MASON & HANGER - SILAS MASON CO., INC.
IOWA ARMY AMMUNITION PLANT - MIDDLETOWN, IOWA

STANDING OPERATING PROCEDURE

S.O.P. No. 455 Rev. 5
Date 23 June 1976
C. N. No. 8
Date 11 March 1985

OPERATING AND EMERGENCY PROCEDURE FOR SOURCE RADIOGRAPHY

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MASON & HANGER - SILAS MASON CO., INC.
IOWA ARMY AMMUNITION PLANT - MIDDLETOWN, IOWA
CHANGE NOTIFICATION
TO
STANDING OPERATING PROCEDURE

Item Source Radiography
Building No. X-Ray Facilities of Each Line
Effectivity Date CO Approval
Authority for Change Production Engineering

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NOTE: On a changed page the portion of the text affected by the change is indicated by this symbol, #, followed by the number of the change notification.

Changes are designated by a # 8 to the left of the change. Pages with changes are indicated on the cover page (Page i) by a 8 below the page number.

Distr:

Quality	5
Safety	1
SMCIO-S	1
SMCIO-Q	2
Engineering File	1

Prepared By J. D. Burbridge

Quality Engineer	Quality Operations Manager	Safety Manager	Commander
Carl Beaird			COL

SMCIO-QA Dennis L. Kelsmeier

SMCIO-SF

FORM-OOU (Rev. 18) (11/83)

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#8 SAFETY REQUIREMENTS:

Reference S.O.P. No. 525, "General Safety Requirements."
THIS SYMBOL, SF, APPEARING IN THE SOP DESIGNATES A SAFETY NOTE.

#8 SENSITIVE MATERIAL CONTROL REQUIREMENTS:

This symbol, Ø, appearing in the SOP indicates that sensitive material is involved and the portions of "Sensitive Material Control Procedure" apply.

#8 ITEMS REQUIRING CALIBRATION: Page

#8 EQUIPMENT LAYOUTS:

#8 OTHER SOP's APPLICABLE TO THIS ITEM:

APPROVED

Mason & Hanger-Silas Mason Co., Inc.	Prepared By: Charles E. Piper	Quality Operations Manager	Safety Director	Division Manager of Quality Robert B. Reed
COREP IAAP	Chief Engineer George H. Mabbitt	Safety Manager Wm. J. Brown	Commanding Officer	Date: 26 Jan 77

FORM-RRZb (Rev. 3) (6/75)

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SECTION I: GENERAL OPERATION INSTRUCTIONS

ITEMS

1. #7 The exposure device will be operated only by personnel qualified as radiographers or radiographers assistant.

2. #1 Operations will be conducted strictly per the Standing Operating Procedures issued by the Company which are based up on NRC regulations. No deviations from these procedures will be permitted.

3. #7 A functioning and properly calibrated survey meter must be present at all radiographic sites.

4. No operation of the exposure device will be conducted unless the radiographer is wearing a film badge and pocket dosimeter.

5. The radiographic area must be properly restricted and posted per Attachment D.

6. The source must be secured, locked and properly stored after usage.

7. The source may not be transported, except under the conditions and procedures in Attachment E. Movement of source will be via truck.

8. A utilization log must be maintained for each source used for radiography. The log shall include:

   a. Description of the radiographic exposure device (make and model).
   b. The utilization made of the source.
   c. The line and building of usage.
   d. Date of use.
   e. Signature of radiographer.

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SECTION II: RADIATION PROTECTION PROGRAM

ITEMS

1. The radiation protection program will be conducted by the #1 Radiation Protection Officer (RPO) in compliance with Title 10, Parts 19, 20, 21 and 34.

2. On the job adherence to all regulations is the responsibility of the shift radiographer.

3. Exposure to radiation will be maintained in line with appropriate sections 10 CFR, Part 20.

4. The Radiation Protection Officer will make a report of over-exposure to the NRC and the individual concerned, as required in 10 CFR, Part 20.

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SECTION III: SPECIFIC INSTRUCTIONS FOR RADIOGRAPHIC OPERATIONS BUILDING 3A-100

Prior to beginning operations, the Radiation Protection Officer (RPO) will survey the area with source exposed. The maximum source strength allowed for this
#1 operation is 1000 Ci.

