 19, 20, 30, and 34) and operational environments, all within an equivalent or greater degree than those of a qualified radiographer.

b. Procedure: Audits shall be conducted only by those personnel designated below, within each quarter of each calendar year on an unannounced basis. Preferably, audit selection time frames should coincide with on-going radiography operations.

Chief, Safety Office (Radiation Protection Officer (RPO)), Team Leader
Safety and Occupational Health Specialist (Assistant RPO), Alternate Team Leader
Quality Assurance Director (Radiation Control Officer)
Chief, Management and Acceptance Division (Alternate Radiation Control Officer)

Additional technical personnel may be appointed by the RPO in specific areas of need; however, such appointments shall not replace the above-named personnel.

2. Report and Response:

a. Report: Each audit team shall utilize the guideline criteria in Annex 4 for inspection and report results to the commanding officer. Reports shall specify deficiencies noted, recommended corrective action and section responsible. Each report shall bear team member signature. Observance of unsafe operational conditions or equipment shall be cause for immediately ceasing radiography operations and effecting corrective action plans.

b. Response: Corrective action response to discrepancies is required within 15 working days of the report issuance date; however, actual corrective action should be completed as quickly as possible. Failure to respond within the 15-day time period shall necessitate a follow-up memorandum request issued by the RPO.

Encl 4

Appendix A

ANNEX 4

McALESTER ARMY AMMUNITION PLANT
REPORT OF ANNUAL INTERNAL AUDIT
OF RADIOGRAPHIC FACILITIES

1. Purpose.

2. Scope. Area of process audited.

3. Audit Team Members. (List name, position, and activity symbol)

4. Persons Contacted (including activity symbol).

5. Summary.

6. Audit Findings and Recommendations.

Findings ( ): State the finding clearly and concisely.

Discussion ( ): Background and explanatory comments.

Recommendation ( ): Recommendations for corrective action to be taken should be specific, avoid ambiguity. The corrective action that an activity must take should be clearly assigned to that one activity.

ACTION:

SIGNATURES OF AUDIT TEAM

_____ Date _____

_____ Date _____

_____ Date _____

Appendix A

SCHEDULED AUDIT QUESTIONNAIRE

Use in conjunction with Annex 4 of this Appendix.

Activity and Process to be Audited: Receipt, possession, and use of radioactive isotopes.

Purpose of Audit: To determine compliance with the requirements of Code of Federal Regulations, Title 10, Parts 19, 20, 30, and 34.

STATUS		QUESTIONS
Yes	No	
___	___	1. Does the radiographer have his operating and emergency procedures readily available?
___	___	2. Does the radiographer perform the operational check of the radiac instrument properly?
___	___	3. Does the radiographer properly complete the daily inspection of exposure devices and storage containers?
___	___	4. Does the radiographer properly complete the utilization logbook?
___	___	5. Does the head radiographer know if the last leak and wipe tests were satisfactorily completed?
___	___	6. Does the radiographer properly perform the required radiation surveys?
___	___	7. Does the radiographer properly post the radiation and high radiation areas?
___	___	8. Does the radiographer know how to establish the high radiation areas without unnecessarily exposing himself?
___	___	9. Does the radiographer know what action to take in case of accidents or emergencies?
___	___	10. Does the radiographer know how to complete the required information for pocket dosimeters?
___	___	11. Are the area safeguards in proper operational condition?
___	___	12. Is there any equipment out of calibration?
___	___	13. Are the records for survey instrumentations maintained and up to date?
___	___	14. Are the records for pocket dosimeters maintained and up to date?

Appendix A

STATUS		QUESTIONS
Yes	No	
___	___	15. Are the records for receipt, transfer, and disposal of licensed Byproduct Material maintained and up to date?
___	___	16. Are the records for the leak and wipe tests maintained and up to date?
___	___	17. Are the records for the quarterly physical inventory maintained and up to date?
___	___	18. Are the records for the utilization logbook maintained and up to date?
___	___	19. Are the records for the radiation surveys maintained and up to date?
___	___	20. Are the records for the pocket dosimeter readings maintained and up to date?
___	___	21. Are the records for the daily inspection of exposure devices and storage containers maintained and up to date?
___	___	22. Are the records for the quarterly inspection and maintenance of exposure devices and storage containers maintained and up to date?
___	___	23. Are the records for the bi-annual inspection of area safeguards maintained and up to date?
___	___	24. Are the records for the personnel training and qualification maintained and up to date?
___	___	25. Are the posting requirements of 10 CFR 19 met in full?

Appendix A

SECTION III

INTERNAL INSPECTING (AUDITING) SYSTEM

1. Purpose: To verify that receipt, possession, and use of radioactive materials are continually controlled, audits shall be conducted internally at periodic intervals. Such audits will provide management with an objective evaluation of program problems and training needs. Formal internal audit personnel qualifications, responsibilities, and procedures are as follows:

a. Personnel Qualification: Each individual tasked to perform internal audits shall as a minimum have first-hand knowledge of operating and emergency procedures, use of the sealed source equipment, license conditions, NRC regulations (particularly CFR, Title 10, Parts 19, 20, 30, and 34) and operational environments, all within an equivalent or greater degree than those of a qualified radiographer.

b. Procedure: Audits shall be conducted only by those personnel designated below, within each quarter of each calendar year on an unannounced basis. Preferably, audit selection time frames should coincide with on-going radiography operations.

Chief, Safety Office (Radiation Protection Officer (RPO)), Team Leader
Safety and Occupational Health Specialist (Assistant RPO), Alternate Team Leader
Quality Assurance Director (Radiation Control Officer)
Chief, Management and Acceptance Division (Alternate Radiation Control Officer)

Additional technical personnel may be appointed by the RPO in specific areas of need; however, such appointments shall not replace the above-named personnel.

2. Report and Response:

a. Report: Each audit team shall utilize the guideline criteria in Annex 4 for inspection and report results to the commanding officer. Reports shall specify deficiencies noted, recommended corrective action and section responsible. Each report shall bear team member signature. Observance of unsafe operational conditions or equipment shall be cause for immediately ceasing radiography operations and effecting corrective action plans.

b. Response: Corrective action response to discrepancies is required within 15 working days of the report issuance date; however, actual corrective action should be completed as quickly as possible. Failure to respond within the 15-day time period shall necessitate a follow-up memorandum request issued by the RPO.

Encl 4

Appendix A

ANNEX 4

McALESTER ARMY AMMUNITION PLANT
REPORT OF ANNUAL INTERNAL AUDIT
OF RADIOGRAPHIC FACILITIES

1. Purpose.

2. Scope. Area of process audited.

3. Audit Team Members. (List name, position, and activity symbol)

4. Persons Contacted (including activity symbol).

5. Summary.

6. Audit Findings and Recommendations.

Findings ( ): State the finding clearly and concisely.

Discussion ( ): Background and explanatory comments.

Recommendation ( ): Recommendations for corrective action to be taken should be specific, avoid ambiguity. The corrective action that an activity must take should be clearly assigned to that one activity.

ACTION:

SIGNATURES OF AUDIT TEAM

_____Date_____

_____Date_____

_____Date_____

Appendix A

SCHEDULED AUDIT QUESTIONNAIRE

Use in conjunction with Annex 4 of this Appendix.

Activity and Process to be Audited: Receipt, possession, and use of radioactive isotopes.

Purpose of Audit: To determine compliance with the requirements of Code of Federal Regulations, Title 10, Parts 19, 20, 30, and 34.

STATUS		QUESTIONS
Yes	No	
___	___	1. Does the radiographer have his operating and emergency procedures readily available?
___	___	2. Does the radiographer perform the operational check of the radiac instrument properly?
___	___	3. Does the radiographer properly complete the daily inspection of exposure devices and storage containers?
___	___	4. Does the radiographer properly complete the utilization logbook?
___	___	5. Does the head radiographer know if the last leak and wipe tests were satisfactorily completed?
___	___	6. Does the radiographer properly perform the required radiation surveys?
___	___	7. Does the radiographer properly post the radiation and high radiation areas?
___	___	8. Does the radiographer know how to establish the high radiation areas without unnecessarily exposing himself?
___	___	9. Does the radiographer know what action to take in case of accidents or emergencies?
___	___	10. Does the radiographer know how to complete the required information for pocket dosimeters?
___	___	11. Are the area safeguards in proper operational condition?
___	___	12. Is there any equipment out of calibration?
___	___	13. Are the records for survey instrumentations maintained and up to date?
___	___	14. Are the records for pocket dosimeters maintained and up to date?

Appendix A

STATUS		QUESTIONS
Yes	No	
___	___	15. Are the records for receipt, transfer, and disposal of licensed Byproduct Material maintained and up to date?
___	___	16. Are the records for the leak and wipe tests maintained and up to date?
___	___	17. Are the records for the quarterly physical inventory maintained and up to date?
___	___	18. Are the records for the utilization logbook maintained and up to date?
___	___	19. Are the records for the radiation surveys maintained and up to date?
___	___	20. Are the records for the pocket dosimeter readings maintained and up to date?
___	___	21. Are the records for the daily inspection of exposure devices and storage containers maintained and up to date?
___	___	22. Are the records for the quarterly inspection and maintenance of exposure devices and storage containers maintained and up to date?
___	___	23. Are the records for the bi-annual inspection of area safeguards maintained and up to date?
___	___	24. Are the records for the personnel training and qualification maintained and up to date?
___	___	25. Are the posting requirements of 10 CFR 19 met in full?

Appendix B

DAILY INSPECTION CHECKLIST OF
EXPOSURE DEVICE, CELL, AND AREA SAFEGUARDS

ITEM	INSPECTIONS REQUIRED AND (METHOD)	SAT	*UNSAT
Area Posting	A. All radiation emblems and cautionary placards are present and properly displayed (Visual)		
EXPOSURE CELL AND AREA SAFE-GUARDS	B. Security locks are functioning properly (Visual-Trial)		
	C. Interlock of cell door to exposure device functions properly (Trial)		
	D. Area Monitor/Gammalarm audible and visual signals are proper (Trial)		
	E. Electrical cable is not frayed, pinched, or broken (Visual)		
	F. Lead and concrete shielding are intact (Visual)		
	G. Exposure device container is free from obvious damage (Visual)		
	H. Barrel lock and shutter function properly (Visual-Trial)		

*NOTE: Any element found unsat will be reported to radiographer supervisory. DO NOT OPERATE EQUIPMENT until corrective action has been accomplished through the radiographer supervisor.

RADIOGRAPHER (Signature)_____

DATE_____

FIGURE 10

Encl 5

Appendix B

DAILY INSPECTION CHECKLIST OF
EXPOSURE DEVICE, CELL, AND AREA SAFEGUARDS

ITEM	INSPECTIONS REQUIRED AND (METHOD)	SAT	*UNSAT
Area Posting	A. All radiation emblems and cautionary placards are present and properly displayed (Visual)		
EXPOSURE CELL AND AREA SAFE-GUARDS	B. Security locks are functioning properly (Visual-Trial)		
	C. Interlock of cell door to exposure device functions properly (Trial)		
	D. Area Monitor/Gammalarm audible and visual signals are proper (Trial)		
	E. Electrical cable is not frayed, pinched, or broken (Visual)		
	F. Lead and concrete shielding are intact (Visual)		
	G. Exposure device container is free from obvious damage (Visual)		
	H. Barrel lock and shutter function properly (Visual-Trial)		

*NOTE: Any element found unsat will be reported to radiographer supervisory. DO NOT OPERATE EQUIPMENT until corrective action has been accomplished through the radiographer supervisor.

RADIOGRAPHER (Signature)_____

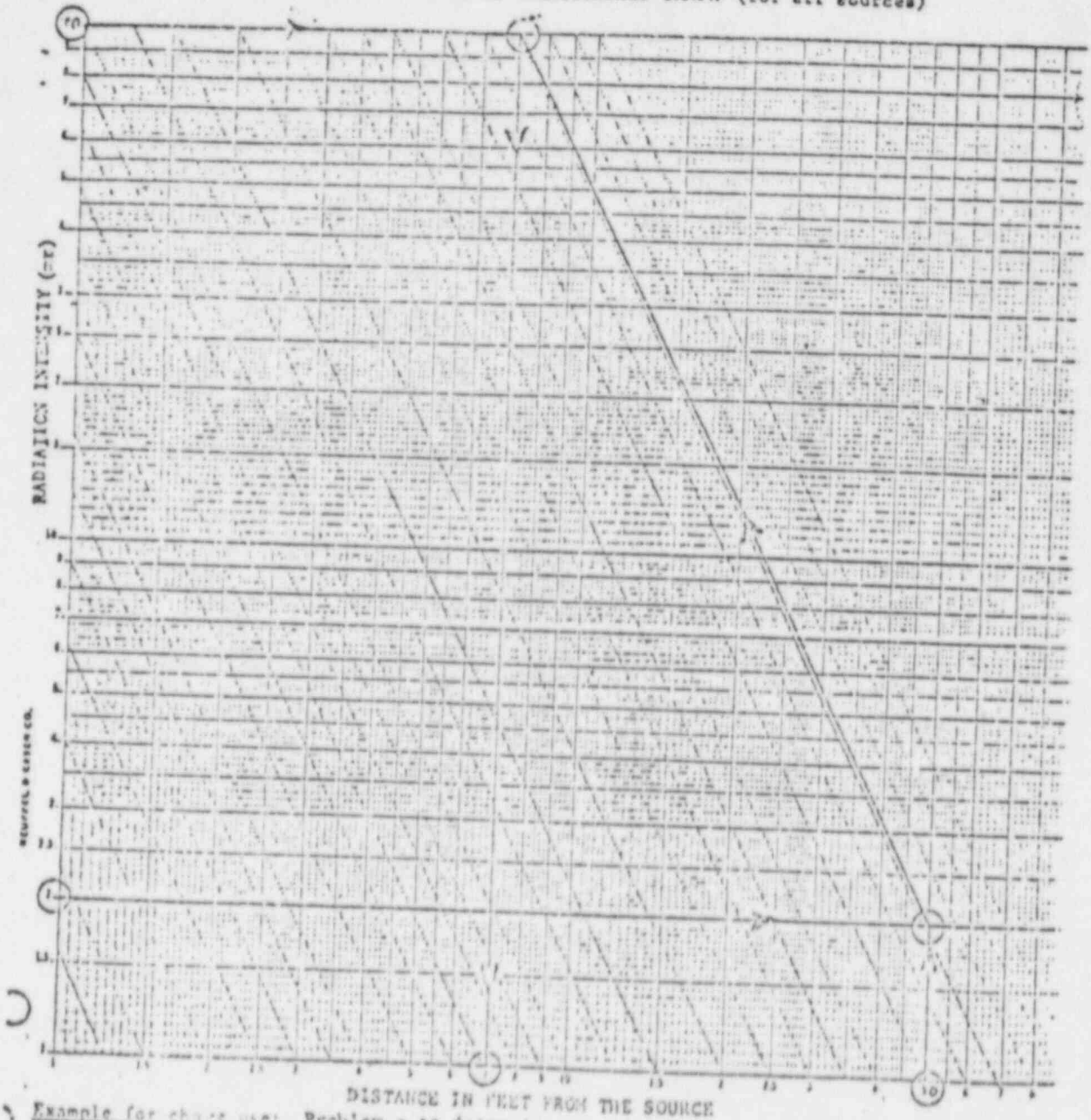
DATE_____

FIGURE 10

Encl 5

Appendix B

RADIATION INTENSITY-DISTANCE RELATIONSHIP GRAPH (for all sources)



Example for above use: Problem - to determine the 100 mr location from the source.

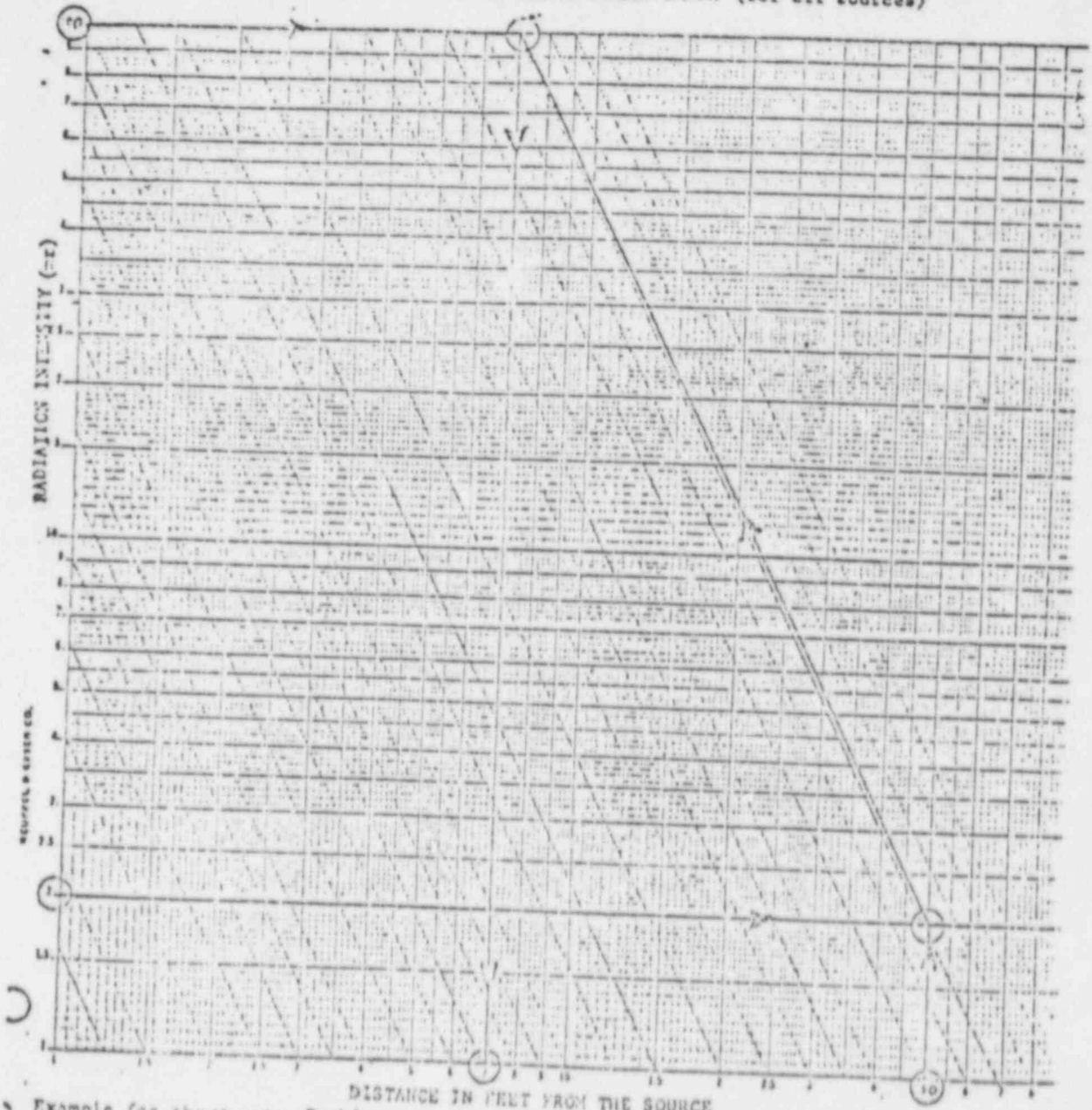
1. Determine 2 mr location (distance from exposed source) with a radiac. For example: 2 mr at 50 feet.
2. From the intersection of lines (drawn on the above graph) from the 2 mr and 50 foot points, locate an intersection along a parallel diagonal to those shown with a horizontal line from the 100 mr point.
3. From the 100 mr line intersection, vertically find the 7.1 feet distance which is the 100 mr location from the source.