All operations will be in accordance with General Operating Instructions,
#1 Section I of this SOP and Attachments F-1 & F-2.

ITEMS

1. The source housing will be kept in the radiography bay proper. This will be its storage and operating location. If it is required to move
#8 the device to another area, the Radiation Protection Officer (RPO) must be notified and the appropriate sections of this procedure followed.

2. The control unit will be located in the control room.

3. The door to the radiography bay will be kept closed and locked by a padlock (in addition to the source interlock system) during exposures.

   Keys will be in custody of the radiographer.

4. Source Exposure Procedure:

   a. Source is located in projector in radiography bay. Source
#1 guide tube is attached, if required, with source position switch located in center of ring. Control cable has been passed through wall and connected to control box.

#1 b. With controls locked, check radiography bay to ensure no personnel are inside. Close and lock door. Control light should be green.

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4. Cont'd

#1 c. Expose source by operating control unit per operating instructions.

d. Check indicating lights over control box. Amber light on indicates source has left housing and is in guide tube. Red light indicates source capsule is in source position switch assembly.

NOTE: For a few seconds after the source leaves the projector, an audible alarm will sound.

#1 e. Lock controls.

f. Check red warning lights outside radiography bay. These should be on.

NOTE: Persistence of green light when source has been apparently positioned on switch assembly or any failure of light system will be immediately investigated. Rework
#1 control unit to attempt to make position switch contact.
#1 If lights continue to malfunction, retract the source, lock controls, and call Radiation Protection Officer (RPO) and Supervisor of Radiography. Do not re-enter radiography bay or open door until authorized, then proceed with Step 5 of this Section.

#1 5. Instructions for Retracting Source and Re-Entering Radiography Bay:

a. Radiography bay is closed and locked.

b. Operate control unit to retract source per operating instructions in Attachments F-1 and F-2.

c. Check lights.

d. If lights indicate source is retracted, lock controls.

ITEMS

5. Cont'd

e. If necessary to enter radiography bay, proceed as follows:

(1) Retract source per operating instructions.
(2) Set up restricted area to cover area adjacent to radiography bay door so radiation from open door would not expose personnel.

NOTE: A functioning radiation survey meter must be available during this operation.

Personnel Radiation Monitor must be worn by Radiographer when entering radiography bay.

(3) Unlock door switch padlock.
(4) Open the door 18 inches.
(5) If door does not open, it could mean interlock is still functioning and source may be still exposed. Repadlock the controls and investigate.
(6) Check Radiation levels at open door using wall or door as a shield.
(7) If levels are such as to indicate source is still exposed, immediately close and lock door. Call Radiation Protection Officer (RPO) and Supervisor of Radiography.
(8) If levels are normal, enter area and survey source container per Attachment E.

NOTE: If malfunction of lights or projector control unit occurs, proceed per NOTE, Item 4.f.

#7 An emergency switch is located inside the radiography bay door. Personnel who might be trapped in bay when door is closed should immediately activate this switch. This will activate a horn alarm. Should this alarm sound, the source will not be exposed or, if already exposed, source will be retracted and cause of alarm investigated.

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6. Description of Method Used to Set Up Restricted Area at Door of Exposure Area:

   a. The area around the door will be roped off with warning signs attached.
   These barriers do not delineate the area of radiation when source is exposed and door is open, but are the most feasible locations to restrict entrance to the area.

   b. When all personnel, except qualified radiographers wearing film badges and dosimeters, are free of restricted area, proceed to open door. Keep barriers under surveillance to ensure unqualified personnel do not enter area.

7. A periodic survey will be made of radiation levels in the building with special reference to the walls of the radiography bay and in control room.

8. #2 The radiography bay door will be marked as a high radiation area with the words "Danger - High Radiation Area" and "Caution - Radioactive Materials".

9. When source is exposed and the radiography bay door is locked, the remainder of the building shall be considered in unrestricted area. If, at any time, a survey reveals levels in excess of those defining an unrestricted area, the appropriate areas will immediately be restricted and posted and the Radiation Protection Officer (RPO) notified.