FIGURE 7

Encl 6

Appendix B

RADIATION INTENSITY-DISTANCE RELATIONSHIP GRAPH (for all sources)



Example for above use: Problem - to determine the 100 mr location from the source.

1. Determine 2 mr location (distance from exposed source) with a radius. For example: 2 mr at 50 feet.
2. From the intersection of lines (drawn on the above graph) from the 2 mr and 50 foot points, locate an intersection along a parallel diagonal to those shown with a horizontal line from the 100 mr point.
3. From the 100 mr line intersection, vertically find the 7.1 foot distance which is the 100 mr location from the source.

FIGURE 7

Encl 6

DEPARTMENT OF THE ARMY
McALESTER ARMY AMMUNITION PLANT
McALESTER, OKLAHOMA 74501

McAAPR REGULATION
No. 702-4

6 November 1984

Product Assurance

RADIOACTIVE ISOTOPE RADIOGRAPHY PROGRAM

1. Purpose. To establish management and technical procedures for the control and use of radioactive isotopes associated with industrial radiography at McAAP.

2. Scope. This regulation establishes distinct internal management and operating and emergency requirements and procedures for any operation involving isotope radiography.

3. Requirements. Each installation planning to receive, store or use by-product materials must obtain prior license approval from the Nuclear Regulatory Commission (NRC) as required by Title 10 of the Code of Federal Regulations and NRC Licensing Guide for Industrial Radiography. These regulations, in conjunction with AR 385-11 and DARCOM-R 385-25, provide basic requirements for obtaining, amending and renewing installation license.

4. Policy. The Commander's policy on matters pertaining to radiation safety remains that of "no compromise or deviation" from established requirements. Accordingly, the contents of this regulation, as formulated upon NRC, AMC, and AMCCOM requirements, shall rigidly be enforced in all situations involving installation receipt, storage, and usage of radioactive isotope materials.

5. Responsibilities. Director, office chiefs, and technical personnel responsibilities in the usage and control of radioactive isotope material used in industrial radiography are specifically addressed in Appendix A of this regulation. Additionally, technical operating and emergency procedures for attendant radiography personnel are explicitly provided in Appendix B. Collectively, Appendices A and B

* This regulation supersedes McAAPR 702-4, dated 1 September 1981 with Change 1.

establish and define both management and technician responsibilities for assuring that radioactive material possessed or used by this installation is in compliance with current regulations and practices.

6. Changes. Changes to this regulation shall be submitted through the Director of Quality Assurance and Director of Safety for approval by the Plant Commander.

7. References.

a. Code of Federal Regulations, Title 10

b. AR 385-11

c. ARRCOM Suppl 1 to DARCOM-R 385-25

(SMCMC-QA)

Appendix A

MANAGEMENT PROCEDURE FOR THE CONTROL AND USE OF RADIOACTIVE ISOTOPES ASSOCIATED WITH INDUSTRIAL RADIOGRAPHY

1. Purpose: To establish the internal management procedures for the control and use of radioactive isotopes associated with industrial radiography.

2. Scope: This appendix addresses management procedures and related inspection systems necessary for assuring that Nuclear Regulatory Commission (NRC) license conditions, commission regulations, and operating and emergency procedures are followed by radiographic personnel.

3. Policy: The Commander's policy regarding personnel safety is that of "no compromise." This policy is especially applicable to radiography utilizing radioactive isotopes.

4. General: Code of Federal Regulations (CFR), Title 10, parts 19, 20, 30, and 34 in conjunction with NRC Licensing Guide for Industrial Radiography establish radiography program requirements as well as procedures to be enacted for application, approval, and amendment of license. The latter regulation further advises that management procedures should be prepared separate and apart from operating and emergency procedures provided to radiographers and radiographer assistants. AR 385-11 provides procedures for Department of Army agencies for licensing and control of sources of ionizing radiation while ARRCOM Suppl 1 to DARCOM-R 385-25 establishes ionizing radiation protection standards.

5. Responsibilities: McAAP management personnel designated in this appendix as responsible in the control and usage of radioactive isotopes shall familiarize themselves with the contents that affect applicable operations as specified herein.

Appendix A

SECTION I

RADIOGRAPHIC PERSONNEL AND REQUIRED QUALIFICATIONS

1. Personnel Definition and Responsibility

a. Definition: A radiographer is a person performing or supervising on-site radiographic operations who is directly responsible for compliance with CFR and plant license conditions. An assistant radiographer is any person who, under direct supervision of a radiographer, uses radiographic equipment, sealed sources, or radiation survey instruments in radiography operations.

b. Responsibility: The responsibilities of a radiographer as defined above shall never be assigned to an assistant radiographer. Assistant radiographer shall never be allowed to assume the responsibilities of a radiographer.

2. Qualifications

a. Assistant Radiographer: Prior to assignment to assistant radiographer duties, each person must meet the following qualifications:

(1) Receive instruction in subjects outlined in Section II and Appendix B of this regulation.

(2) Receives latest revised copy of Appendix B (Operating and Emergency Procedures for Isotope Radiograph) and CFR, Title 10, Parts 19, 20, 30, and 34 and is familiar with the contents therein.

(3) Successfully completed written and practical tests/examinations on subject matter outlined in Appendix B.

(4) Successfully completed the written and practical tests/examinations of the last periodic (annual refresher) training program.

b. Radiographer: Prior to assignment to radiographer duties, each person must meet the following qualifications: Successfully completed the requirements listed in paragraph 2a(1) for assistant radiographer and has received at least 40 hours on-job-training (OJT) in isotope radiography for the specific source device to be operated under the direct supervision of a radiographer or radiographer supervisor.

3. Trainee Entrance: Persons may enter the radiography field as trainees; however, they shall not be utilized as a radiographer assistant in isotope radiography until satisfactory completion of the requirements listed in paragraph 2a above.

Appendix A

4. Requalification: Radiographers and Assistants. Annual refresher training will normally be conducted during the first quarter of each calendar year; however, mission requirements may dictate an alternate time within that same calendar year. Refresher training will encompass current pertinent regulations and any changes to procedures or equipment. Duration of time for refresher training shall normally be at least four hours; however, actual time used should be dependent upon personnel needs. Written tests shall be administered to assure effectiveness of the training and individual trainee retention. A minimum test score of 80% correct response is required on refresher tests developed jointly by the Radiological Protection Officer (RPO) and Quality Assurance Director (SMCMC-QA). Memoranda of individual requalification will be issued to SMCMC-QAM and SMCMC-PT. Failure of an individual to attain an 80% correct response on written examinations should be followed by further refresher training and retesting in deficient areas.

Appendix A

SECTION II

TRAINING PROGRAM

1. Program Requirements: Assurance to the general public and McAAP must be provided such that personnel are not unknowingly exposed to dangerous levels of radiation. Such assurance is available through the operation of an effective training program for radiographer personnel as required by CFR, Title 10, paragraph 34.11(b). Accordingly, this training program will insure that personnel handling, transporting, and using byproduct licensed material are adequately trained in all aspects of radiation safety.

2. Hiring:

a. All personnel hired or designated to perform radiographic operations shall receive initial training at the assistant radiographer level. Personnel subsequently qualified as radiographer assistants for at least six months may be re-examined to qualify as radiographers.

b. Personnel hired or designated to perform radiographic operations shall never be allowed to assume nor be assigned to radiographer or radiographer assistant duties until official training, qualification, and certification actions are completed.

3. Initial Training: Each person hired or designated to eventually perform radiographic operations shall receive training in accordance with Radiation Safety Course outlined in Annex 1. Official qualification shall be granted subsequent to satisfactory completion of written and practical examinations for each area of training.

4. On-Job-Training (OJT): All qualified radiographer assistants will receive a minimum of 40 hours OJT for purposes of improving competency in the handling and use of exposure devices, sealed sources, and related equipment as well as proper inspection of area safeguards. In all cases of OJT application, the radiographer assistant shall be supervised by a qualified radiographer and shall not be allowed to function under his own guidance.

5. Refresher Training: Annual training will normally be conducted during the first quarter of each calendar year; however, this time frame may be altered to allow for mission requirements. All radiographers and assistants will receive training on current policy, techniques, emergency procedures, and equipment. Administration of training shall be in accordance with Annexes 1, 2, or 3. In all instances of refresher training, each radiographer and radiographer assistant must satisfactorily comply with written and practical aspects of the refresher training examination. Subsequent to satisfactory completion of refresher training, radiographers and assistant radiographers shall be annually recertified in writing by joint approval of the RPO and SMCMC-QA.

Appendix A

6. Examination, Qualification, and Certification:

a. Examinations: Each trainee shall take daily and summary written examinations to verify instruction material retention and individual competency in handling and usage of equipment. Test score results shall be at least 80% in order to qualify for certification. Failure to attain 80% correct response will necessitate additional instructions and re-examination by a different test.

b. Qualification: Radiographers and radiographer assistants shall be considered qualified with successful completion of the training program and demonstration of competence and understanding in specified subjects. Qualified radiographer assistants with six months experience may be re-examined to qualify as radiographer.

c. Certification: Successful completion of the qualification requirements and assignment to radiographer or radiographer assistant functions shall be certified by SMCMC-QA. Subsequent to qualifying physical examination as required by DARCOM-R 385-25, the radiographer or radiographer assistant may function in his certified area.

Appendix A

SECTION III

INTERNAL INSPECTING (AUDITING) SYSTEM

1. Purpose: To verify that receipt, possession, and use of radioactive materials are continually controlled, audits shall be conducted internally at periodic intervals. Such audits will provide management with an objective evaluation of program problems and training needs. Formal internal audit personnel qualifications, responsibilities, and procedures are as follows:

a. Personnel Qualification: Each individual tasked to perform internal audits shall as a minimum have first-hand knowledge of operating and emergency procedures, use of the sealed source equipment, license conditions, NRC regulations (particularly CFR, Title 10, Parts 19, 20, 30, and 34) and operational environments, all within an equivalent or greater degree than those of a qualified radiographer.

b. Procedure: Audits shall be conducted only by those personnel designated below, within each quarter of each calendar year on an unannounced basis. Preferably, audit selection time frames should coincide with on-going radiography operations.

Chief, Safety Office (Radiation Protection Officer (RPO)), Team Leader
Safety and Occupational Health Specialist (Assistant RPO), Alternate Team Leader
Quality Assurance Director (Radiation Control Officer)
Chief, Management and Acceptance Division (Alternate Radiation Control Officer)

Additional technical personnel may be appointed by the RPO in specific areas of need; however, such appointments shall not replace the above-named personnel.

2. Report and Response:

a. Report: Each audit team shall utilize the guideline criteria in Annex 4 for inspection and report results to the commanding officer. Reports shall specify deficiencies noted, recommended corrective action and section responsible. Each report shall bear team member signature. Observance of unsafe operational conditions or equipment shall be cause for immediately ceasing radiography operations and effecting corrective action plans.

b. Response: Corrective action response to discrepancies is required within 15 working days of the report issuance date; however, actual corrective action should be completed as quickly as possible. Failure to respond within the 15-day time period shall necessitate a follow-up memorandum request issued by the RPO.

Appendix A

SECTION IV

ORGANIZATION STRUCTURE OF RADIOGRAPHY PROGRAM

1. Organizational Chart: Figure 2 provides a standard directorate chart for the plant radiography program reflecting directorate, office symbol, and brief summary of related function.

2. Organizational Responsibilities: With regard to the Radiography Program, eight Directorates, organized in an equal plane of authority, are assigned responsibility. Specific responsibilities are described below for each major participant.

a. Commanding Officer (SMCMC-CO): As the applicant for the NRC license, the Commanding Officer has overall responsibility for all aspects of the radiography program, which includes:

(1) Providing facilities, radiographic exposure devices, radiation detection equipment, operating and emergency procedures, and radioisotope training programs which optimize safety in radiation functions.

(2) Procurement of required byproduct materials.

(3) Control of the possession, use, and transfer of byproduct materials.

(4) Arranging for the disposal of decayed sources.

b. Production Support Officer (SMCMC-AO):

(1) Operational control of the building/facility with the exception of the radiographic operations.

(2) Administrative control over the building/facility.

c. Radiological Protection Officer (SMCMC-SF):

(1) Design and modification/change approval.

(2) Performs formal license request, amendment, and renewal correspondence actions including appendicing personnel qualifications sample test, instructor personnel, and audit forms as required by references a and b.

(3) Monitors to assure that source disposal or replacement operations are conducted properly.

(4) Jointly approves preparation and revision of current operating and emergency procedures.

(5) Establishes and guides training programs for the qualification of radiographers and radiographers' assistants. Provides lecture and demonstration training services.

(6) Notifies appropriate NRC Officer by telephone or telegraph and in writing of reportable incidents involving isotope radiography.

(7) Reviews, monitors, and insures that required records are maintained pertinent to personnel dosimetry, radiation surveys, source utilization, quarterly inventory, procurement, transfer, and shipment.

(8) Establishes and directs radiation survey and personnel monitoring equipment/instrument program.

(9) Approves safety program utilized in the radiography facility.

(10) Establishes periodic monitoring test program.

(11) Assumes charge during emergency situations, investigates their causes, and determines corrective action/measures.

(12) Insures that personnel dosimetry is effected in accordance with DARCOM-R 385-25 and related NRC Regulations.

(13) Prepares annual personnel exposure report to Director, Office of Nuclear Regulatory Research, US Nuclear Regulatory Commission, Washington, DC 20555.

(14) Coordinates all contact with NRC concerning plant radioisotope application matters which bear on employee radiation dose records at time of hiring or termination of employee. Acts in advisory capacity to management.

(15) Establishes procedures for the inspection and maintenance of radioisotope source storage containers and exposure devices, coordinates periodic inspections and maintenance work performed on contract, and insures that required records are maintained.

d. Director, Quality Assurance Directorate (SMCMC-QA), RCO:

(1) Administratively responsible for radiographic test functions. Maintains control over material in use, during transport, disposal or replacement and storage. Reviews to insure pertinent records are properly maintained. Serves as Radiation Control Officer.

(2) Administers training program for radiographers and radiographer assistants as determined by the RPO.

(3) Maintains exposure device, facilities, and associated equipment.

(4) Directs the examination and certification of radiographers, radiographer assistants and trainee level personnel.

(5) Ascertains timely scheduling of initial on-job-training (OJT), periodic and refresher training program as required by personnel and license requirements.

Appendix A

(6) Establishes and maintains internal inspection, inventory, license recording, and utilization logging systems.

(7) Assures training records are maintained. Controls training material.

(8) Prepares and approves operating and emergency procedures. Coordinates approval with the RPO, SMCMC-SF.

(9) Assumes control, investigates and institutes corrective action relating to emergency situations.

(10) Acts in advisory position for radiography to Command.

(11) Coordinates plans and actions relative to source exchange, disposal, and need changes in equipments or procedures with SMCMC-SF and SMCMC-AO.

e. Chief, Test and Acceptance Branch (SMCMC-QAM-T):

(1) Maintains roster of qualified radiographers and radiographer assistants.

(2) Notifies and assists RPO and SMCMC-QA concerning emergency situations.

(3) Implements training program as directed by SMCMC-QA.

(4) Supervises division personnel and directs daily maintenance of the facility and related survey and monitoring equipment.

(5) Monitors to assure personnel restricted areas allow only authorized entrance and dosimetry equipment is properly worn, collected, and forwarded for processing.

(6) Assures quarterly inventories of sealed source and reports results to the RPO.

(7) Monitors to insure safe storage of sealed sources in exposure devices, source container, and vaults/cells.

(8) Assures that only currently calibrated survey meters are used.

(9) Assures that at least two qualified radiographer personnel are present during radioisotope operations and that at least one is a certified radiographer.

(10) Ascertains leak tests are conducted every six months.

(11) Collects mini-form of Isotope Exposure Log from radiographer and forwards the form to Medical Officer for purpose of recording dosimeter date.

(12) Maintains Access Control Roster for the installation. This roster will be composed of those persons having a functional requirement to visit the controlled area. Each directorate is responsible for submitting a current listing that states names of candidates as follows: name, age, date of birth. A copy of the roster will be provided to the Medical Officer to be used for issue and control of film badges.

f. Chief, Equipment and Environmental Division (SMCMC-QAE):

(1) Assures survey meter recall and recalibration within each 90 days.

(2) Issues and stores survey meters.

g. Radiographer:

(1) Controls and approves personnel entry into restricted area. Allows only authorized personnel entry and then only when appropriately equipped with film badges, two dosimeters, and preceded by appropriate radiation survey equipment monitor.

(2) Conducts and reports quarterly inventory results.

(3) Insures safe storage of sealed source in exposure device and source container.

(4) Assures only current calibrated survey meters are used.

(5) Assures required personnel dosimetry is adhered to by each radiation worker.

(6) Collects and forwards film badges each month at the Medical Officer's direction, and issues new film badges.

(7) Conducts and forwards radiation survey records to the RPO.

(8) Monitors leak testing performed under contract.

(9) Maintains all records pertaining to Utilization Logbook.

(10) Assures proper functioning of the exposure device and conducts exposures within safety procedures contained in regulations and established procedures.

(11) Assures proper functioning, presence, calibration currency, and usage of radiation survey equipment.

(12) Conducts radiation readings at required intervals during exposure operations and other periods pursuant to determining isodose lines and area identification control. Makes annotations, sketches, and other required documented entries concerning radiation levels.

Appendix A

(13) Wears appropriate pocket dosimeters and assigned film badges during work hour assignment and records all dosimeter readings before and after each shift. Conducts a minimum of two dosimeter readings on all radiation personnel during each shift assignment.

(14) Reports any emergency condition to the Ammunition Production Supervisor, RPO, and SMCMC-QA.

(15) Secures exposure device at shift's end and enters such action statements in a permanent utilization log within the facility.

(16) Maintains custody of permanent utilization logs.

(17) Maintains exposure equipment keys.

(18) Specifically knowledgeable in basic procedures applicable to radioisotope operations (NRC byproduct license and regulations contained in Parts 19, 20, 30, and 34 of Title 10 of CFR as well as Appendix B (Operating and Emergency Procedure) of this regulation and the Plant Safety Manual.

(19) Submits periodic request to the Medical Clinic for radiation personnel blood counts and physical examinations.

h. Radiographer Assistant:

(1) Under supervision of the radiographer, assists in the processes of film placement, collection, identification, and development and operates sealed source during radiography.

(2) Assists radiographer in area security and personnel dosimetry and badging adherence.

i. Medical Officer (HSUA-PCM):

(1) Collects film dosimeter badges each month for shipment to Lexington Blue Grass Depot, ATTN: DRXAX-OCP, Lexington, KY.

(2) Upon receipt of film dosimetry records, maintains entries in personnel film dosimetry files and performs other functions as prescribed in DARCOM-R 385-25.

j. Administrative Service Directorate (SMCMC-AS): Provides forms/records.

k. Force Development Division (SMCMC-RMD): Assists in procedures development and staffing studies.

3. Personnel Qualifications: Personnel qualifications attendant to or affecting active control over the radiography program at McAAP shall be maintained within the Civilian Personnel Office, SMCMC-PT. A tabulation/summary of radiographic and related qualifications shall be appended to this instruction and submitted to the NRC as a portion of the license request.

RECORD OF OCCUPATIONAL EXPOSURE TO IONIZING RADIATION

FOR INSTRUCTIONS, SEE REVERSE OF SHEET.

1. IDENTIFICATION NUMBER	2. NAME (Last, first, middle initial)	3. SOCIAL SECURITY NUMBER	4. RANK/RATE TITLE OF POSITION	5. DATE OF BIRTH (Day, month, year)
442168700	DOE, DONALD L.	442-16-8700	WG-11	29 Jul 30

PLACE WHERE EXPOSURE OCCURRED	PERIOD OF EXPOSURE		DOSE THIS PERIOD (rem) 1. Method of monitoring is presumed to be film badge reading unless otherwise specified under Item 16, "REMARKS."				ACCUMULATED DOSE (rem)		INITIAL
ACTIVITY	FROM (Day-Mo-Yr)	TO (Day-Mo-Yr)	SKIN DOSE (Soft)	GAMMA AND X-RAY	NEUTRON	TOTAL THIS PERIOD	TOTAL LIFETIME	PERMISSIBLE LIFETIME 5(N-18)	PERSON MAKING ENTRY
6	7	8	9	10	11	12	13	14	15
MCAAP	11Apr80	14May80	00.003	00.010	NU	00.013	00.013	50.000	DLP
MCAAP	10Oct80	30Jan81	00.010	00.005	NU	00.015	00.028	50.000	DLP
MCAAP	11Mar81	30Jul81	00.000	00.018	NU	00.018	00.046	50.000	LKC

SAMPLE

16. REMARKS (Continue on additional sheet if necessary)

NU (Not Used)

TO BE RETAINED PERMANENTLY IN INDIVIDUAL'S MEDICAL RECORD

DD FORM 1 MAY 67 1141

PREVIOUS EDITIONS ARE OBSOLETE.

Figure 1

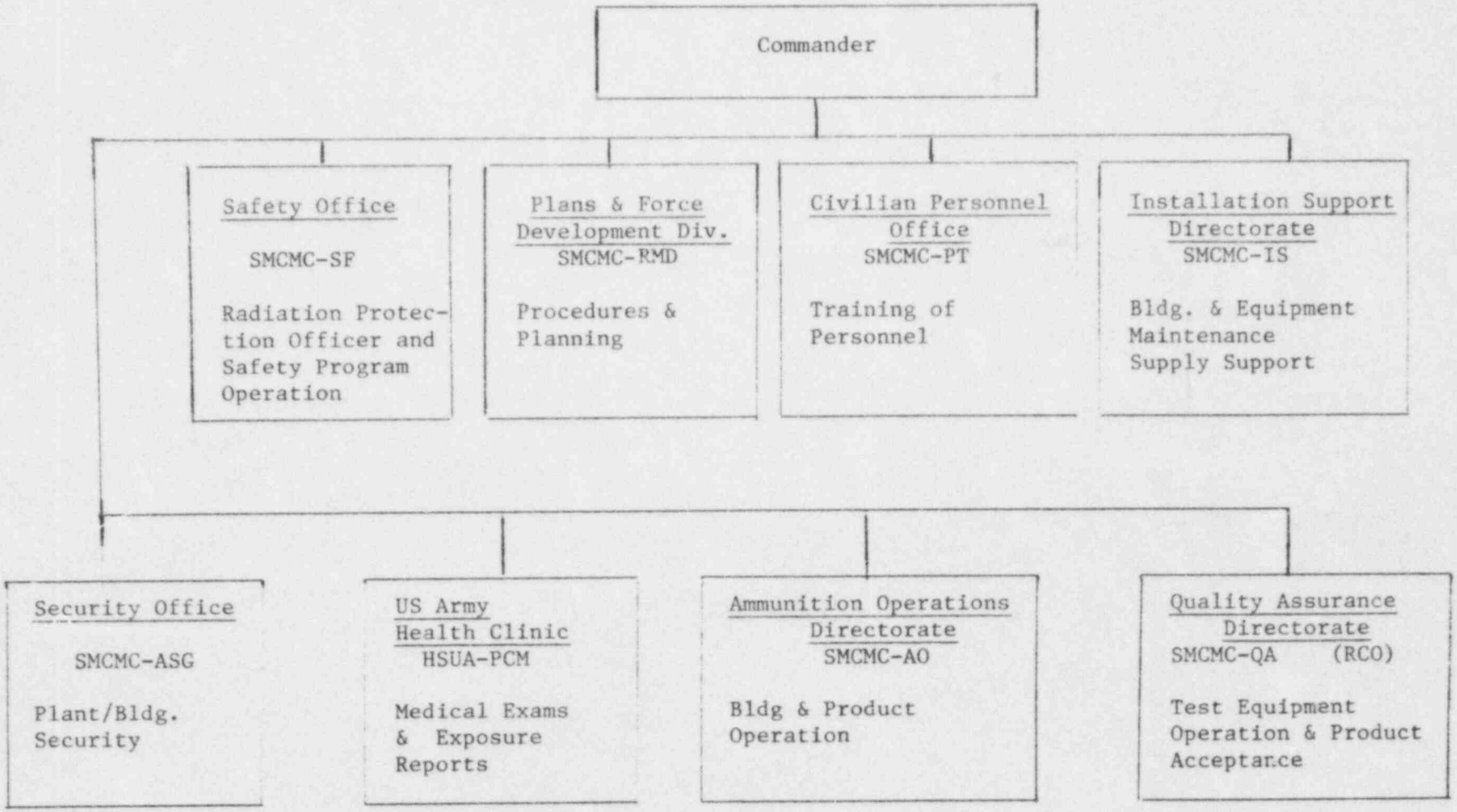

Commander
Safety Office
SMCMC-SF
Radiation Protection Officer and Safety Program Operation
Plans & Force Development Div.
SMCMC-RMD
Procedures & Planning
Civilian Personnel Office
SMCMC-PT
Training of Personnel
Installation Support Directorate
SMCMC-IS
Bldg. & Equipment Maintenance
Supply Support
Security Office
SMCMC-ASG
Plant/Bldg. Security
US Army Health Clinic
HSUA-PCM
Medical Exams & Exposure Reports
Ammunition Operations Directorate
SMCMC-AO
Bldg & Product Operation
Quality Assurance Directorate
SMCMC-QA (RCO)
Test Equipment Operation & Product Acceptance

Figure 2

Appendix A

SECTION V

LEAK TESTING

1. Leak test of the sealed source shall be conducted twice each year at six-month intervals. Sample wipe operations shall be monitored by SMCMC-SF and SMCMC-QA.

2. Leak test results exhibiting leakage of 0.005 microcuries or more of radioactivity shall be cause for immediate isolation of the source and for effecting procedures contained in Section XII of Appendix B.

Appendix A

SECTION VI

CALIBRATION OF RADIATION SURVEY INSTRUMENTS

1. All radiation detection instruments used in radiography operations shall be calibrated within each 90-day period.

2. Radiacs are maintained for issue and recall by the Calibration Laboratory, Bldg #7. Calibration is conducted by the Army Area Calibration Laboratory, Sacramento Army Depot, Sacramento, CA. A copy of calibration support agreement letter is retained on file by SMCMC-QA

3. Pocket dosimeters are calibrated by the Army Area Calibration Laboratory, Sacramento Army Depot, Sacramento, CA. Controlled charging, issue, and monitoring are conducted by nondestructive test branch personnel (SMCMC-QAM-T).

Appendix A

SECTION VII

MAINTENANCE OF RECORDS

1. Specific records required by Appendix B will be maintained for inspection by the Chief, Test and Acceptance Branch, SMCMC-QAM-T, and related audit management personnel from SMCMC-SF and SMCMC-QA. Records identification, location, and related requirements are as follows:

a. Instrument Calibration Records: Each radiation survey instrument used must be calibrated at intervals not to exceed 90 days and after each instance of servicing or maintenance. All instruments are received by SMCMC-QAE after calibration by the Army Area Calibration Laboratory, Sacramento Army Depot, Sacramento, CA. SMCMC-QAE (Calibration Laboratory, Bldg #7) maintains a record of receipt and issues which shall be available for inspection. Record reflects survey meter identification, model number, serial number, calibration due date, date issued, date returned, and signature of person receiving the instrument.

b. Receipt and Transfer of Licensed Byproduct Material: A record of each receipt and transfer action on equipment or material designated as radioactive shall be readily available for inspection at Bldg #111. Each form must be completed to reflect source custodian (or designated representative) and related receipt or transfer information.

c. Leak and Wipe Test: Regardless of vendor or agents of source replacement, acceptance actions shall not be made without accompanying certification of leak test with negative results, performed within 30 days of the shipping date. Subsequent to receipt, each sealed source shall be leak tested by a licensed contractor at intervals not to exceed six-month intervals. Record must reflect test date, source material, source model and serial number, shipping container, model and serial numbers, leak test results, and testing contractor/vendor. Plant contracts with contractor/vendor shall assure current licensing by NRC, specific dates for testing to be performed and procedures to be followed in wipe test sample selection. Leak test results shall be on file at Bldg #111. Copy will be on file with RPO.

d. Quarterly Physical Inventory: SMCMC-QAM-T issues a memorandum of inventory actions conducted during March, June, September, and December of each year. Record is submitted to RPO thru SMCMC-QA and is on file at Bldg #111. Records (memoranda) shall include source identification and related data contained in Section X of Appendix B.

e. Utilization Logbook: The Utilization Logbook is one or more logs maintained at the source location (Bldg #111) as a permanent record of operation and precautionary inspection actions. Each time the source material is utilized, an entry shall be made by the radiographer in the log reflecting radiographer name. physical radiation survey results (prior to usage), time, date, and exposure site. Prior to securing the sealed source, an entry shall be made to record physical radiation survey results, time, date, and name of the radiographer.

Appendix A

f. Radiation Surveys: Radiation surveys are to be conducted whenever a source is to be exposed, transported, exchanged, or any other occasion when required for personnel safety or source security. Radiation survey occasions are further addressed in Section V of Appendix B. Each instance of survey action is to be recorded.

g. Pocket Dosimeter Readings: The daily pocket dosimeter readings annotated on McAAP Isotope Exposure Log and entered into the Utilization Log at Bldg #111 is the official record for each individual. These daily records, as required by Section X of Appendix B, shall be retained for a period of three years. Reduced copy of daily record will be forwarded through Chief, QAM-T, to Medical Officer.

h. Daily Inspection of Exposure Device, Cell, and Area Safeguards: The Daily Inspection Checklist of Exposure Device, Cell, and Area Safeguards (Figure 10) as completed in accordance with Section XI of Appendix B form the official record. Radiographer supervisors are to review daily inspection actions prior to source exposure. Records shall be entered into the Utilization Log and maintained for three years.

i. Quarterly Inspection and Maintenance of Exposure Devices and Storage (as applicable): Quarterly inspections and maintenance actions are to be conducted in accordance with Section XI of Appendix B. Checklist of required inspections and any maintenance will be completed as prescribed by McAAP contract with the licensed contractor/vendor. The record shall be filed in the Utilization Log and copies provided to SMCMC-SF and SMCMC-QA. Records will be retained on file for three years.

j. Bi-Annual Inspection of Area Safeguards: In addition to daily usage inspection of area safeguards by the radiographer and radiographer supervisor as established in paragraph 2, Section XI, of Appendix B, SMCMC-SF and SMCMC-QA shall conduct an inspection of all area safeguards within each successive six-month period. The inspection team shall include the radiographer and radiographer supervisor from SMCMC-QAM-T. Checklist, Figure 11, of Appendix B, shall be utilized and, when completed, it shall form an official record. Retention is to be three years.

k. Verification of Conformance: SMCMC-QAM shall establish a suspense file to assure inspections and maintenance requirements on sealed source are timely completed. SMCMC-QAM-T shall establish a suspense file to assure timely calibration requirements are completed.

l. Training and Certification of Personnel: SMCMC-PT shall retain initial and refresher training and qualification records in each person's record jacket. Copies of such records shall be available with the radiographer supervisor at Bldg #136.

Appendix A

SECTION VIII

FACILITY AND EQUIPMENT

1. Equipment and Facility Description

a. Equipment: A Model 6145A Cyclops Cobalt-60 Radiography Unit of a 2000-curie source strength. The unit was manufactured by Picker X-Ray Corporation and consists of a 19-inch brass jacketed lead sphere enclosing a 2000-curie source, Model No. NPI-20-2000W, serial number T-520, installed on 19 October 1981.

b. Description of Radiographic Facility: The Major Caliber Radiographic Facility is located in a brick and concrete reinforced building previously used for explosive loading of major caliber (up to 16 inch) projectiles. Wall thickness is approximately 12 inches. Roof frame support is metal with metal asbestos type covering. Windows are located on side and end walls. The Picker Cyclops exposure device, Model 6145A, is located near the center of the east end of the building within an explosive press cell (Cell No. 3) which has concrete and metal reinforced walls four feet thick and 14 feet high. Doors are of five-inch-thick steel with additional one-half inch lead shielding at edges. Source container is located in attached Figures 3 through 5. Not shown in Figures 3 through 5 are additional concrete and earth embankments on the north, south, and east sides to a height of 14 feet. Cell roof is overfill of 18 inches of sand.

(1) The facility building is located more than one-fourth mile from other production areas. Entrance to the facility building is gained only by one set of rail tracks and a single vehicular road approaching from the west. Track and roadway approaches are posted with the proper NRC cautionary radiation symbol and warning: "CAUTION-RADIATION AREA - RADIOACTIVE MATERIALS - AUTHORIZED PERSONNEL ONLY." The building external walls bear readily visible radiation symbols and cautionary signs: "CAUTION - RADIATION AREA - KEEP CLEAR," as well as additional signs denoting restricted access, subject to area supervision approval prior to entrance in any portion of the area.

(2) Access to the radiation area and high radiation area (exposure cell) is further restricted to approval only by the radiographer who has full view of the cell and cell doors. Doors contain radiation symbols and caution words: "CAUTION - HIGH RADIATION - PERSONNEL MONITORING REQUIRED." These doors operate by interlock system with the control panel and shutter; thus, cannot be externally opened while an exposure action is being conducted. They do, however, contain panic bars for internal opening.

(3) In addition, there are visible (action lights) and audible (buzzer) alarms which denote periods of exposure actions. Area monitor gammalarm equipment preset to initiate at 2 mR/hr are located as shown in Figures 3 and 4.

Appendix A

(4) Design of cell and supporting shielding reduces external (outside of cell doors and concrete side walls) radiation to less than 2 mR/hr.

2. Security: Access to the exposure device was purposely designed to prevent unauthorized personnel entrance. To obtain access, all of the following sequence of actions must be peformed:

a. Building #111: Key Control Branch of the Security Directorate requires personnel to log out key.

b. Cell/Vault #3: Access to the cell containing the Cobalt-60 Source exposure device cannot be obtained with Bldg. #111 key alone since the cell also contains a lock. Keys to cell lock are issuable only to radiographers and radiographer supervisors. This key is controlled by SMCMC-QA at Bldg #1.

c. Exposure Device: Key to the cyclops and control panel is in file custody at Bldg. #136 and issuable only by the radiographer or radiographer supervisor.

d. Added Requirement: Since the 5" thick steel doors to the exposure cell are pneumatically powered, doors will not open until electrical power is established for air compressor operation.

e. Securing Exposure Operations: During periods of non-operations, the radiographer shall assure electrical power is secured and that all security locks are properly closed before accomplishing key return in reverse order of steps 2a - 2d. Civilian or military security guards shall provide security monitoring on the area, including assurance that main roadway security fence gates are locked at night.

3. Facility Radiation Levels: Due to design of radiograph cell/vault and extent of lead shielding as described above, radiation levels outside the cell walls are less than 2 mR/hr with exposure action in progress. Design features and shielding aspects with regard to the 2 mR/hr have been verified by Quality Assurance personnel and the plant RPO.