10. Regularly assigned radiographer must wear a film badge during their work assignments.

11. Radiographers must wear dosimeters during all source exposures.

* 12. The source will normally remain exposed for two (2) full shifts and be retracted and locked only at the end of the second shift, and exposed again at the beginning of the morning shift. During three (3) shift operations, the source will remain exposed except for weekends and holidays.

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ITEMS

12. Cont'd

Alternative procedure for Retraction of Source:

#8 Source will be retracted and locked at the end of the last shift of each working week.

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SECTION IV: SPECIFIC INSTRUCTIONS FOR RADIOGRAPHIC OPERATIONS BUILDING 3A-05-2

Prior to beginning operations, the Radiation Protection Officer (RPO) will survey the area with source exposed. The maximum source strength will not exceed 1000 Ci.

#1 All operations will be in accordance with General Operating Instructions, Section I of this SOP and Attachments F-1 & F-2.

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1. The source housing will be kept in the radiography bay proper. This will be its storage and operating location. If it is required to move the device to another area, the Radiation Protection Officer (RPO) must be notified and the appropriate sections of this procedure followed.

#1 2. The interlocked control unit will be located near the trap door entrance to the radiography bay. The keys to the controls shall be in possession of the shift radiographer.

3. The trap door to the radiography bay shall be interlocked into the system plus physically locked. Keys shall be in the custody of the radiographer.

#1 4. Source Exposure Procedure:

a. Source is located in projector in radiography bay. Source guide tube is attached, if required, with source position switch located in center of ring. Control cable has been passed through wall and connected to control box.
b. Check radiography bay to ensure no personnel are inside. Close and lock door. Control light should be green.
c. Expose source by operating control unit per operating instructions.

ITEMS

4. Cont'd

d. Check indicating lights over control box. Amber light on indicates source has left housing and is in guide tube. Red light indicates source capsule is in source position switch assembly.

NOTE: For a few seconds after the source leaves the projector, an audible alarm will sound.

#1 e. Lock controls.

f. Check red warning lights outside rediography bay. These should be on.

NOTE: Persistence of green or amber lights when source has been apparently positioned in switch assembly or any failure of light system or audible alarm system will be

#1 immediately investigated. Rework control unit to attempt to make position switch contact. If lights continue to malfunction, close box, lock, and call Radiation Protection Officer (RPO) and Supervisor of Radiography. Do not re-enter radiography bay or open door until authorized, then proceed with Step 5 of this Section.

#1 5. Instructions for Retracting Source and Re-Entering Radiography Bay:

a. Radiography bay is closed and locked.
b. Operate control unit to retract source per operating instructions.
c. Check lights.
d. If lights indicate source is retracted, lock controls.

ITEMS

5. Cont'd

e. If necessary to enter radiography bay, proceed as follows:

(1) Retract source per operating instructions.
(2) Set up restricted area to cover area adjacent to radiography bay door so radiation from the open door would not expose personnel.

NOTE: A functioning radiation survey meter must be available during this operation.

Personnel Radiation Monitor must be worn by Radiographer when entering radiography bay.

#7

(3) Unlock trap door switch.
(4) Open the hatch door.
(5) If door does not open, it could mean interlock is still functioning and source may be still exposed. Repadlock the controls and investigate.
(6) Check radiation levels at open door.
(7) If levels are such as to indicate source is still exposed, immediately close and lock door. Call Radiation Protection Officer (RPO) and Supervisor of Radiography.
(8) If levels are normal, enter area and survey source container per Attachment E.

NOTE: If malfunction of lights or projector control unit occurs, proceed per NOTE, Item 4.f.

#7

An emergency switch is located inside the radiography bay door. Personnel who might be trapped in bay when door is closed should immediately activate this switch. This will activate a bell alarm and release trap door locks. Should this alarm sound, the source will not be exposed, or, if already exposed, source will be retracted and cause of alarm investigated.

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ITEMS

5. Cont'd

NOTE: Two (2) lights are located inside the radiography bay. A RED light on indicates the vault door is closed and a GREEN light on indicates the vault door is open.

6. Description of Method Used to Set Up Restricted Area at Door of Exposure Area:

a. The area around the trap door will be roped off with warning signs attached. These barriers do not necessarily delineate the area of radiation when source is exposed and door is open, but are the most feasible locations to restrict entrance to the area.

b. When all personnel, except qualified radiographers wearing film badges and dosimeters, are free of restricted area, proceed to open door. Keep barriers under surveillance to ensure unqualified personnel do not enter area.