PLAN LAYOUT W.
CONCRETE BLOCKS
CELL # 3

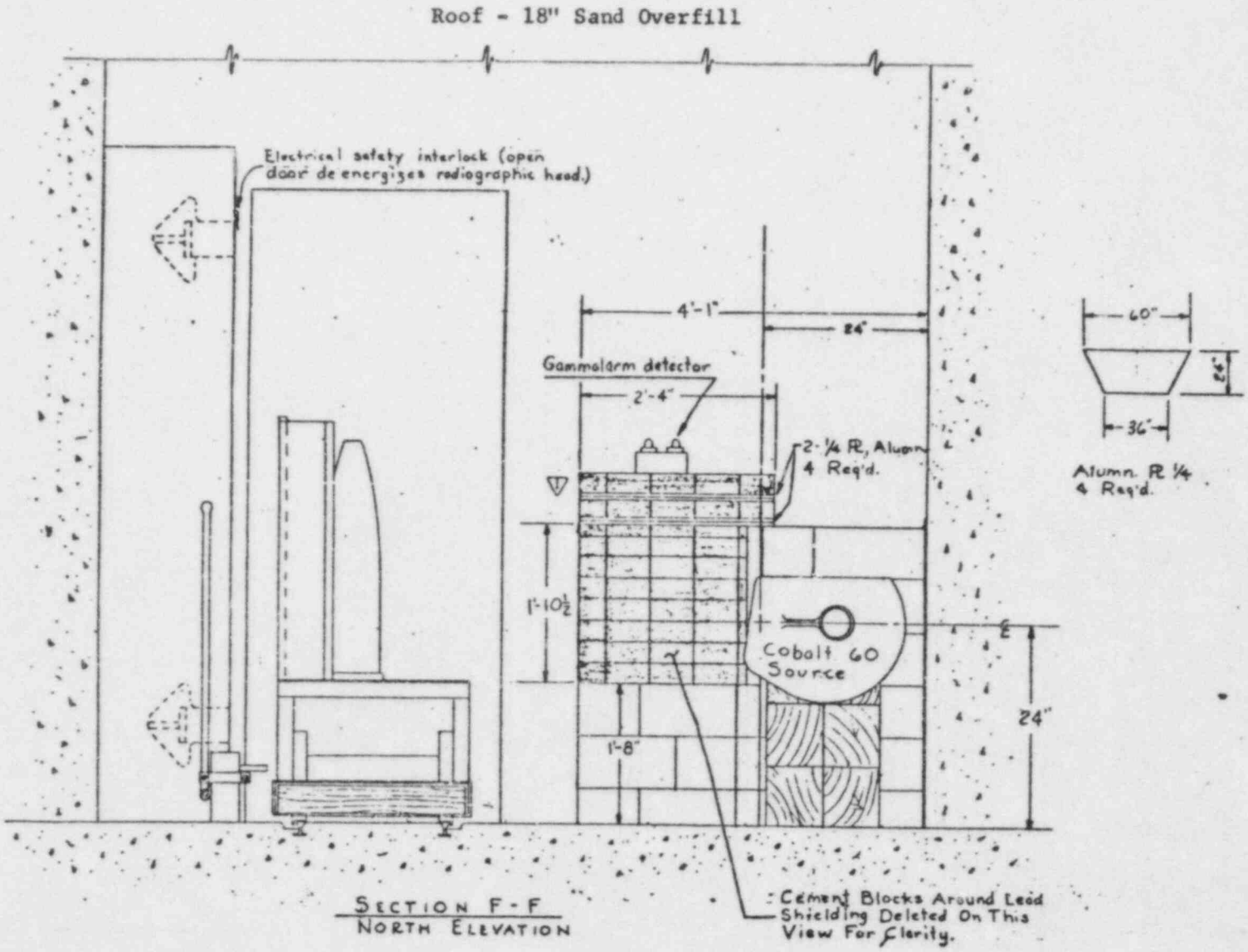
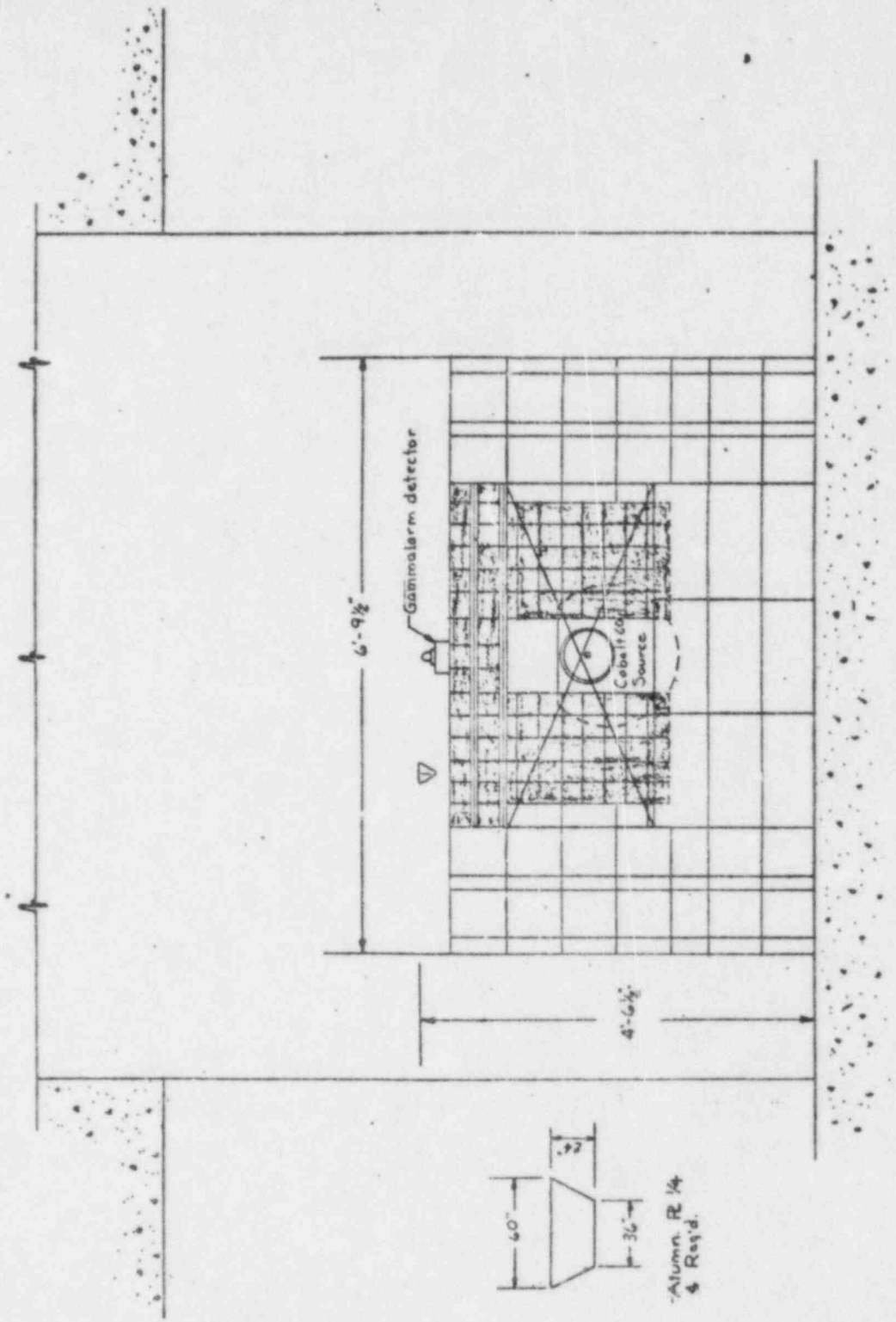


FIGURE 3



SECTION - G-G
EAST ELEVATION

FIGURE 4

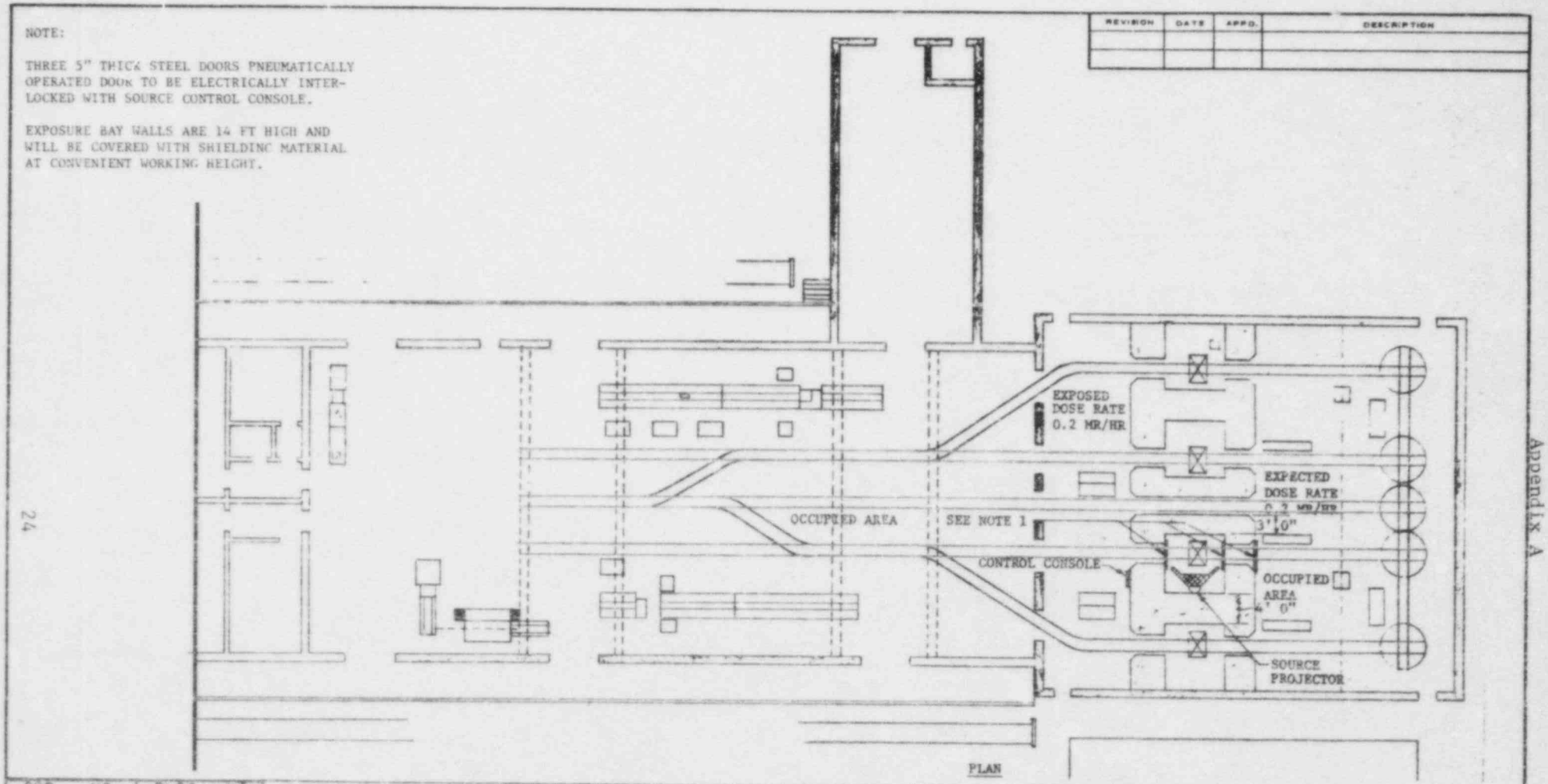

NOTE:
THREE 5" THICK STEEL DOORS PNEUMATICALLY OPERATED DOOR TO BE ELECTRICALLY INTERLOCKED WITH SOURCE CONTROL CONSOLE.
EXPOSURE BAY WALLS ARE 14 FT HIGH AND WILL BE COVERED WITH SHIELDING MATERIAL AT CONVENIENT WORKING HEIGHT.
REVISION
DATE
APP'D.
DESCRIPTION
EXPOSED DOSE RATE 0.2 MR/HR
EXPECTED DOSE RATE
OCCUPIED AREA
SEE NOTE 1
3' 0"
CONTROL CONSOLE
OCCUPIED AREA
4' 0"
SOURCE PROJECTOR
PLAN
SOP NO
BLDG NO
REMOVE BURRS AND SHARP EDGES .... R (OR CHAMFER) MAX.
DIE STAMP DRAWING NUMBER ON FINISHED PRODUCT
HEAT TREATMENT
DO NOT SCALE THIS DRAWING
MATERIAL:
MCA APPROVAL
DATE
DESIGNED
SUPV.
CHECKED
DRAWN
APPROVED
DIRECTOR, P&S
DATE
SAFETY
PROD.
ENGRG.
SCALE
UNIT WEIGHT
BLDG. NO.
DEPARTMENT OF THE ARMY
U. S. ARMY AMMUNITION PLANT
MCALESTER, OKLAHOMA
DRAWING NO.
SHEET ____ OF ____
SARMC Form 157-1 1 Dec 77

FIGURE 5

RADIATION SAFETY COURSE

Annex 1

	PHASE I			PHASE II		
	MONDAY	TUESDAY		WEDNESDAY	THURSDAY	FRIDAY
0830	INTRODUCTION & BRIEF HISTORY OF RADIATION & RADIOGRAPHY 1. Pitchblend Mining 2. X-Ray Discovery 1865 3. Dial Painters (50 min)	PROBLEM SOLVING SESSION		REGULATIONS a. 10 CFR 1. Part 19 2. Part 20 3. Part 30 4. Part 34	MANAGEMENT PROCEDURES	PRACTICAL RADIOGRAPHY EXERCISE (BLDG 111) OR 60 CYCLOPS DEVICE 1. Issue of Dosimetric Devices 2. Lecture: a. Facilities b. Theory of Radiography c. Math on Isotope 3. Tour of Facility 4. Actual Exposure
0930	CHARACTERISTICS OF IONIZING RADIATION a. Basic Nuclear Structure 1. Atomic Structure 2. Shell Theory 3. N&P 4. Energys b. Decay Modes	(2 Hours)				
1030	1. α 2. β 3. χ	INSTRUMENTATION THEORY AND DEVELOPEMENT a. Gold Leaf b. GM Tube c. Ion Chamber (1 hour)				
1230	c. Units of Measure 1. Rem, Rad, Rep 2. Curie (3 Hours)	SURVEY INSTRUMENTS a. Calibration Req b. Operation of Inst — Victoreen CDR-15, CDR-27, IM231 c. Calib. d. Limitations (1 hour)		(4 Hours)	EMERGENCY OPERATING PROCEDURES (4 Hours)	Developing of Exposed Film (4 Hours)
	LUNCH	LUNCH		LUNCH	LUNCH	LUNCH
1300	HAZARDS OF EXCESSIVE EXPOSURE TO RADIATION	SURVEY TECHNIQUES (30 min) PERSONAL DOSIMETRY DEVICES 1. Film Badges 2. Pocket Dosimeters 3. Pocket Chambers		b. 29CFR Part 10 (OSHA) c. DARCOM-R 395-25 d. AR 385-11 e. DARCOM-R 385-9 f. AR 40-14	RADIOGRAPHIC EQUIPMENT a. Remote Handling Equipment b. Radiographic Exposure c. Storage Container	REVIEW SESSION (1½ Hours)
1400	(2 Hours)					
1500	LEVELS OF RAD FROM LICENSED MAT'L 1. Restricted Area 2. Radiation Area 3. High Radiation Area 4. Air Borne Radiation	(2½ Hours)			RADIATION EXPOSURE DUE TO ACCIDENT (3 Hours) (3 Hours)	FINAL EXAM
1600	METHODS OF CONTROLLING RAD DOSE 1. Working Time 2. Working Distances (Inverse Square Law) 3. Shielding	Daily Exam (30 min) Critique & Review (30 min)		Daily Exam (30 Min) Critique & Review (30 min)	Daily Exam (30 min) Review & Discussion (30 min)	CRITIQUE

Appendix A

ANNEX 2

ANNUAL REFRESHER COURSE FOR RADIOGRAPHER
AND ASSISTANT RADIOGRAPHER

1. CONTENT OF COURSE

a. Incidents/Events Reported (Instructor - SMCMC-SF) 1 Hour

(1) External

(2) Internal

b. Procedure Review (Instructor - SMCMC-SF and SMCMC-QAM-T) 3 Hours

(1) McAlester Operating and Emergency Procedures

(2) Radiation Doses, Measurement, and Personnel Protection

c. Equipment (Instructor - SMCMC-QAM-T) 1 Hour

(1) Exposure Devices

(2) Storage Containers

d. Improvements and State of the Art Growth (Instructor - SMCMC-SF) 1 Hour

(1) Radiation Detection Equipment

(2) Exposure Devices

(3) Personnel Safety and Management Procedures

e. Testing (SMCMC-SF and SMCMC-QA) 1 Hour

2. TESTING/EXAMINATION: Special tests shall be prepared and administered upon the subject matter provided in each annual refresher training cycle. Approximately 50 percent of questions should be directed toward review of operating and emergency procedures.

Appendix A

ANNEX 3

RADIATION SAFETY COURSE

SAMPLE TEST _____ FOR PHASE I TRAINING

NAME_____ GRADE_____

BADGE NO._____ PASSED_____ FAILED_____

DATE_____ GRADED BY_____

(Representative Sample Test in Support of Annex 1, Appendix B)

_____ 1. Pocket dosimeters depend upon a _____ for their indication.

a. G-M tube
b. battery to provide electrical power
c. Quartz film electroscope
d. theory that like charges attract and dislike charges repel.

_____ 2. The formula for the inverse square law is:

a. $\frac{I_2}{\overline{I_1}} = \frac{D_1^2}{\overline{D_2^2}}$

b. $\frac{I_1^2}{\overline{I_2^2}} = \frac{D_1^2}{\overline{D_1^2}}$

c. $\frac{I_1}{\overline{I_2}} = \frac{D_2}{\overline{D_1}}$

d. $\frac{I_1}{\overline{I_2}} = \frac{D_2^2}{\overline{D_1^2}}$

_____ 3. Biological half life is:

a. The time it takes 1/2 of the atom of a radioisotope to disintegrate.

b. The time it takes 1/2 of a radioactive material to be passed from the body as waste material.

c. The time it takes to rid the body of 1/2 of a radioactive material by a combination of biological elimination and radioactive decay.

_____ 4. Radiation intensity at a certain point is 20 r/hr. How many HVL are required to reduce the intensity to 5 r/hr?

Appendix A

_____ 5. Radioactive half-life is:

a. The time it takes one-half of the atom of a radioisotope to disintegrate.
b. The time it takes one-half of a radioactive material to be passed from the body as waste material.
c. The time needed to rid the body of one-half of a radioactive material by a combination of biological elimination and radioactive decay.

_____ 6. Gamma and x-radiation damage human body tissue by a process known as _____.

_____ 7. The HVL of lead for CO-60 is 0.49 inch. At a certain distance from the CO-60 source, radiation is 600 mr/hr. What thickness of lead is required to reduce the intensity to 75 mr/hr?

_____ 8. The whole body radiation dose must normally be limited to a dose of:

a. 1-1/4 rems/qtr
b. 18-3/4 rems/qtr
c. 7-1/2 rems/qtr
d. 5 rems/qtr

_____ 9. Portable instruments used to monitor radiation areas are called:

a. film badges
b. survey meters
c. personnel monitoring devices
d. environmental badges

_____ 10. The unit that compares the biologists' effectiveness of the different types of radiation is the:

a. rem
b. RAD
c. RBE
d. roentgen

_____ 11. A given radiation dose will cause less damage if it is received over a very short period of time than if it is received over a long period of time.

a. True
b. False

_____ 12. The term RAD stands for:

_____ 13. In most radiographic operations, the ionization chamber survey meter is more desirable than the G-M counter.

a. True
b. False

_____ 14. The intensity at 1 foot from a 10 curie source of IR-192 is 59 r/hr. The standard dose rate for 1 curie at 1 foot for IR-192 is _____.

Appendix A

_____ 15. The time rate at which a radiation dose is received is called:

_____ _____

_____ 16. The most penetrating radiation from radioisotopes is:

a. Beta particles
b. Alpha particles
c. Gamma rays
d. X-rays

_____ 17. At 10 feet from an isotope, radiation intensity is 150 mr/hr. The intensity at 1 foot would be _____. (Show your work.)

_____ 18. Radiation intensity at 6 feet from an isotope is 40 r/hr. At what distance would the intensity be reduced to 10 r/hr. (Show your work.)

_____ 19. Two types of personnel monitoring devices are:

a. _____

b. _____

_____ 20. The physical effects of radiation on the body of the individual receiving the radiation are called:

a. Somatic effects
b. Latent effects
c. Genetic effects
d. Radiosensitive effects

_____ 21. The permissible accumulated dose for a person who is 37 years old is _____.

_____ 22. The primary hazard in radiography comes from:

a. internal radiation
b. gamma rays and alpha particles
c. beta particles
d. external radiation

_____ 23. Materials exposed to gamma rays and x-rays become radioactive and dangerous to handle.

a. True
b. False

Appendix A

_____ 24. An x-ray machine presents an internal hazard.

a. True
b. False

Appendix A

FINAL EXAMINATION
SAMPLE TEST

NAME_____ GRADE_____

BADGE NO._____ PASSED_____ FAILED_____

DATE_____ GRADED BY_____

_____ 1. The standard dose rate of a radioisotope is expressed in:

a. Roentgens per hour per curie at any standardized distance not exceeding 75 feet.
b. Roentgens per hour per curie per foot.
c. Roentgens per hour per curie at a distance of one foot.
d. None of the above.

_____ 2. When a body tissue cell is damaged by radiation:

a. The cell may lose its ability to reproduce.
b. The cell may die.
c. Damage is caused by knocking an electron out of the orbit of its parent atom.
d. All of the above.

_____ 3. The pocket dosimeter has the advantage of:
a. Being more accurate than the film badge.
b. Providing an immediate indication of radiation exposure.
c. Providing a permanent record of radiation exposure.
d. All of the above.

_____ 4. There are five variables which influence the effect that radiation doses have on individuals. List three of these variables.

a. _____

b. _____

c. _____

_____ 5. The most serious radiation exposure is to the:

a. Whole body
b. Feet and ankles
c. Skin
d. Hands and forearms

Appendix A

_____ 6. Radiation intensity at 6 feet from an isotope is 40 r/hr. What distance would the intensity be reduced to 10 r/hr?

_____ 7. When reading low levels of radiation, the _____ (G-M counter or ion chamber meter) is more effective.

_____ 8. A person who becomes contaminated with radioactive material can spread contamination to other persons.

a. True
b. False

_____ 9. Effective half-life is:

a. The time it takes one-half of the atoms of a radioisotope to disintegrate.
b. The time it takes one-half of a radioactive material to be passed from the body as waste material.
c. The time needed to rid the body of one-half of a radioactive material by a combination of biological elimination and radioactive decay.