7. A periodic survey will be made of radiation levels in the building with special reference to the walls of radiography bay and in control room.

8. The radiography bay door will be marked as a high radiation area with the words "Danger - High Radiation Area" and "Caution - Radioactive Materials".

9. When source is exposed and the radiography bay door is locked, the remainder of the building shall be considered an unrestricted area. If, at any time, a survey reveals levels in excess of those defining an unrestricted area, the appropriate areas will immediately be restricted and posted and the Radiation Protection Officer (RPO) notified.

10. All personnel regularly assigned to this area will wear film badges. (See Attachment A).

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11. Radiographers must wear dosimeters during all source exposures.

#7 12. The source will normally remain exposed for one (1) full shift and be retracted and locked at the end of the shift. During three (3) shift operations, the source will remain exposed except for weekends and holidays.

Alternate procedure for Retraction of Source:

Source will be retracted and locked at the end of the last shift of each working week.

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SECTION V: Instructions for Radiographic Operations in shielded and controlled facilities such as Buildings 2-10 and 3-10. #8

Prior to beginning operations, the Radiation Protection Officer (RPO) will survey the area with source exposed. The maximum source strength will not exceed 1000 Ci. #7

All operations will be in accordance with General Operating Instructions, Section I of this SOP and Attachments F-1 & F-2. #1

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1. The source housing will be kept in the radiography bay proper. This will be its storage and operating location. If it is required to move the device to another area, the Radiation Protection Officer (RPO) must be notified and the appropriate sections of this procedure followed.

#1 2. The interlocked control unit will be located outside the radiography bay The keys to the locked control box shall be in possession of the shift radiographer.

3. The door to the radiography bay shall be interlocked into the system plus the door switch control must be physically locked. Keys shall be in the custody of the radiographer.

#1 4. Source Exposure Procedure:

a. Source is located in projector in radiography bay. Source guide tube is attached, if required, with source position switch located in center of ring. Control cable has been passed through wall and connected to control box.

b. With controls locked, check radiography bay to ensure no personnel are inside. Close and lock door. Control light should be green.

c. Expose source by rotating control unit per operating instructions.

d. Check indicating lights over control box. Amber light on indicates source has left housing and is in guide tube. Red light indicates source capsule is in source position switch assembly.

NOTE: For a few seconds after the source leaves the projector, an audible alarm will sound.

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ITEMS

4. Cont'd

#1 e. Lock controls.

f. Check red warning lights outside radiography bay. These should be on.

NOTE: Persistence of green or amber lights when source has apparently positioned in switch assembly or any failure of light system or audible alarm system will be immediately investigated. Rework control unit to attempt to make position switch contact. If lights continue
#1 to malfunction, lock controls, and call Radiation Protection Officer (RPO) and Supervisor of Radiography. Do not re-enter radiography bay or open door until authorized, then proceed with Step 5 of this Section.

#1 5. Instructions for Retracting Source and Re-Entering Radiography Bay:

a. Radiography bay is closed and locked.
b. Operate control unit to retract source per operating instructions.
c. Check lights.
d. If lights indicate source is retracted, lock controls.
e. If necessary to enter radiography bay, proceed as follows:

(1) Retract source per operating instructions.
(2) Set up restricted area to cover area adjacent to radiography bay door so radiation from the open door would not expose personnel.

NOTE: A functioning radiation survey meter must be available during this operation.

Personnel Radiation Monitor must be worn by Radiographer when entering radiography bay.

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5. e. Cont'd

(3) Unlock the door.
(4) Open the door.
(5) If door does not open, it could mean interlock is still functioning and source may be still exposed. Relock the controls and investigate.
(6) Check radiation levels at open door.
(7) If levels are such as to indicate source is still exposed, immediately close and lock door. Call Radiation Protection Officer (RPO) and Supervisor of Radiography.
(8) If levels are normal, enter area and survey source container per Attachment E.

NOTE: If malfunction of lights or projector control unit occurs, proceed per NOTE, Item 4.f.

#7 An emergency switch is located inside the radiography bay. Personnel who might be trapped in bay when door is closed should immediately activate this switch. This will activate a bell alarm and open the door. Should this alarm sound, the source will not be exposed or, if already exposed, source will be retracted and cause of alarm investigated.

6. Description of Method Used to Set Up Restricted Area at Door of Exposure Area:

a. The area around the door will be roped off with warning signs attached.

These barriers do not necessarily delineate the area of radiation when source is exposed and door is open, but are the most feasible locations to restrict entrance to the area.

ITEMS:

6. Cont'd

b. When all personnel, except qualified radiographers wearing film badges and dosimeters, are free of restricted area, proceed to open door. Keep barriers under surveillance to ensure unqualified personnel do not enter area.

7. A periodic survey will be made of radiation levels in the building with special reference to the walls of radiography bay and in control room.

8. The radiography bay door will be marked as a high radiation area with the words "Danger - High Radiation Area" and "Caution - Radioactive Materials".

9. When source is exposed and the radiography bay door is locked, the remainder of the building shall be considered an unrestricted area. If, at any time, a survey reveals levels in excess of those defining an unrestricted area, the appropriate areas will immediately be restricted and posted and the Radiation Protection Officer (RPO) notified.

10. All personnel regularly assigned to this area will wear film badges. (See Attachment A).

11. Radiographers must wear dosimeters during all source exposures.

#8 12. The source will normally remain exposed for two (2) full shifts and be retracted and locked only at the end of the second shift, and exposed again at the beginning of the morning shift. During three (3) shift operations, the source will remain exposed except for weekends and holidays.

Alternate procedure Retraction of Source:

#8 Source will be retracted and locked at the end of the last shift of each working week.

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#8 ITEMS 13, 14 and 15 (Deleted)

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#8 SECTION VI: (DELETED)

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#8 SECTION VI: (DELETED)

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SECTION VII: PICKING UP, RECEIVING AND OPENING PACKAGES CONTAINING RADIOACTIVE MATERIAL

A. Pick Up of Packages Containing Radioactive Material

1. When a package containing radioactive material is expected, personnel shall be available to:

   a. receive the package at the time of delivery, if the package is to be delivered by the carrier, or
   b. receive notification of arrival at the carrier's terminal, if the package is to be picked up there.

2. If the package is to be picked up at the carrier's terminal, the pick up shall be made as soon as practicable (if possible, within two (2) or three (3) hours) after receiving notification that the package is available.

B. Receiving Packages Containing Radioactive Material

1. Monitoring package for radioactive contamination on external surfaces.

   a. Upon receipt, the external surfaces of the package shall be monitored for radioactive contamination caused by leakage of the radioactive contents.
   b. The monitoring shall be performed as soon as practicable after receipt of the package but in no case shall be:

      (1) later than three (3) hours after receipt, if received during normal working hours.
      (2) later than 18 hours after receipt, if received after normal working hours.

   c. If removable radioactive contamination in excess of 0.01 microcuries (22,000 disintegrations per minute) per 100 square centimeters of package surface is found on the external surfaces of the package, the following will be notified immediately by telephone and telegraph:

B. 1. c. Cont'd

(1) The final delivering carrier.
(2) The USNRC Inspection and Enforcement Regional Office for Region III in Glen Ellyn, Illinois.

2. Monitoring Radiation Levels External to the Package

a. Upon receipt of a package containing quantities of radioactive material, the radiation levels external to the package shall be monitored.

b. The monitoring shall be performed as soon as practicable after receipt of the package, but in no case shall be:

(1) later than three (3) hours after receipt, if received during normal working hours, or
(2) later than 18 hours after receipt, if received after normal working hours.

c. If radiation levels are found on the external surface in excess of 200 millirem per hour, or at three (3) feet from the external surface of the package in excess of 10 millirem per hour, the following will be notified immediately by telephone and telegraph:

(1) The final delivering carrier.
(2) The USNRC Inspection and Enforcement Regional Office for Region III in Glen Ellyn, Illinois.

C. Opening Packages Containing Radioactive Materials

1. The packages containing radioactive material will be opened in accordance with the Vendor's instructions.

2. The Radiation Protection Officer or the Alternate Radiation Protective Officer shall be present during the opening process.

3. The Radiation Protection Officer or the Alternate Radiation Protection Officer shall have the appropriate radiation instrument(s) for monitoring the material being handled.