_____ 10. Pocket dosimeters depend upon a _____ (fill in from below) for their indication.

a. G-M tube.
b. Battery to provide electrical power.
c. Quartz fiber electroscope.
d. Theory that like charges attract and unlike charges repel.

_____ 11. Two types of survey meters are _____ and _____.

_____ 12. The normal operating range of a pocket dosimeter is:

a. 0 to 200 mr.
b. 50 to 500 mr.
c. 0 to 75 r/hr.
d. 25 to 250 r.

_____ 13. At 10 feet from an isotope, radiation intensity is 150 mr/hr. The intensity at 1 foot would be _____.

Appendix A

_____ 14. The term "RBE" stands for _____.

_____ 15. Devices attached to the clothing of people working in radiation areas for measurement of radiation are called:

a. Survey instruments.
b. G-M counters.
c. Personnel monitoring devices.
d. Portable rate meters.

_____ 16. The standard dose rate at 1 foot for CO-60 is 14.5 r/hr/curie. What is the intensity at 1 foot for a 7 curie source of CO-60?

a. 14.5 r/hr
b. 75 r/hr
c. 145 r/hr
d. 101.5 r/hr

_____ 17. For each year a person is past age 18, how many rems are deposited in his radiation bank account for whole-body exposure?

a. 18-3/4 rems
b. 12 rems
c. 1-1/4 rems
d. 5 rems

_____ 18. The formula for finding permissible accumulated dose is:

a. 12 (N-18)
b. 18 (5+N)
c. 5 (N-18)
d. 12 (N+18)

_____ 19. The inverse square law as applied to radiation protection states that:

a. Radiation intensity varies inversely as the square of the time spent near the source.
b. Radiation intensity varies proportionally with distance from the source.
c. Radiation intensity varies inversely as the square of the distance from the source.

_____ 20. The basic unit of measure used to express gamma or X-radiation exposure is the:

a. rem
b. rad
c. roentgen
d. RBE

Appendix A

_____ 21. The radiation effects which can be passed on to the offspring or to a later generation of a person receiving radiation are called:

a. Future effects
b. Genetic effects
c. Somatic effects
d. Radiosensitive effects

_____ 22. The unit that expresses the biological dose produced in humans by any type of radiation is the:

a. rem
b. rad
c. roentgen
d. RBE

_____ 23. Radiation intensity at a certain point is 20 r/hr. How many HVL are required to reduce the intensity to 5 r/hr?

_____ 24. In relation to radiation effects, MLD stands for?

_____ 25. List concrete, lead, and steel in order of their effectiveness in providing shielding against radiation.

a._____

b._____

c._____

_____ 26. We have a 1 Ci source of F^{17} ($T_{\frac{1}{2}}$=66.6 sec.) whose original activity was 128 Ci. How much time has passed?

_____ 27. Ten years ago 60 Ci of CO-60 was purchased. With a half-life of 5.28 years, what is its activity in Ci now?

_____ 28. If sand has a density of 100 lbs/ft^3 and concrete a density of 150 lbs/ft^3, it takes 3/4 as much sand as concrete to give the same shielding effect.

a. True
b. False

Appendix A

_____ 29. It is necessary for an occupationally exposed individual (radiation workers) to perform most of his duties 5 meters away from a 25 Ci. source of Sodium-22 (radiation level for 1 Ci. at 1 meter is 1.2 r/hr). What is the dose rate of the radiation field he must work in if no shielding is provided?

_____ 30. Using the answer to problem 29, how many half thicknesses of shielding must be provided to reduce the dose rate to less than 2 mR/hr?

Appendix A

ANSWER SHEET

Corresponding answers to Radiation Safety Course Phase I and Final Examination.

Phase I (Sample Test)

1. Quartz film (fiber) electroscope
2. d
3. b
4. 2
5. a
6. Ionization
7. 1.47
8. a
9. b
10. c
11. b
12. Radiation Absorbed Dose
13. a
14. 5.9
15. Exposure/Dose Rate
16. c
17. I_z = 15 r/hr
18. D_z = 12 ft
19. Film Badges and Pocket Dosimeters
20. a
21. 95
22. d
23. b
24. b

Final Examination (Sample Test)

1. c
2. d
3. b
4. Area of Body Exposure
   Real time of exposure
   Chronological age
   Body part
   Biological aspect of individual
5. a
6. 12 ft
7. GM counter
8. a
9. c
10. c
11. Ionization Chamber/G-M Counter
12. a
13. 15 R/hr
14. Relative Biological Effectiveness
15. c
16. d
17. d
18. 5(N-18)
19. c
20. c
21. b
22. a
23. 2
24. Median Lethal Dose
25. Lead, steel, concrete
26. 466.2 Sec (7 half-life)
27. 16.585 curies
28. b
29. 1.2 R/hr
30. 10 HVL

Appendix A

ANNEX 4

McALESTER ARMY AMMUNITION PLANT
REPORT OF ANNUAL INTERNAL AUDIT
OF RADIOGRAPHIC FACILITIES

1. Purpose.

2. Scope. Area of process audited.

3. Audit Team Members. (List name, position, and activity symbol)

4. Persons Contacted (including activity symbol).

5. Summary.

6. Audit Findings and Recommendations.

Findings ( ): State the finding clearly and concisely.

Discussion ( ): Background and explanatory comments.

Recommendation ( ): Recommendations for corrective action to be taken should be specific, avoid ambiguity. The corrective action that an activity must take should be clearly assigned to that one activity.

ACTION:

SIGNATURES OF AUDIT TEAM

_____ Date _____

_____ Date _____

_____ Date _____

Appendix A

SCHEDULED AUDIT QUESTIONNAIRE

Use in conjunction with Annex 4 of this Appendix.

Activity and Process to be Audited: Receipt, possession, and use of radioactive isotopes.

Purpose of Audit: To determine compliance with the requirements of Code of Federal Regulations, Title 10, Parts 19, 20, 30, and 34.

STATUS		QUESTIONS
Yes	No	
___	___	1. Does the radiographer have his operating and emergency procedures readily available?
___	___	2. Does the radiographer perform the operational check of the radiac instrument properly?
___	___	3. Does the radiographer properly complete the daily inspection of exposure devices and storage containers?
___	___	4. Does the radiographer properly complete the utilization logbook?
___	___	5. Does the head radiographer know if the last leak and wipe tests were satisfactorily completed?
___	___	6. Does the radiographer properly perform the required radiation surveys?
___	___	7. Does the radiographer properly post the radiation and high radiation areas?
___	___	8. Does the radiographer know how to establish the high radiation areas without unnecessarily exposing himself?
___	___	9. Does the radiographer know what action to take in case of accidents or emergencies?
___	___	10. Does the radiographer know how to complete the required information for pocket dosimeters?
___	___	11. Are the area safeguards in proper operational condition?
___	___	12. Is there any equipment out of calibration?
___	___	13. Are the records for survey instrumentations maintained and up to date?
___	___	14. Are the records for pocket dosimeters maintained and up to date?

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STATUS		QUESTIONS
Yes	No	
___	___	15. Are the records for receipt, transfer, and disposal of licensed Byproduct Material maintained and up to date?
___	___	16. Are the records for the leak and wipe tests maintained and up to date?
___	___	17. Are the records for the quarterly physical inventory maintained and up to date?
___	___	18. Are the records for the utilization logbook maintained and up to date?
___	___	19. Are the records for the radiation surveys maintained and up to date?
___	___	20. Are the records for the pocket dosimeter readings maintained and up to date?
___	___	21. Are the records for the daily inspection of exposure devices and storage containers maintained and up to date?
___	___	22. Are the records for the quarterly inspection and maintenance of exposure devices and storage containers maintained and up to date?
___	___	23. Are the records for the bi-annual inspection of area safeguards maintained and up to date?
___	___	24. Are the records for the personnel training and qualification maintained and up to date?
___	___	25. Are the posting requirements of 10 CFR 19 met in full?

Appendix A

ANNEX 5

PERSONNEL QUALIFICATIONS

Personnel qualifications affecting active control over the radiography program at this installation are listed by office symbols and name as follows:

1. SMCMC-SF, L. V. MAXWELL (Radiation Protection Officer)

a. Formal Education:

(1) BS, Oklahoma State University

(2) Life Science Courses, US Navy

b. Experience:

(1) Seventeen years experience in ionization and non-ionization radiation equipment associated with depot production safety.

(2) Chief, Safety Office, McAlester Ammunition Facility, for 20 years, 1965 to present.

2. SMCMC-SF, John D. Watson (Alternate Radiation Protection Officer)

a. Education:

(1) Academic Graduate, McAlester High School

b. Experience:

(1) Ordnanceman, 66-69

(2) Foreman, Ordnanceman, 69-71

(3) Industrial Engineering Technician, 71-75

(4) Safety Specialist, 75 to present

c. Technical Training:

(1) Industrial Safety

(2) Munitions Safety

(3) Safety Program Management

(4) Hazardous Material Transport and Handling

(5) Occupational Safety and Health

(6) Accident Prevention

Appendix A

3. SMCMC-QA, E. D. FOWLER, QA Director (RCO)

a. Formal Education:

(1) BS (Math and Physics), East Central State College (OK), 1958.

(2) Masters Degree Candidate, Highlands University, Las Vegas, NM, 1960.

b. Experience:

(1) Secondary level teacher in Math, Physics, and Science, 58-62.

(2) Special Weapons Technician and Training Coordinator, Naval Ammunition Depot (NAD), McAlester, OK, 62-65.

(3) Quality Assurance Department Manager, NAD, McAlester, OK, 65-77.

(4) Director, Quality Assurance, McAlester Ammunition Facility, 77 to present.

c. Other Training:

(1) Special Weapons Cadre, Various Systems, DASA, Albuquerque, NM.

(2) Tritium monitoring, NAD, McAlester, OK.

4. SMCMC-QAM-T, JIMMY L. HOLMAN

a. Formal Education:

(1) A/A (Management), Eastern Oklahoma State College

(2) 30 hours (Business Management), SE Oklahoma State University

b. Experience:

(1) Advanced Weaponsman, 63-67

(2) Inspector, Gages C, 67-72

(3) Quality Assurance Specialist, 72-83

(4) Supvr Quality Assurance Specialist, Test and Acceptance Branch, Mar 84 to present.

b. Technical Training:

(1) 310 hours, DASA (Navy GMT Nuclear Weapons Course)

Appendix A

(2) 160 hours, DASA (Navy Nuclear Weapons Advanced Course)

(3) 40 hours, Oklahoma Civil Defense (Radiological Monitoring)

(4) 2 years, OSU Technical School (Radio and TV)

5. SMCMC-QAM-M, RANDELL L. COOK

a. Formal Education:

(1) BS (Business Administration), Central State University (1972).

(2) US Army Defense Ammunition Center and School (Jan 78 - Apr 79), Savanna, IL.

b. Experience (McAAP):

(1) QASAS (May 79 - Jun 80)

(2) Quality Assurance Specialist (Ammo), Quality Verification Div (Jul 80 to Apr 84).

(3) Supervisory Quality Assurance Specialist (Ammo), Management Services Branch, Apr 84 to present.

c. Technical Training:

(1) Radiographic Testing Course, Level I, 40 hrs, completed 8 May 81.

(2) Radiographic Film Interpretation, 40 hrs, completed 15 May 81.

NOTE: Both courses were completed at the Army Materials and Mechanics Research Center, Watertown, MA.

6. SMCMC-QAM-T, RONNIE L. SMITH

a. Formal Education:

(1) A/S (Applied Science), Eastern Oklahoma State College

(2) BS (Management), SE Oklahoma State University

b. Experience (McAAP):

(1) Machine Tool Operator, 4 months

(2) Ordnance Worker, 4 years, 9 months

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(3) Munitions Inspector, 5 years, 5 months

(4) Inspector/Radiographer, Metals, 4-17-83 to present

c. Technical Training:

(1) 80 hours, McAAP (Ultrasonics Level I-S)

(2) 40 hours, Watertown, MA (Radiographic Inspection, Level I)

(3) 40 hours, Watertown, MA (Radiographic Film Interpretation)

(4) 40 hours, Watertown, MA (Radiographic Inspection, Level II)

(5) 80 hours, McAAP (OJT, Industrial Radiography Helper)

(6) 80 hours, DARCOM (Munitions Safety)

7. SMCMC-QAM-T, D. MEADOWS

a. Formal Education:

(1) 1 year (Math), East Central Oklahoma State University

(2) AA Degree, Eastern Oklahoma State College

b. Experience:

(1) Industrial Radiography, 71-76

(2) Industrial Radiographer, 76-77

(3) Inspector/Radiographer, Metals "A," 77 to present

c. Technical Training:

(1) 40 hours, NWC, Concord (OJT, Gamma Radiography), 1974

(2) 80 hours, NAD, MCA (OJT, Radiography), 1974

(3) 40 hours, NWS, Concord (Gamma Radiography with Isotope), 1977

8. SMCMC-QAM, D. L. PRESCOTT (Alt RCO)

a. Formal Education:

(1) Academic Graduate, St. John's High School, McAlester, OK

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b. Experience:

(1) Security Assistant, 61-67

(2) Quality Assurance Specialist, 67-74

(3) Supervisory Quality Assurance Specialist, 74-81

(4) Chief, Mgt and Acceptance Division, 81 to present.

c. Technical Training:

(1) Munition Safety

(2) Ammunition Capstone Course

(3) Radiography for QA Specialists

(4) Value Engineering

(5) Hazard Control

(6) Various QA Related Training

With regard to the above-listed personnel qualifications, key individuals are authorized to provide instruction to radiographers, assistant radiographers, and trainees in the Radiation Safety Training Program outlined in Annex 3 and 4 of this appendix. Individuals and related instructor fields are contained in the attached listing.

Appendix A

INSTRUCTOR PERSONNEL, RADIATION SAFETY

The following personnel are responsible for the training and certification of personnel requiring entry to areas of restricted access:

COURSE	LENGTH	PERSONNEL
RADIATION SAFETY COURSE (Phase I & II)	1 Week	L. V. Maxwell John D. Watson E. D. Fowler D. L. Prescott Randell Cook
ON-JOB-TRAINING (OJT)	1 Week	Don Meadows Ronnie L. Smith
ANNUAL REFRESHER TRAINING	1 Day	John D. Watson E. D. Fowler Randell Cook D. L. Prescott
QUALIFICATION AND CERTIFICATION ACTIONS		L. V. Maxwell E. D. Fowler

Appendix B

OPERATING AND EMERGENCY PROCEDURES FOR THE USE OF
RADIOACTIVE ISOTOPES ASSOCIATED WITH INDUSTRIAL RADIOGRAPHY

1. Purpose: To provide plant operating and emergency procedures for radioactive isotope testing associated with industrial radiography.

2. Scope: This appendix applies to all personnel assigned to nondestructive testing operations utilizing radioactive isotopes in related industrial radiography. Compliance in all aspects is mandatory to assure that McAAP personnel and the general public (as applicable) are fully protected from unnecessary radiation exposure.

3. Responsibility: This appendix shall be issued to and used by radiographic personnel whenever isotopes are involved. In no case shall decisions be made individually to depart from these established procedures except through advance approval and formal change. A copy of this appendix shall always be in possession of the radiographer or on-site during any operations involving radioactive isotopes.

4. Procedure: Subsequent portions of this appendix provide specific operating and emergency procedures for attendant radiographer and radiographer assistant personnel. Any operational phase under consideration and planned should be accomplished in accordance with applicable portions of this appendix.

Appendix B

SECTION I

INTRODUCTION

1. Reference: The contents of this document are based upon the specific requirements of Code of Federal Regulations, Title 10, Parts 19, 20, 30, and 34.

2. Scope: Application of contents of this document is designated for radiographic personnel.

3. Responsibility: Radiographic personnel shall comply with all aspects of this document in all situations. Should situations reflect need for change or revision of contents, a formal request should be forwarded to SMCMC-SF through SMCMC-QA.

Appendix B

SECTION II

PROCEDURE FOR NOTIFYING RESPONSIBLE PERSONNEL IN THE EVENT THAT AN ACCIDENT OR EMERGENCY CONDITION IS ENCOUNTERED

1. Notification Action Requirements: In the event of an accident or emergency situation involving radioactive source material, the on-site Production or Facilities Engineering supervisor shall be promptly notified. At least one of the following personnel in each of the following categories must be contacted by phone.

CATEGORY A

NAME	CODE	TITLE	OFFICE	HOME
Eddie D. Fowler	SMCMC-QA	Director, Quality Assurance	2557	379-2933
Jimmy L. Holman	SMCMC-QAM-T	Chief, Test & Acceptance Br	2522	423-5502
D. L. Prescott	SMCMC-QAM	Chief, Mgt & Acceptacne Div	2557	423-0560

CATEGORY B

NAME	CODE	TITLE	OFFICE	HOME
Lee V. Maxwell	SMCMC-SF	Radiological Protection Off	2433	423-7750
John D. Watson	SMCMC-SF	Asst Radiological Protection Off	2433	423-0803

CATEGORY C

Security Supervisor (after normal duty shift) — Call "Operator"

2. Reference Action: Subsequent to notification requirements above, explicit sections/parts of this appendix shall be followed without deviation. The Radiological Protection Officer, SMCMC-SF, determines course of actions to be taken and discloses the essential information to the NRC as specified in paragraphs 20.402, 20.403, and 20.405 of CFR, Title 10. NRC division of compliance is Region IV, USNRC, Office of Inspection and Enforcement, 611 Ryan Plaza Drive, Suite 1000, Arlington, Texas 76102, Phone - Day or Night 817-860-8100 or FTS 728-8100.

Appendix B

SECTION III

MINIMIZING EXPOSURE OF PERSONNEL
IN THE EVENT OF AN ACCIDENT OR EMERGENCY

1. Accident or Emergency at Bldg #111: In the event of an accident or emergency situation at the facility, attendant radiographic personnel shall exercise primary efforts to: (1) Protect any/all personnel in the area from dangerous exposure to radiation, and (2) Protect the source from damage. Achievement is by maintaining radiation area limits based upon a survey with a calibrated radiation detector assuring that the source is in the retrieved (SAFE) position, cell doors are secured, ascertaining radiographic workers or other personnel are evacuated from the facility/ Building #111, and notification is accomplished as listed in Section II of this appendix. Absolutely no attempt shall ever be made to physically manipulate the source shutter from the exposed to the shielded position. Potential emergency and accident situations are discussed below:

a. Fire During Explosive Material Evaluation: NO attempt shall be made to contain a fire of major proportions in the cell area. Cell doors should be remotely closed, the area evacuated, and the fire alert (phone extension 333) given. Assure all personnel are evacuated. Fires of minor proportions (waste paper/rag containers) should be promptly extinguished.

b. Loss of Power: The Cyclops exposure device operates on standard alternating current and thus is subject to failure time; however, it should be noted that the source contained in the Cyclops eye (shutter) opens by means of electromagnets and closes due to spring tension/load. Accordingly, the reliance on returning the source to the shielded position is not dependent upon electrical power. Where electrical power loss occurs, radiographers shall secure cell doors and establish precautionary survey boundaries at the 2 mR/hr level. Assure personnel are removed from the area.

c. Water Entry: Damage to equipment as a result of flooding is extremely remote since the cell and Cyclops unit are well above any conceivable flooding level. If such situation should arise, electrical power should be secured subsequent to cell door closing.

d. Source Remains in the Exposed Position: Due to safety interlocks in the steel doors, console, and shutter, failure of the source to return to a shielded position will result in the following:

(1) Console lights and area monitor gammalarm will reflect source is still exposed.

(2) Shielded doors will not automatically open by remote control. After repeated trials to return the shutter to the shielded position

remotely, radiographers should immediately report the situation as directed in Section II of this appendix. DO NOT ATTEMPT to enter cell or physically manipulate the source to the shielded position. Promptly maintain RADIATION AREA limits, survey the area with a calibrated detection meter, and assure all personnel are removed from the area.

2. Security: Radiographers shall not leave the Cyclops unit unattended or keys to the source in an accessible location. In all cases of absence from the area, the source shall be secured completely.

Appendix B

SECTION IV

PROCEDURE FOR HANDLING AND USE OF LICENSED
SEALED SOURCE AND EXPOSURE DEVICE

1. Equipment Description: One portable Cobalt-60 exposure device Model 6145A Cyclops unit manufactured by Picker X-Ray Corporation. Exposure device consists of a 2000 curie source in the 19-inch-long brass-jacketed lead sphere exposure container. Device contains a built-in spring-loaded shutter which returns the source material to the shielded position within the shielding sphere. The shutter also contains a lock. Accompanying console allows for operation of the exposure device from a remote location (external) to the exposure cell (Cell #3).

2. Source Replacement: Source material is replaceable; however, replacement shall be performed by a licensed firm as arranged for by the RPO (Refer to Section XII, paragraph 2, of this appendix).

3. Handling and Radiographic Exposure Procedures:

a. Authorized Areas and Conditions: Cell #3 is the only authorized area for conducting radiographic exposure actions. Cell walls of 4-feet-thick concrete and 14 feet high accompanied by a roof overfill of 18 inches of sand are adequate to reduce external radiation to less than 2 mR/hr. Actual radiation levels recorded during operation are contained in Figure 6. Described cell (Cell #3) is the approved storage location for the source during non-usage intervals.

b. Access Procedures: Exposure of the radiographic source material at Bldg. #111 requires access to three different keys. Such security measures are deliberate to avoid unauthorized entry and inadvertent exposure of individuals to radiation emissions. Additionally, two of the three keys are issuable only to radiographer and safety personnel. The following security procedures must be followed in order to gain access to the Cyclops exposure device:

(1) Keys:

(a) Building #111: This key is controlled by the Security Office at Key Control Central in accordance with McAAP Reg 190-2. Such procedure is developed upon the security procedures of AR 190-11 and AR 190-51. Accordingly, building keys must be signed for by authorized personnel and returned each day. Additionally, special written authorization is required for duplication of keys.

(b) Cell Key: The key to cell #3 within building #111 is controlled by the Director of Quality Assurance at building #1. Key is maintained in a locked file cabinet and is issuable only to the radiographer or radiographer supervisor. Log of issue and return, by signature, is maintained.

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(c) Equipment Key: Key to the Cyclops control panel and exposure head is in the custody of the radiographer supervisor at Bldg #136. Log of issue and return, by signature, i maintained. During custody, the key is placed in a locked file cabinet.

(2) Additional Access Requirements: Steel doors of Cell #3 cannot be opened without electrical power and related air compressor activation. Accordingly, key to the control console will operate the steel doors only when pneumatic equipment is energized. Doors can, however, be closed manually.

c. Setup: The exposure device is arranged in a fixed position with lead shield bricks and concrete blocks overlay. Any planned alteration of position or in shielding must be reported to SMCMC-SF. It is desirable to conduct all radiographic setup actions outside the exposure cell. Such actions include object marking, film placement, etc., followed by utilizing the existing track car (buggy) equipped with film holders, shielding, etc. Exposures above six feet height, toward doorways, or inclined above a horizontal plane, are not authorized.

NOTE: The radiographer shall assure that radiation warning and limit signs are properly positioned and that all personnel are clear of the cell before commencing exposure. Area guarding/monitoring actions shall be discussed with regard to perimeter/barriers established, break periods, and control methods.

d. Exposure Device Operations: Obtain calibrated radiation detection equipment (AN/PDR-43 and AN/PDR-27 or Victoreen Gamma Survey Meter, Model 592B or Ludlum Geiger Counter, Model 6, from Bldg #7). Conduct radiation survey before unlocking cell and activating Cyclops control panel. Record readings in utilization log, unlock cell doors and control panel. Conduct operations as follows:

NOTE: The Radiographer will be familiar with Picker Manual T55-223 and will be supplied a copy and check out on Emergency and Operating Procedures by supervisors and the RPO prior to unit use.

(1) Approach the Cyclops with a survey meter to ensure that the source is not exposed. Radiation levels should never exceed 40 mR/hr at the surface with the shutter closed.

(2) Check that Cyclops is positioned as required.

(3) Insert the electrical plug into an outlet. Ground the Cyclops if explosives or propellants are present.

(4) Remove locking bolt in front of head. Unlock the Cyclops. The barrel of the lock will snap back.

(5) Remove the key and relock by pushing the barrel back into place. This will permit operation from the control console.

(6) Position the film in trays on dollies located outside the cell. Feed one dolly into the cell where it automatically centers. Check security (no personnel in cell) and close. Permit no one to enter or approach cell doors.

(7) Turn on main switch. Green light will appear. If the green light does not appear, terminate operations and notify the building supervisor.

(8) Set timer(s) (hours, minutes, seconds).

(9) Press and reset button(s) and timer(s).

(10) Actuate shutter drive mechanism by turning momentary contact key switch until click is heard; then release. Both red and green lights will flash until the shutter is completely open. When the shutter is completely open, only the red light will flash.

(11) If the lock on the shutter wheel has not been unlocked and positioned properly, the shutter will open only partially, and both the red and green lights will continue flashing. Proper shutter opening is indicated when the green light goes out and the red light continues flashing. This should occur six to eight seconds after actuation of the momentary contact key switch.

(12) If both lights stay on, press firmly on the "emergency" switch bar until a click is heard.

(13) Wait approximately eight seconds.

(14) If the red light goes out, it is probable that the lock on the shutter wheel has either not been unlocked, or not positioned properly.

(15) Ensure that the shutter wheel is unlocked (repeat 4 and 5, above), and positioned properly and attempt to make the exposure.

(16) If both lights remain on (repeat 12 above), secure the unit and report incident as directed by Section 2 of this appendix.

(17) The following are instructions which the RPO may use in closing the shutter:

(a) Turn main switch off.

(b) If shutter does not close, leave room immediately and call Picker X-Ray Service Engineer.

(c) Maintain surveillance of restricted area until Cyclops has been repaired and stored.

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(18) The Cyclops shutter is designed to close automatically when the power is shut off. The shutter reopens when the key switch is actuated. The timer will continue its original cycle after the key switch is reactuated. The length of the originally set exposure may be changed by using the black knob on the control console.

(19) When the timer terminates an exposure, it automatically resets to duplicate the exposure. However, the red reset button must be depressed, and the key switch actuated to initiate another exposure.

(20) Always approach the Cyclops with a survey meter to remove exposed film, or for any other reason.

(21) Approach the Cyclops with a survey meter subsequent to the last exposure of the day to ensure that the shutter has closed. Radiation levels at the surface should never exceed 40 mR/hr with the shutter closed.

(22) At the conclusion of operations, lock the shutter, secure the cell doors. Building supervisor secures electrical power and locks the building.

(23) Lock control console and return all locking keys to security locations described in paragraph 3b of Section 4 of this appendix.

COBALT-60 EXPOSURE CELL
RADIATION SURVEY RECORD

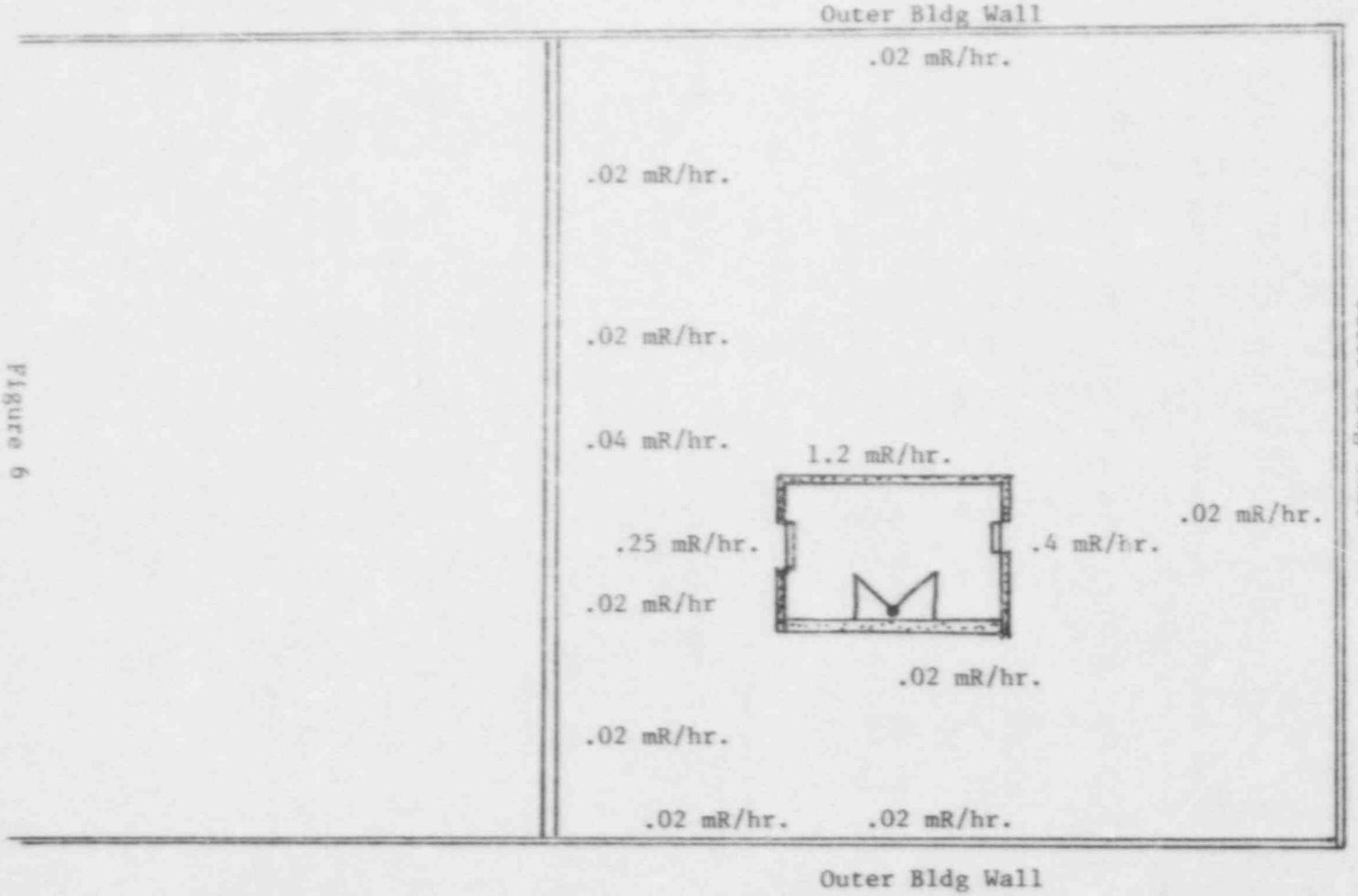

Figure 6

NOTE: Readings (in mR/hr.) represent actual maximum levels measured on two different occasions using calibrated radiacs. Measurements occurred during normal radiographic operations of 105mm (WP) projectiles. Related information as follows: Ludlum Model No 6, Ser 24746 and AN/PDR-27C. Surveys were conducted 15 August 1984 by MCAAP Radiographer D. Meadows. Readings confirm original survey readings by NWS, Concord, Radiographer Supervisor R. Dutcher on 3 Feb 75.

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SECTION V

METHODS AND OCCASIONS FOR CONDUCTING RADIATION SURVEYS

1. Radiation Detection and Measuring Equipment: There are four types of measuring equipment approved for use at McAAP. These are:

a. AN/PDR-27 have scale ranges of 0 to 0.5, 0 to 5, 0 to 50, and 0 to 500 mR/hr.

b. AN/PDR-43 having scale ranges of 0 to 5, 0 to 50, and 0 to 500 R/hr.

c. Victoreen Gamma Survey Meter Model 592B having ranges of 0 to 1000, 0 to 100, and 0 to 10 mR/hr.

d. Ludlum Geiger Counter, Model 6, Scale Ranges 0 to 10, 0 to 100, and 0 to 1000 mR/hr.

2. Maintenance and Calibration of Detection and Measuring Equipment: All of the above (para 1a through 1d) equipments are maintained and calibrated by the Army Area Calibration Laboratory, Sacramento Army Depot, Sacramento, CA, on a frequency of not more than 90 days. The date of calibration and next calibration due date are annotated both on the affixed calibration tag and the accompanying record card inside each radiac storage container.

3. Preparation and Usage: If a radiac (detection and measuring) meter for any reason has not been calibrated during the preceding 90 days or is found inoperable or inaccurate by the following procedures, it shall not be used.

a. Preparation: Several AN/PDR-43, AN/PDR-27, Ludlum, Model 6, and Victoreen Model 592B's are maintained in a current calibration status at the Calibration Laboratory, Building #7. Each unit contains an accompanying instruction manual for operation. Prior to any usage, each such instrument will receive the following minimum checks:

(1) AN/PDR-27

(a) The range selector switch is turned to the "BATT" (Battery Check Setting). If the needle does not move to the right of the "BATT" marking on the scale, the battery is weak and the radiac is not to be used.

(b) Radiacs which are not functioning properly are segregated and their condition reported to the shift supervisor. The Chief, Equipment and Environmental Division, Bldg #7, is responsible for replacement of defective radiacs.

(2) AN/PDR-43

(a) The range selector switch is turned to the "BATT" setting. If the needle does not move within the battery marking on the scale, the batteries are weak and the radiac is not to be used.

(b) Surveys are ended by turning the range selector switch to the "OFF" setting. The switch is never to be in any other than the "OFF" position unless a survey is in progress.

(3) Victoreen, Model 592B

(a) Turn the range selector switch to "ZERO" position.

(b) Adjust ZERO control (right side knob) such that needle reads exactly zero units. Failure of meter to adjust to zero position reflects batteries are weak and the unit is not to be used.

(c) If meter zeros properly, move range selector switch through positions marked "X100," "X10," and "X1." Equipment/unit will properly measure gamma radiation.

NOTE: Each time the equipment/unit is turned off, the meter must be readjusted to the zero position (see steps (a) through (c) above).

(4) Ludlum, Model 6 Geiger Counter

(a) Turn the instrument range switch to BATT. The meter should deflect to the battery check portion of the meter scale. If the meter does not respond, recheck that the batteries have proper polarity.

(b) Turn the range switch to X1. Expose the instrument to a radiation check source. The meter should respond.

(c) Check calibration and proceed to use the instrument.

4. Occasions: Radiation surveys are made whenever a sealed source in an exposure device or container is:

a. Exposed.

b. Placed in a transporting vehicle.

c. Exchanged for a new source.

d. On other occasions when required for personnel safety or security of the source.

5. Procedures: All radioisotope operations commence by determining whether the radiacs are calibrated and properly functioning.

a. Radiation surveys in conjunction with the exposure of a source consists of approaching the source with a radiac adjusted to a scale that registers some level of radiation. These surveys are conducted for the safety of radiographic personnel. Radiation levels at specified distances from the source container are noted. If the levels are normal, the surveys are accounted for

by entering a summary statement, such as "Prelim Survey - OK," on a form like that on Figure 9. The forms are incorporated into the permanent utilization log. If the surveys show abnormal radiation levels, the RPO and supervisory personnel are immediately notified.

b. Radiation surveys made (preparatory to, during, and subsequent to test usage and the exchange of sources) are conducted by measuring radiation levels at explicit distances from the surfaces of the sealed source container. The records of the surveys are reported to the RPO in the memoranda covering such operations by the Lead Radiographer or other personnel authorized by the RPO to perform these operations. Reports of surveys in connection with test, usage, source exchange, or other operations conducted under the direction of the RPO will be forwarded to SMCMC-QA and will be filed at the McAAP facility with other records required by the NRC.

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SECTION VI

METHODS FOR CONTROLLING ACCESS TO RADIOGRAPHIC AREAS
AND RADIATION EXPOSURE OUTSIDE RADIOGRAPHIC AREAS

1. Definitions:

a. Radiation Area: This is an area accessible to personnel in which radiation exists at such levels that the major portion of a person's body could receive, in any one hour a minimum dose of 5 millirems (but not more than 100 millirems), or in any five consecutive days a dose in excess of 100 millirems.

b. High Radiation Area: This is an area accessible to personnel in which radiation levels exist at such levels that the major portion of a person's body could receive in any one hour a dose in excess of 100 millirems.

2. General Procedures for Protection of Personnel through Controlled Access: No person other than authorized radiographic personnel may enter any posted radiation area without the approval of the radiographer on duty. The radiographer shall ensure that everyone entering an area with radiation levels of 2 mR/hr or greater is wearing a film badge and two dosimeters. Establishment and posting of radiation areas shall be as follows:

a. Establishing the Radiation Area: Industrial radiographic operations at McAlester shall require establishment of a 5 mR per hour perimeter around the source exposure point. A calibrated low range radiac meter such as the AN/PDR-27 shall be used.

b. Posting the Radiation Area: Each 5 mR per hour perimeter shall be conspicuously posted at dividing or partitioning walls within the facility building or on ropes surrounding the defined Radiation Area. Posting shall contain the radiation caution symbol and caution words, "RADIATION AREA - RADIOACTIVE MATERIAL - AUTHORIZED PERSONNEL ONLY." Radiographers and attendant radiographic personnel shall properly guard the area posted.

c. Establishing the High Radiation Area: A 100 mR/hr perimeter shall always be established around the radiation source point by using the Radiation Intensity Distance Graph, Figure 7, in conjunction with the 2 mR/hr perimeter established above.

d. Posting the High Radiation Area: Each high radiation area will have its boundary/perimeter secured by rope or by utilization of existing natural barriers such as building walls, etc. Rope or natural barriers will be conspicuously placarded with signs bearing the radiation caution symbol and the words, "CAUTION - HIGH RADIATION AREA," with additional personnel monitoring statements. The radiographer and assistant radiographer personnel shall guard the area posted.

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e. Controlling Personnel Entry into Posted Radiation Areas: The radiographic supervisor shall assure the presence of sufficient personnel to guard access routes to the radiation area. Authorized entrance into a radiation area requires the personal approval of the senior radiographer on duty.

f. Unauthorized Personnel Entry into a Posted Radiation Area: While unauthorized personnel entrance into a radiation area is a remote possibility, such occurrence will require the radiographer to effect the following procedures:

(1) Take person's name and badge number.

(2) Note the time that the action occurred.

(3) Determine how long the person has been in the area.

(4) Determine the path that the person has taken while in the area.

(5) Tentatively determine exposure from the dosimeter. Remove the film badge and forward to the Health Clinic. If the person does not have a film badge, determine the approximate dose of radiation that has been received.

(6) Notify immediately by telephone SMCMC-QAM, SMCMC-QA, and SMCMC-SF of circumstances. SMCMC-SF will notify the Army Health Clinic and SMCMC-AO as necessary.