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SECTION VIII: ATTACHMENTS

ATTACHMENT A - FILM BADGE PROCEDURES

Film badges are issued to an individual and are not to be worn by other than the person to whom issued. He will be responsible for his film badge just as for his security badge. Mistreatment or abuse of the badges is strictly forbidden, as is any intentional exposure of the badge to radiation. The exposed portion of the film packet should not be touched nor should any attempt be made to remove the film or disassemble the badge as this could lead to an erroneous reading. The film is sensitive to heat, humidity and pressure.

The following specific procedures will be followed:

1. Badges are to be worn by the radiographer at all times during the work period. Radiographic personnel shall wear film badges as indicated by the License and Amendments.

2. Badges will be placed in designated locations at end of shift.

3. Badges will be changed every four (4) weeks.

4. The program will be conducted and records maintained and reviewed by the Radiation Protection Officer (RPO).

ATTACHMENT B - POCKET DOSIMETER AND PERSONNEL RADIATION MONITOR PROCEDURES

Pocket Dosimeter

#1 The pocket dosimeter is a delicate instrument and must not be subjected to any abuse. It should be fastened securely to the wearer's clothing to avoid dropping. If dropped or bumped, the needle may be jarred up scale and indicate a false reading. If damage is suspected, the wearer should immediately notify a radiographer who will notify the Radiation Protection Officer (RPO).

Some charge will leak from the dosimeters naturally, especially if they have not been frequent use. High humidity may increase the rate of leakage. Any Dosimeter displaying rapid leakage should not be used and should be set aside for evaluation by the Radiation Protection Officer (RPO). Should a dosimeter become fully discharged, the Radiation Protection Officer (RPO) will have the wearer's film badge processed immediately and will check out dosimeter to determine rate of leakage, as well as checking radiation levels in area where dosimeter was worn.

The following specific procedures will be followed:

1. Radiographers must wear a dosimeter during source exposures.

2. Dosimeters must be worn by personnel entering the radiography bay for any reason when the source projector is present.

3. All dosimeters will be charged by a radiographer prior to being worn and will be read frequently during and at end of shift or operation.

4. Users will be logged as to:

   a. Name, date and time
   b. Number of dosimeters

#4 5. Radiographers will immediately notify the RPO if a dosimeter discharges beyond its range.

ATTACHMENT B: Cont'd

Personnel Radiation Monitor

The personnel radiation monitor should be treated with the same respect and care as the pocket dosimeter and survey instruments.

It may be worn clipped to the pocket or carried in the pocket.

The radiation monitor is required only when entering the exposure bay and will be worn only by radiographer.

The monitor will be worn in addition to, and not in place of, pocket dosimeters or film badges, nor will it be used in place of a survey instrument.

#8 ATTACHMENT C - OPERATING INSTRUCTIONS FOR VICTOREEN MODEL 592B GAMMA DOSE RATE METER

1. Turn range switch to zero. Allow to warm up for a few minutes.

2. Zero needle, if necessary, by adjusting the zero control. Needle should be re-zeroed for each use and checked periodically during long periods of operation.

3. Switch to X1. The instrument is now measuring gamma radiation in the range 0 - 10 mr/hr.

NOTE: If any evidence of instability or malfunctioning is noticed during the above steps or during use, or if instrument will not zero properly, the instrument must not be used. Obtain another properly functioning instrument and make arrangements for repair of the faulty meter. Questions as to meter performance should be referred to the Safety Department, Extension 7013 or 7308. #1

4. Should the meter needle peg on the high side of scale during operations, immediately switch to X10 position which covers range of 0 - 100 mr/hr.

5. If needle pegs on X10 position, switch to X100 position which covers range of 0 - 1000 mr/hr.

NOTE 1: Radiation levels in excess of 1,000 mr/hr. (1 r/hr) cannot be measured with the Model 592.

NOTE 2: Any radiation levels above those normal to the operation being performed should be checked immediately, and if verified, indicate an emergency situation. In this event, emergency procedures should be followed.

NOTE 3: Instruments will be calibrated at intervals not to exceed three (3) months, and after each time instrument is serviced. The Safety Department will perform calibration and maintain records.