(7) File a report to SMCMC-QA explaining the above conditions. Provide a copy to SMCMC-SF.

3. Permanent Exposure Facility at Building #111: Preceding (above) portions of this Section addressed requirements for the establishment, posting, and control of any radiation area. Remaining procedures apply specifically to the permanent radiographic facility at Bldg. #111.

a. Exposure Area: Cell #3 of Building #111 is the only presently approved exposure area. There are two points of access, an east and west door comprised of 5-inch steel. Lead shielding 1 1/2 inch thick has also been placed on the inner wall directly facing the emergent beam from the source as well as supplemental lead plates at doorway regions and on sample carrying carts. Steel doors are interlocked with the Cyclops control console, the shutter on the exposure device, and action lights on outer face of the cell such that an exposure cannot be performed with doors opened. An area monitor alarm detector placed inside the cell initiates on sensing 2 mR/hr intensity emission. In turn, an action buzzer (alarm) and light are activated.

b. Radiation and High Radiation Areas: Due to the design, supplemental shielding, and built-in safety interlocks, radiation intensity external to

the cell walls has been measured repeatedly as less than 2 mR/hr. Actual survey results at specific points are available on Figure 6. Based upon these repeated survey results, cell #3 within Bldg #111 has been established as a radiation and high radiation area. Accordingly, access doors on the east and west walls shall contain a sign bearing the radiation caution symbol and the words, "CAUTION - HIGH RADIATION AREA," with a supplemental personnel monitoring statement. Entrance into the cell is to be closely monitored by the radiographer on duty.

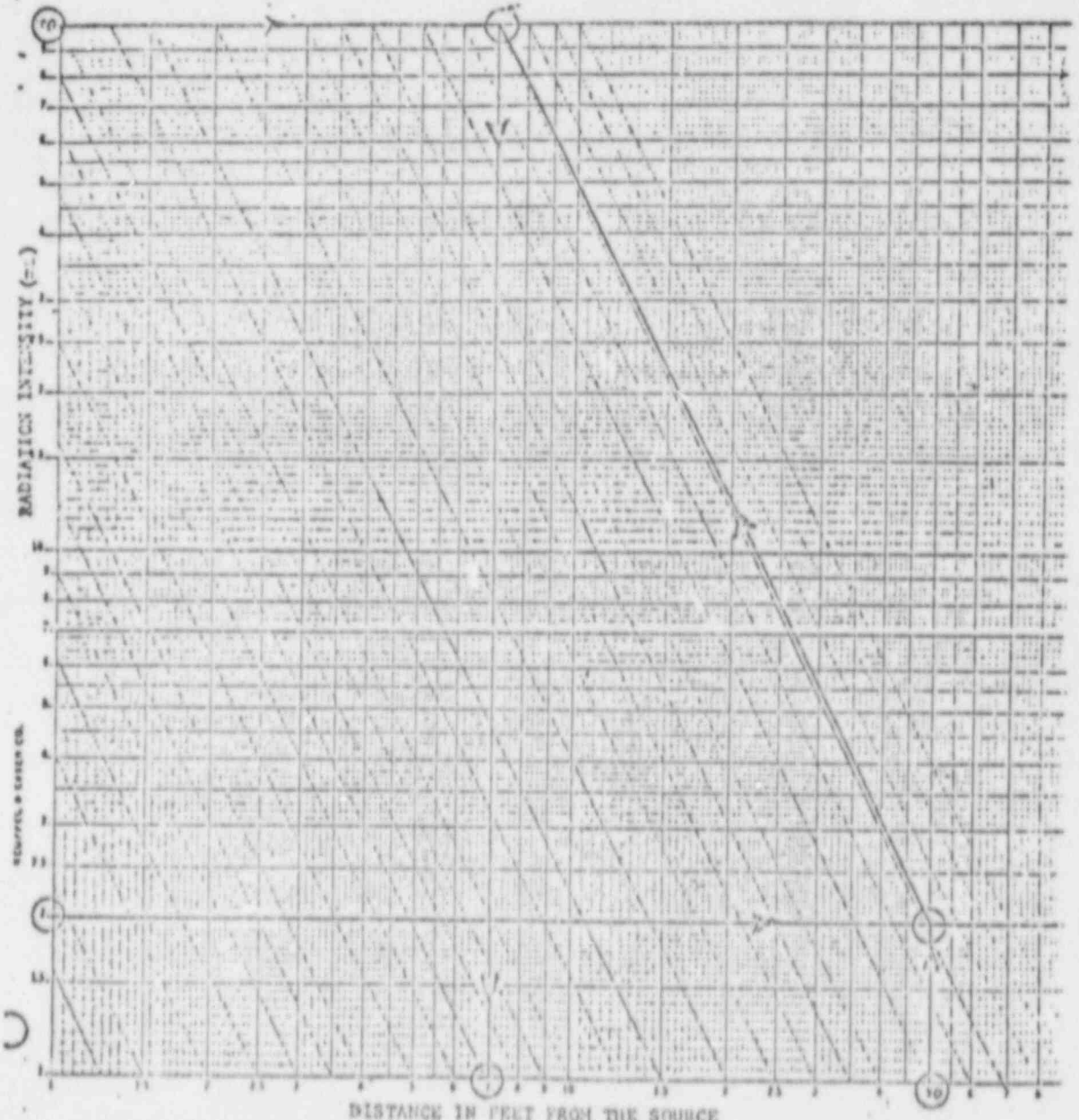
c. Posting Specific Radiation Warning Signs/Labels: In addition to locating the "CAUTION - HIGH RADIATION AREA" sign (at least 10" x 12" in size, bearing the magenta radiation symbol), other required cautionary or informational signs/placards shall be posted before exposure actions are attempted:

(1) The exposure device inside cell #3 shall contain a label with the radiation caution symbol, "CAUTION - RADIOACTIVE MATERIAL," Cobalt-60, quantity of Cobalt-60, and last date that Cobalt-60 quantity was measured. AEC-586 label may be used.

(2) The inside dividing partition on the east side and doorways leading into the east room containing cell #3 shall be posted with signs (at least 10" x 12") bearing the radiation caution symbol and statement "CAUTION - RADIOACTIVE MATERIALS - KEEP CLEAR." Additionally, accessible (open) doorways leading into this area shall be posted with "RESTRICTED AREA - PERSONNEL DOSIMETRY MONITORING REQUIRED."

(3) Each side of Building #111 shall have cautionary radiation symbol sign with statements, "CAUTION - RADIOACTIVE MATERIALS - KEEP CLEAR."

RADIATION INTENSITY-DISTANCE RELATIONSHIP GRAPH (for all sources)



Example for chart use: Problem - to determine the 100 mr location from the source.

1. Determine 2 mr location (distance from exposed source) with a radiac. For example: 2 mr at 50 feet.
2. From the intersection of lines (drawn on the above graph) from the 2 mr and 50 foot points, locate an intersection along a parallel diagonal to those shown with a horizontal line from the 100 mr point.
3. From the 100 mr line intersection, vertically find the 7.1 foot distance which is the 100 mr location from the source.

FIGURE 7

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SECTION VII

METHODS AND OCCASIONS FOR SECURING RADIOGRAPHIC EXPOSURE DEVICES AND STORAGE CONTAINERS

1. Equipment Storage: Any exposure device storage container or sealed source will be stored in a specifically prescribed storage cell or magazine designed or approved by the RPO as adequate for the prevention of unauthorized entry and unnecessary exposure. Approved storage areas/vaults and related equipments are as follows:

a.	Exposure Device	Cyclops, Model 6145 A
b.	Isotope and Capacity	Cobalt 60-2000 Ci
c.	Primary Storage Vault	Cell #3 of Building #111
d.	Alternate Storage Vault	*Magazine 112

* To be used only for receipt, storage, and preparation for shipment actions of source material in approved storage or shipping container.

2. Locking of Storage Containers and Vaults/Cell: The Cyclops exposure device contains a lock at the vicinity of the shutter to prevent unauthorized or accidental exposure of the sealed source. This lock will be secured at all times when exposure operations are not being conducted. The enclosing cell (or vault; steel doors also contain a separate lock which must be likewise secured when exposure action has been terminated. Access to both keys, unlocking operations, and exposure actions are limited to radiographers and radiographer supervisors. The key to the cell is maintained by SMCMC-QA at Building #1 while the key to the Cyclops barrel lock and control panel is secured by radiography supervisory personnel in a locked cabinet in Building #136. Thus, all access to the source material and initiation of any exposure operation require obtaining individual keys at different locations. The definition of a locked enclosure is a secured and locked area under direct supervision of the responsible radiographic personnel.

3. Temporary and Alternate Storage: Magazine #112 is the approved alternate storage location for the Cyclops exposure/storage head provided that the following conditions and requirements regarding prevention of tampering and unauthorized removal are adhered to:

a. Storage container is placed in an approved shipping container and locked. Keys are to be retained by the radiographer or under lock at Building #136.

b. Magazine #112 constructed of concrete with earth overfill and steel door shall be also padlocked and access key retained by the radiographer or Security Office.

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c. The locked enclosure (Magazine #112) containing the Cyclops unit shall be physically surveyed to ensure that the resulting radiation level is not more than 2 mR per hour. The area shall be posted on four sides with radiation symbol and words, "CAUTION - RADIATION AREA." Rope or wire cable barriers across the single roadway entrance shall be present. Barriers shall also contain radiation symbol and sign reading, "CAUTION - RADIOACTIVE MATERIALS."

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SECTION VIII

PERSONNEL MONITORING AND USE OF PERSONNEL MONITORING EQUIPMENT

1. Monitoring Equipment: Radiographic personnel assigned to any task involving radioactive sources or X-ray machines must wear two dosimeters and one film badge during all hours of the shift/work period. Equipment authorized for the personnel monitoring program shall be firmly attached to the outer clothing in the body trunk area. Equipment authorized is listed below:

a. Film Badge: Consists of Holder (NSN 6665-299-9825 or equivalent) and Film (EK Type 3 or equivalent).

b. Dosimeters: Landsverk, Victoreen, Bendix, or other manufactured equipment meeting the requirements determined by the RPO and having direct reading of cumulative radiation dosage. Two ranges of instruments are required as follows:

(1) 0 - 200 mR (for normal usage in permanent radiographic locations).

(2) 0 - 5 R (for use during emergency situations).

2. General Personnel Dosimetry Procedures: Pocket dosimeters shall be charged each day before issue to radiography personnel, read at the end of the day, and doses recorded by SMCMC-QAM-T personnel. SMCMC-QAM shall be immediately notified of any dosimeter discharge reading of 20 mR or more, and the RPO shall investigate each such instance to determine obvious defective dosimeter. Where total discharge is evidenced on one or both dosimeters, the film badge shall be submitted to the medical officer for processing, and the person removed from further exposure to radiation sources. Each month replacement film badges will be provided, returned units developed, and results recorded by the Army Health Clinic. Daily reports of pocket dosimeter readings shall be prepared and posted by SMCMC-QAM-T personnel within the facility/building. For industrial radiographic purposes, any person whose cumulative dosimeter dosage exceeds 100 mR in any seven consecutive days will be removed from further exposure to radiation sources until:

a. SMCMC-SF and SMCMC-QA investigation of cause and corrective action have been accomplished, and

b. SMCMC-SF approval has been given for the person to return to duty.

3. Daily Radiographic Monitoring: During assignment to testing operations involving a radioactive source or industrial X-ray equipment, two pocket dosimeters and one film badge shall be worn as outlined in paragraph 1 above. Radiography personnel are required to periodically (at least twice per shift) monitor their assigned pocket dosimeters for discharge readings. Should self-readings or senior radiographer monitoring result in a reading of 20 mR or more within a day/shift, the following steps shall be taken:

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a. Senior radiographer and radiography supervisor are notified. Radiographer supervisor contacts SMCMC-SF (RPO) for assistance.

b. Radiography supervisor, SMCMC-SF representative, and the individual determine if the discharge reading is attributable to a defective or damaged dosimeter. Determining elements include:

(1) Comparing the reading of the discharged dosimeter to the reading on the individual's secondary dosimeter (two are required to be worn).

(2) Comparing the reading of the individual's dosimeter to related personnel dosimeter in the same work area. Conduct additional radiac meter survey of the area.

c. Obtain individual statement of circumstances where a discharge reading of 20 mR or more cannot be clearly ascertained as caused by a damaged or defective dosimeter. The individual's film badge and pocket dosimeters shall be collected and the film badge forwarded to the medical officer for processing. Pending film badge development and determination of dosage received, the individual will be removed from further exposure until cleared by SMCMC-SF for return to duty.

4. Non-Monitored Personnel Radiation Exposure: Due to security measures applied, events involving non-monitored personnel entry into radiographic work areas are highly improbable. However, where a film badge is not worn, the following actions shall be taken by the radiographer:

a. Seek assistance of the RPO and the radiographer supervisor.

b. Retain the person in a non-radiation area.

c. Obtain personal information (identity, age, badge number, phone number, address).

d. Make an estimate of radiation exposure experienced by comparing pocket dosimeter indications on personnel doing similar work and analyzing recorded radiation levels and exposure times.

e. Summarize information into memorandum format or on DD Form 1141. Forward a copy of the report to the RPO (SMCMC-SF) and place original into the utilization logbook.

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SECTION IX

TRANSPORTATION OF SEALED SOURCE

1. Receiving:

a. General Provisions: Sealed sources are received as a result of plant contract with a licensed vendor/firm tasked to replace source materials in the Cyclops exposure device. Consequently, contractual provisions addressing vendor/firm shipment (advance leak test, marking, labeling, and related DOT requirements) necessitate the performance of a receipt inspection upon the arrival of source material at McAAP. This inspection will be accomplished by a qualified radiographer and a designated safety representative selected by the Radiological Protection Officer.

b. Receipt Inspection: Upon notification by the General Supply Division of sealed source arrival, the receiving inspection team shall perform the following function:

(1) Obtain one each radiation survey meter, AN/PDR 43, AN/PDR 27 (or Victoreen Model 592B, or Ludlum Geiger Counter, Model 6) and related film badges and pocket dosimeters. Assure operating checks are conducted and that each instrument is within calibration currency.

(2) Conduct radiation survey as soon as possible after receipt, but not later than 3 hours after the packaged shipment arrives at the plant (if received during normal working hours) or within 18 hours (if received after normal working hours). Readings of radiation levels shall not exceed 200 mR/hr on external surfaces or no more than 10 mR/hr at a three-foot distance. Should radiation levels exceed the above allowance, immediately notify the RPO, phone Ext. 2433, and await further instructions. The RPO shall assume charge of further operations and immediately report conditions by telephone and telegraph to both the final carrier and NRC Regional Office IV, Office of Inspection and Enforcement, 611 Ryan Plaza Drive, Suite 1000, Arlington, Texas 76102, Phone - Day or night (817) 860-8100 or FTS 728-8100.

(3) Where satisfactory radiation levels are achieved (above), proceed with visual examination of package and related shipping documents. Failure of vendor/firm to provide certificate of wipe and leak test (with negative results) within 30 days preceding the shipping date shall be cause for not accepting the shipment. Examine shipment for proper labels, marking, etc.

(4) Subsequent to satisfactory attainment of all above requirements, source material package may be received aboard the plant for transport to the radiographic facility or into temporary storage to the conditions prescribed in applicable parts of this appendix.

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1. Transporting On-Plant: All on-plant movement of radioactive isotope material will be performed under the supervision and control of the radiographer, supervisor radiographer, and the RPO (or his designee). Accordingly, the radiographer supervisor shall assure transportation routes, schedule of planned movement times, and date of movements have been fully coordinated with the Security Office and the Safety Office before performing the following actions:

a. Equipment: Assure that the following equipment is present on US Government flat-bed truck with restraining stake sides and ends. Inspect to assure brake, steering, tires, etc. are fully satisfactory. Vehicle Inspection Form DD-6 may be used. Assure all four sides are placarded "RADIOACTIVE" in 4-inch-high black lettering on a yellow background. Letter brush width to be 5/8 inch. Placard must be three to four inches larger than the lettering on all four sides. No other placards or signs are to be on the vehicle. Four radiation warning signs of suitable size to be read at a distance of 300 feet. Signs shall bear the radiation symbol and cautionary statement, "RADIATION AREA - DO NOT ENTER." The four signs shall be carried by the radiographer for establishment during emergency/accident situations. Rope (at least two segmented sections) of approximately 50 feet length each shall accompany the radiographer for deployment at the 2 mR/hr perimeter distance during emergency/accident situations. One AN/PDR-43 and one AN/PDR-27 or one Victoreen, Model 592B, or a Ludlum Geiger Counter, Model 6, inspected to assure operability and current calibration status (within last 90 days). Two dosimeters and one film badge for each person engaged in the source material movement. One copy of this appendix.

b. Procedure: Subsequent to satisfying the above requirements, transportation of the source material package will proceed as follows:

(1) The source device must be positioned on the vehicle as far as possible from the driver and properly blocked, braced, or restrained to prevent movement from normal road shocks incident to transporting.

(2) The radiographer (and escort team of radiographer supervisor and RPO/designee) must accompany each vehicle movement of a sealed source and shall conduct radiation surveys with an operable and currently calibrated radiac meter (AN/PDR-43 and AN/PDR-27 or equivalents). Survey results must be 2 mR/hr or less in the driver area and 10 mR/hr or less at three-foot distances from external surfaces of the packed source.

(3) Radiacs must be in the immediate driver's area during transport movement.

(4) Dosimeters and film badges shall be worn by all personnel involved in the vehicle transporting of the sealed source. All personnel must be briefed on the emergency procedures in Section II of this appendix.

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(5) The radiographer conducts a radiation survey of the sealed source container or device upon arrival at destination and oversees off-loading. The storage area shall be promptly and correctly secured and identified as required by the procedures contained in Title 10 of the Code of Federal Regulations.

3. Transporting Off-Plant: Any movement of radioactive isotope material beyond the confines of McAlester Army Ammunition Plant shall be by a commercial firm specifically licensed to transport such material. The RPO shall assure the firm is properly licensed and source material is properly prepared for shipment.

4. Emergency Procedures - Vehicular Accident:

a. All on-plant vehicles carrying isotope material will be accompanied by a radiographer and team escorted by the radiographer supervisor and the RPO (or his designated representative).

b. In the event of plant accident to a vehicle carrying a radioactive source, the radiographer and escort personnel shall establish a 2 mR/hr perimeter/region around the source container and vehicle. The 2 mR/hr perimeter shall initially be determined from the source strength - radius distance provided in Figure 8. DO NOT assume the source remains shielded or rely on pocket dosimeter readings. Regardless of the extent of damage to a vehicle or source container, withdraw all personnel to a safe 2 mR/hr perimeter distance as depicted on Figure 8, and then commence radiation survey actions. Survey should commence at the initial 2 mR/hr established by use of Figure 8 and slowly approach the vehicle.

c. If survey results reflect no abnormal levels of radiation, and visual inspection of the source and vehicle reveals it is safe to proceed, continue on to destination.

d. If survey results reflect damage to the source, or visual inspection of the source and vehicle indicates an unsafe condition exists, assure all personnel are restrained beyond the 2 mR/hr perimeter. The RPO shall direct further actions to be taken and notify NRC Division Compliance as required by Title 10 of CFR and directed in Section II of this appendix.