NOTE 4: Instrument maintenance will be performed by Instrument Shop.

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ATTACHMENT D - POSTING AND RESTRICTION REQUIREMENTS

1. Each radiation area shall be conspicuously posted with signs bearing the radiation symbol and the words "Caution (or Danger) - Radiation Area".

   A radiation area is defined as an accessible area in which radiation levels are such that a major portion of the body could receive in any one (1) hour a dose in excess of five (5) millirem or in any five (5) consecutive days a dose in excess of 100 millirem.

2. Each High Radiation Area shall be posted with signs bearing the radiation symbol and the words "Caution (or Danger) - High Radiation Area".

   Post signs described in No. 2 above on areas reading 100 mr/hr.

   A high radiation area is defined as an accessible area in which radiation levels are such that a major portion of the body could receive in any one (1) hour a dose in excess of 100 millirem.

3. Each restricted area shall be posted with signs per No. 1 above.

   A restricted area is defined as an area to which the licensee must control access for the purpose of radiation protection.

4. Posting procedures at this installation shall include placing of signs per No. 1 above at the perimeter of a "restricted area", that is any area in which a person could receive an exposure in excess of two (2) millirem per hour or in excess of 100 millirem in seven (7) consecutive days, if continuously present in the area.

   Post signs described in No. 1 above on areas reading two (2) mr/hr.

5. Since the radiation area marking requirement has been met by the "restricted area" posting, no further posting of the "radiation area" need be done.

ATTACHMENT D: Cont'd

6. Warning signs per the above regulations will be placed around the perimeter of "restricted" and "high radiation" areas at all points where penetration into the areas could occur and must be accompanied by rope, chain, or other physical barriers as to clearly define and restrict entrance to the area.

7. Signs indicating "restricted" and "high radiation" areas may be placed at locations where less than the actual amount of radiation defining these areas is found, if such locations can be more effectively used to restrict entrance into the area.

ATTACHMENT E - RADIATION SURVEYS

In order to handle a radioactive source safely, measurements must be made to determine; (1) the actual amount of radiation present in the area when a source is exposed; (2) that the source is actually present and stored correctly in the container when retracted.

SPECIFIC PROCEDURES FOR MAKING RADIATION SURVEYS:

1. Surveys During Exposures:

   a. Based on calculations of source strength, distance and shielding, determine a restricted area.
   b. Restrict and post this area. Make sure all personnel are out of area. Remember to check upstairs and basement areas, if necessary.
   c. Expose source (See Attachments F-1 & F-2).
   d. Secure a properly calibrated and functioning survey meter (See Attachment C). Place on X1.
   e. Survey area posted by making meter readings at all pertinent points and at all barriers. Move slowly enough to give meter time to respond. This is especially important when surveying shielding for possible leaks.
   f. Maintain a record of the survey. A drawing is preferable showing all important features and data.
   g. Make whatever adjustments are necessary to redefine and restrict the area per Attachment E.
   h. Be sure to resurvey an area whenever a change is made in source position, shielding, collimation, etc.

2. Survey of Projector after Completion of Exposure:

   a. Retract source until indicator light shows stored.
   b. A radiographer will approach projector with functioning survey meter. This person should be the first to approach projector. He will check the device, including the source guide tube, for levels in excess of normal.
   c. If levels are found normal, access to area can be allowed.

ATTACHMENT E: Cont'd

3. Survey of Projector after Final Exposure and Prior to Storage:

a. Perform Items 2.a., b., and c. above.
b. Lock device per Attachment F.
c. Place device in storage area.
d. Using survey meter, meter measure radiation levels at surface of device. Place meter on marked area of device and compare reading with those previously obtained. This serves to; (1) check on proper storage of source capsule; and (2) is a rough check on survey meter performance. In the event levels are considerably at variance with normal levels, immediately recheck with another survey meter.

4. Surveys Prior to Transporting Device:

a. Source should be secured and locked, and surveys made per Item 2 and 3 above.
b. While exposure device is being positioned in vehicle, check levels at outer surface of the truck. These levels should conform to the definition of an unrestricted area, that is, less than two (2) mr/hr. or 100 millirems in seven (7) days.
c. Source must be repositioned or more shielding added if levels are above those defining an unrestricted area.

d. Survey the drivers position to assure the radiation level is less than two (2) mr/hr.