COBALT-60 SOURCE STRENGTH (CURIES)
VERSUS 2mR/hr RADIUS DISTANCE

MCAAPR 702-4

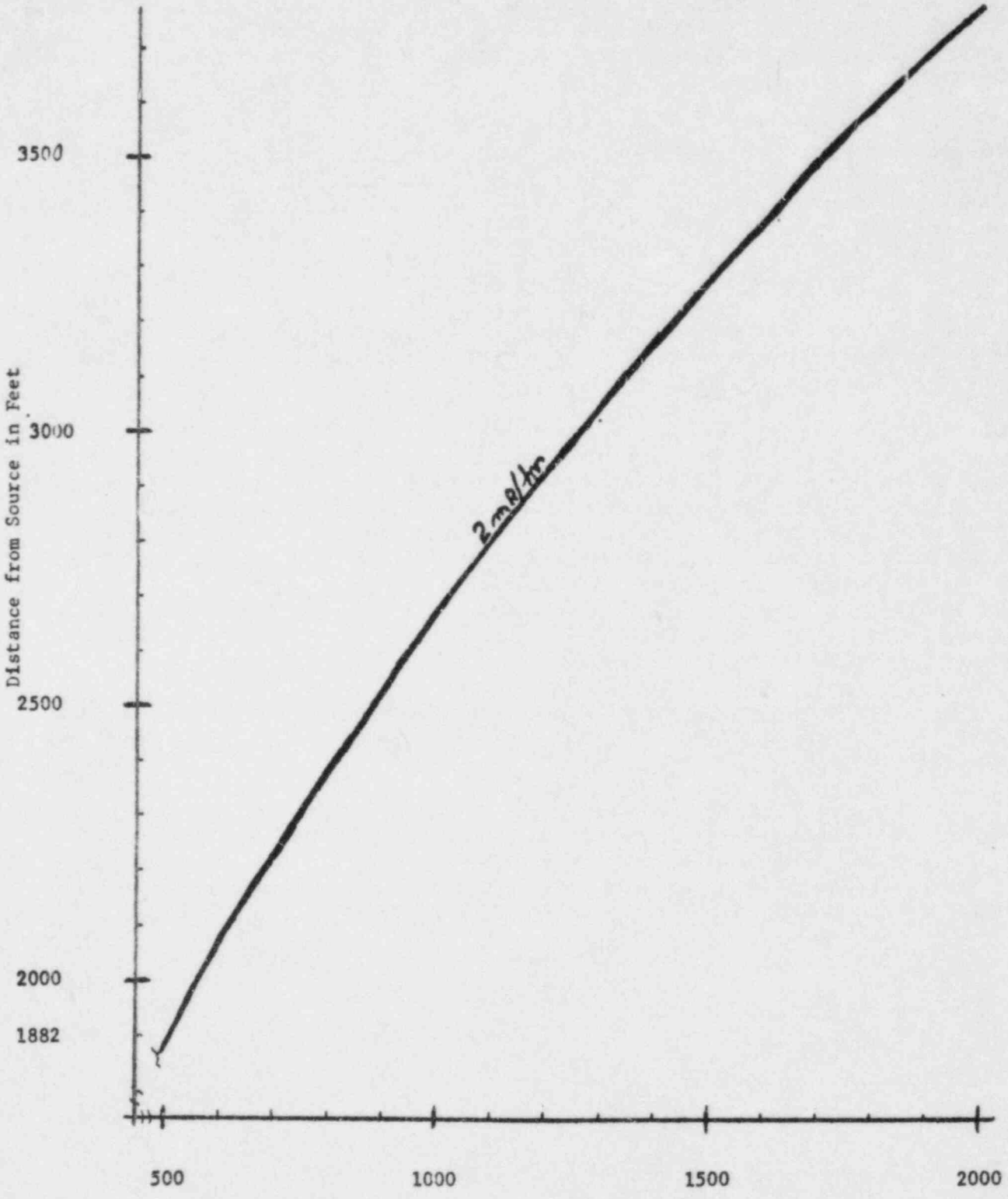

FIGURE 8

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SECTION X

MAINTENANCE OF RECORDS

1. Radiographer and Radiographer Assistant Recording: Each assigned radiographer shall make or assure that the assistant radiographer makes the following records in the manner prescribed:

a. Utilization Log Book: A log book shall be maintained on site at Bldg #111 which represents a permanent log of major actions and events associated with the operation and access to the source material in the storage cell or vault. Each time source exposure operations are conducted, an entry shall be made to record:

(1) Names of all personnel involved in the operation.

(2) Date of operation.

(3) Personnel dosimeter serial numbers and readings prior and subsequent to shift operation.

(4) Source material serial number, exposure device used, and survey meter data.

(5) Total exposure time and number of exposures per shift.

(6) Survey record showing radiation levels and sketch of setup (only outside permanently shielded exposure room).

(7) Survey record of radiation level subsequent to securing the source material. (Enter on Sketch setup described in step (6) above.) Form, Figure 9, Isotope Exposure Log, shall be utilized to contain the information required above. The completed form shall be inserted into the utilization log at Building #111 and a copy provided to SMCMC-QAM-T (Radiographer Supervisor).

b. Pocket Dosimeter Readings: Pocket dosimeters shall be read at the beginning and ending of each shift with intermittent monitoring/observation during the shift (normally 8 hours). Shift readings shall be entered on Isotope Exposure Log at the end of each shift and entered into the Utilization Log.

c. Daily Inspection Checklist for Exposure Device and Storage Container: The assigned radiographer shall inspect the device and/or container as stipulated in Section XI of paragraph 2 of this appendix.

d. Quarterly Inventory: The quarterly inventory is reported by memorandum from the Radiographic Test Branch of Quality Assurance to the Radiological

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Protection Officer through the Director of Quality Assurance. A copy of this report is maintained in the permanent Utilization Log at Bldg #111. Information shall include as a minimum:

(1) Identities of radioisotopes and serial numbers of source.

(2) Present strength of each source.

(3) Original strength of each source.

(4) Exposure device identification.

(5) Date of last periodic maintenance and inspection.

e. Quarterly Inspection and Maintenance Recording: Quarterly Inspection and Maintenance on the Cyclops will be under plant contract with a private company licensed by NRC for such functions as reflected in Section XI of this appendix. In each such instance (90-day period), inspection and maintenance actions shall be witnessed by the radiographer and radiographer supervisor. SMCMC-SF (RPO) shall monitor overall operations. Copies of the completed report of inspections shall be placed in the log book at Bldg #111 and forwarded to both SMCMC-SF and SMCMC-QA. IN NO CASE shall further usage (exposure) be considered where the exposure device or area safeguard is inoperable.

ISOTOPE EXPOSURE LOG

OPERATORS	DATE AND TIME	SOURCE		DOSIMETER SER. NO.	DOSIMETER DATA			SURVEY METER		NUMBER OF EXPOSURES	SURVEY OF STORED EXPOSURE DEVICE 10CFR34 SECT 34.43C RADIATION LEVELS	RADIOGRAPHER'S SIGNATURE AND REMARKS
		NUMBER	STRENGTH		OUT	IN	DOSE	MODEL & SER. NO.	CALIBRATION DATE			

SARMC Form 304, 1 Oct 78

Figure 9

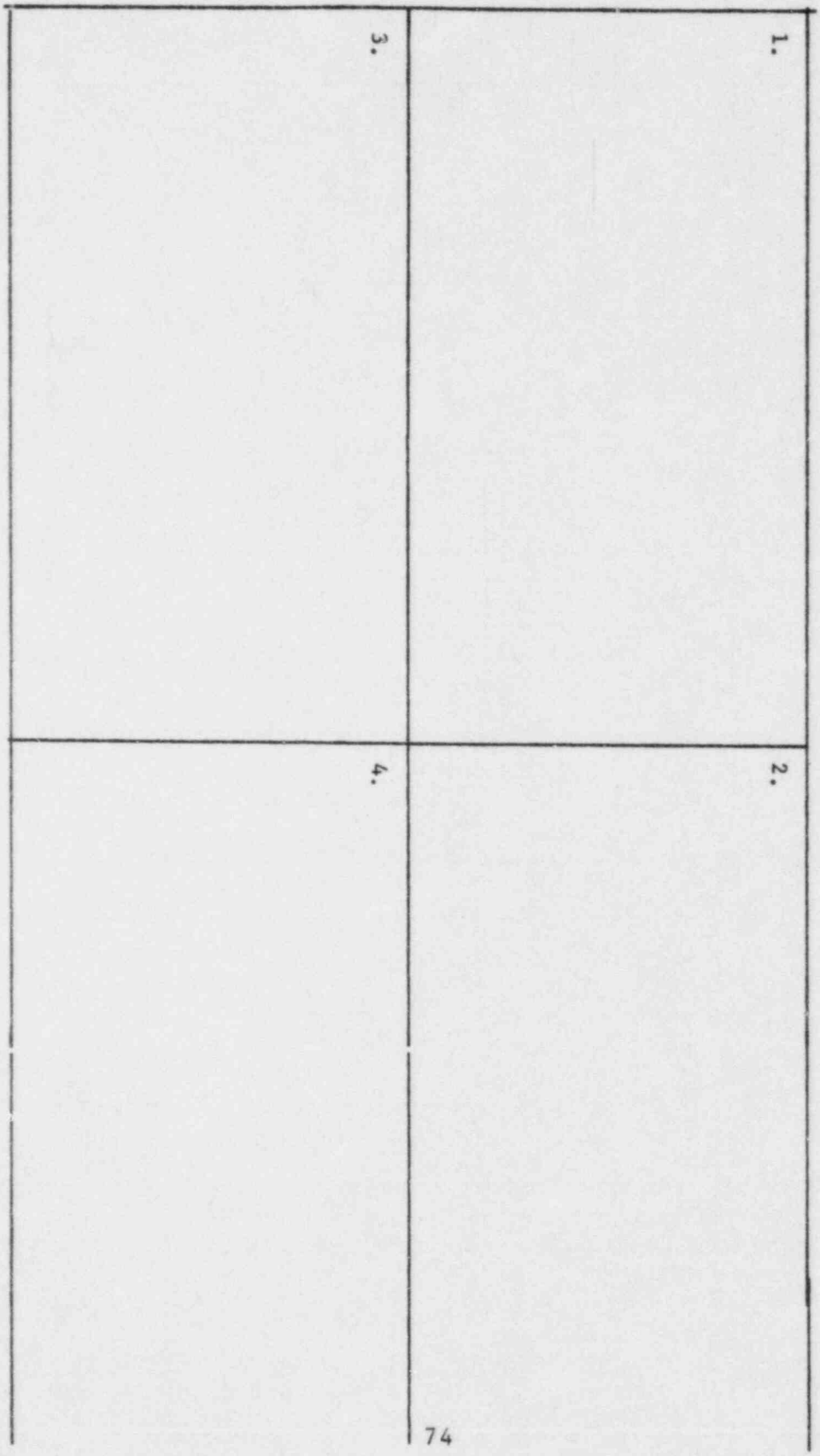

Figure 9a

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SECTION XI

INSPECTION AND MAINTENANCE OF RADIOGRAPHIC
EXPOSURE DEVICES, STORAGE CONTAINERS, AND AREA SAFEGUARDS

1. Definitions:

a. Exposure Device: Defined as the composite grouping of isotope exposure equipment exclusive of storage containers. In relation to the Cobalt-60 Source utilized in the Picker Cyclops, Model 6145A, the term exposure device includes the shielding/protective sphere container and associated barrel locking device, shutter and related console, cables, etc.

b. Storage Container: Defined as that piece of equipment required for additional housing and protection of a radioactive isotope. Due to Picker Cyclops design of a self-containing spherical shield and protective covering and the fact that the device is further contained in its permanent cell/vault, classic concept of a storage container does not apply.

c. Area Safeguard: Defined as all safety shielding and protective and informative devices relating to prevention of personnel exposure to radiation.

2. Daily Inspection: The radiographer shall perform daily inspections of exposure devices, supporting cell area, and area safeguards prior to usage. Inspection results shall be documented on forms provided as Figure 10. Where exposure device or functional safety interlocks are nonconforming or work improperly, NO ATTEMPT SHALL BE MADE BY THE RADIOGRAPHER TO PERFORM MAINTENANCE. The radiographer shall refer the cited maintenance need to the immediate supervisor who, in turn, shall notify SMCMC-QA and SMCMC-SF. Until notified otherwise, the radiographer shall not utilize equipment for exposure action but shall secure the unit as directed in Section IV of this appendix.

a. Minimum Daily Inspection: The following items shall be checked to ensure that proper operation and safe conditions prevail:

(1) Shielding Sphere/Container: Visually inspect the container for damage to external surfaces. Assure barrel lock is fully engaged and shutter assembly is not damaged. Observe lead and mortar brick shielding and supports are intact and properly positioned (with design drawings as referenced). Determine visually that electrical cables are not pinched or frayed.

(2) Cell/Vault Surroundings: Assure by trial and visual means that area monitor and interlocking devices work properly. Observe lead shielding condition and placement. Assure outside cell door locks function properly. Inspect all other cautionary safeguards outside the cell area to assure presence and proper display.

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3. Quarterly Inspection and Maintenance: As reflected in Section X of this appendix, inspection and maintenance shall be conducted on the Picker Cyclops at intervals not to exceed 90 calendar days. Such services are to be provided by plant contract with:

X-Ray Equipment Company
P. O. Box 2431
Fort Worth, Texas 76101

In conjunction with contract service operations, the radiographer and radiographer supervisor shall accompany the quarterly inspection agent to Building #111 to witness agent inspection actions and provide security. The contracting firm shall complete checklist form of quarterly inspection and maintenance, denoting operability or inoperability of the Cyclops unit and any required corrections. This checklist (form) shall be signed by the contractor's inspection agent and copies provided to the log book at Building #111, the RPO, and SMCMC-QA. Exposure device operation and safeguards shall be rendered completely operable before further usage (exposure) is attempted.

4. Bi-Annual Inspection of Area Safeguards: SMCMC-QA and the RPO (or their delegated representatives) shall conduct an inspection of area safeguards within each successive 6 months at Building #111. Safeguards as defined above include cell/vault interior shielding, doors, equipment, interlocks, area monitor/gamma alarm and cell door external locks. Figure 11, Bi-Annual Inspection of Area Safeguards, shall be completed with copies provided as shown.

Appendix B

DAILY INSPECTION CHECKLIST OF
EXPOSURE DEVICE, CELL, AND AREA SAFEGUARDS

ITEM	INSPECTIONS REQUIRED AND (METHOD)	SAT	*UNSAT
Area Posting	A. All radiation emblems and cautionary placards are present and properly displayed (Visual)		
EXPOSURE CELL AND AREA SAFE-GUARDS	B. Security locks are functioning properly (Visual-Trial)		
	C. Interlock of cell door to exposure device functions properly (Trial)		
	D. Area Monitor/Gammalarm audible and visual signals are proper (Trial)		
	E. Electrical cable is not frayed, pinched, or broken (Visual)		
	F. Lead and concrete shielding are intact (Visual)		
	G. Exposure device container is free from obvious damage (Visual)		
	H. Barrel lock and shutter function properly (Visual-Trial)		

*NOTE: Any element found unsat will be reported to radiographer supervisory. DO NOT OPERATE EQUIPMENT until corrective action has been accomplished through the radiographer supervisor.

RADIOGRAPHER (Signature)_____

DATE_____

FIGURE 10

Appendix B

BI-ANNUAL INSPECTION CHECKLIST
OF AREA SAFEGUARDS

AREA OR SITE	INSPECTION REQUIREMENTS AND (METHODS)	*FINDINGS SAT	UNSAT
BLDG #111	1. Audible and visual portions of area monitor/ Gammalarm function properly (Visual-Trial)		
	2. Interlocks of exposure device, cell door and console function (Visual-Trial)		
	3. High Radiation and Radiation areas contain correct posters and cautionary statements (Visual)		
	4. Cell door locking devices are tamperproof and internal panic hardware functions correctly (Trial)		
	5. Cell shielding is intact and conforms to document layout drawings. (Visual)		
	6. Cyclops shutter properly returns to SAFE Position when programmed by the control console (Trial)		
	7. Radiographer assistance action (Evaluation)		

*NOTE: Adverse (unsatisfactory) results in any of the above areas will be addressed in detail below by the Inspectors.

A. Specifics of nonconformance _____

_____

_____

B. Corrective action required (address function, office symbols and dates)

_____

_____

_____

DATE: _____

SIGNATURE SMCMC-QA _____

CF:
SMCMC-QA
SMCMC-SF
SMCMC-QAV

FIGURE 11

Appendix B

SECTION XII

LEAK TESTING AND REPLACEMENT
OF SEALED SOURCES

1. Leak Testing: A sealed source received from a transferor shall be subjected to a leak test at intervals not to exceed six months. The leak test shall be capable of detecting the presence of 0.005 microcurie of removable contamination on the sealed source (at nearest accessible points to the source storage position). In all instances of leak testing, performance shall only be accomplished by persons of firms specifically licensed for conducting such tasks. Leak tests at McAAP shall be accomplished as follows:

a. Plant Contract with Licensed Firm: All leak tests shall be conducted by a firm or agency specifically authorized by NRC for performance in such operations. Present contract and firm conducting leak testing (and quarterly Inspection/Maintenance) is:

X-Ray Equipment Company
P. O. Box 2431
Fort Worth, Texas 76101

Texas Agreement No. RAM 5-1485

b. Leak Test Procedure: Contract firm representative shall be accompanied by the RPO (or designated alternate) and McAAP Radiographer during all leak testing to conduct required survey using calibrated meters, permit access to source, monitor leak test activities, complete log actions, and secure the source.

c. Upon receipt of contractor wipe/swab analysis results, a copy shall be provided to the log at Building #111 and also to SMCMC-SF and SMCMC-QA. In the event that leak test analysis reflects a leakage rate of 0.005 microcuries or more of removable radioactive material, the sealed source shall be considered leaking and the following actions shall be taken:

(1) Assure source remains secured.

(2) RPO determines decontamination, disposition, or corrective measures to be taken.

(3) RPO reports the event in writing, within five days to the Director of Nuclear Materials Safety and Safeguards, US Nuclear Regulatory Commission, Washington, DC 20555, describing the equipment involved, test results, and corrective action taken. A report copy shall be sent to NRC Inspection and Enforcement, 611 Ryan Plaza Drive, Suite 1000, Arlington, Texas 76012 (Phone - day or night is (817) 860-8100 or FTS 728-8100).

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2. Disposal and Exchange of Sealed Sources: Sealed sources within the exposure device are replaced only by technical representatives of agencies licensed specifically by NRC for such tasks. In all cases of source exchange or disposal, the RPO shall arrange for licensed vendor/contractor under plant contract actions. In conjunction with disposal and exchange operations, the RPO (or designated representative) and radiographer personnel shall monitor to assure:

a. Personnel engaged utilize film badges and pocket dosimeters (See Section VIII of this appendix).

b. Surveys of depleted and replacement sources and containers are conducted in accordance with appropriate parts of this appendix (see Section V of this appendix).

c. Records of disposal or replacement actions are completed by the vendor/contractor and copies are provided to the utilization log, RPO, and SMCMC-QA. (See Section VII of Appendix A.)

(SMCMC-QA)

FOR THE COMMANDER:

THEODORE L. ROBERTS, II
LTC, TC
Deputy Commander

DISTRIBUTION:

A
Cdr, AMCCOM (AMSMC-ISS-O)