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#8 ATTACHMENT F-1 - OPERATION INSTRUCTIONS FOR THE MODEL 520 GAMMA RAY PROJECTOR

A properly calibrated and functioning survey meter must be on hand and utilized whenever the source is exposed or retracted. The projector must be checked with the meter before it is put into operation and when it is secured at the end of an exposure period.

#8 OPERATION OF THE PROJECTOR:

1. Place projector in radiography bay.
2. Position source position switch in center of ring.
3. Unlock retaining padlock. Remove plug and attach source tube and lead.
4. Position control unit in control room. Lock. Pass lead and cables through hole to interior of bay and attach to projector.
5. Secure area per Specific Instructions for Radiographic Operations in #1 3A-100, 3A-05-2, 3-10 and 2-10.

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#8 ATTACHMENT F-1: (Cont'd) (DELETED)

#1 ATTACHMENT F-1: Cont'd

#8 6. Expose source by turning crank steadily in counterclockwise direction at about 60 RPM (the proper directions for turning are indicated on the control unit). Note that the indicator lights function properly indicating the "open" position whilecrank is being turned and "on" when source capsule reaches the position switch.

#8 7. If resistance is encountered during cranking, reverse direction for a few turns and resume desired direction of turning. DO NOT FORCE CRANK.

NOTE: If at any time the crank mechanism or indicating lights should malfunction, the source should be withdrawn if possible and the Radiation Protection Officer (RPO) notified.

#8 8. After exposure, retract source by turning crank in a clockwise direction until the "safe" storage indication is obtained.

#8 9. Enter radiography bay and remove source tube and lead, being careful not to alter position of source position switch.

10. Insert plug. Padlock after each period of exposure.

NOTE: Extreme care must be taken at all times to avoid damage to source tube or control cables.

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1 3 ATTACHMENT F-2 - OPERATION INSTRUCTIONS FOR THE GAMMA INDUSTRIES MODEL 180 PROJECTOR

A properly calibrated and functioning survey meter must be on hand and utilized whenever the source is exposed or retracted.

OPERATION OF THE PROJECTOR:

1. Visually inspect source projector and collimator for proper alignment and adjustment.

2. Inspect microswitch and pigtail pins for loose or worn parts.

3. Close and lock vault door.

4. Source position safe light (green) should be on.

5. Depress "test" switch near control box which tests amber and red lights and buzzer.

6. Unlock and push source expose button noting that safe light goes out, amber light and buzzer on then off, and exposed light (red) comes on.

   NOTE: If at any time the indicating lights should malfunction, source should be retracted and the Radiation Protection Officer notified.

7. At end of exposure period, retract source by pushing retract button.

ATTACHMENT G - MOVEMENT OF SOURCE VIA TRUCK

#8 1. Any transportation of the source projector will be made under prior agreement between the Radiation Protection Officer (RPO) and the Supervisor of Radiography, and must be approved by both.

#8 2. Arrangements for a vehicle will be made by the Supervisor of Radiography.

3. The source will be retracted into its housing and fully secured, locked and checked for radiation level per Attachment F.

4. A radiographer will be in constant attendance during transportation and preparations for transportation.

5. The transportation vehicle will be clearly placarded, as required, by the DOT regulation.

6. The exposure device must be firmly secured in the truck by means of chocks and planking.

#8 NOTE: Due to the great weight of the device, it is extremely important that it be firmly fastened in the truck as to prevent any movement.

7. The truck driver will be issued a pocket dosimeter.

8. Radiation levels at the outside of the truck and in the cab will be carefully surveyed. If levels are such as to exceed those for an unrestricted area (See Attachment D), either the source must be repositioned in the vehicle or additional shielding employed. This survey should be done while source device is being initially secured in truck to avoid additional labor.

ATTACHMENT G: Cont'd

9. The Guard Department will be alerted to the fact that the source is being moved, time of departure, route and destination. The route must not take the truck off the IAAP area.

10. Vehicle will proceed directly to the destination with no stops other than due to traffic or normal traffic control devices. Driver and radiographer will remain in truck at all times, except in an accident, until destination is reached.

11. The truck will be accompanied by another vehicle bearing a radiographer with a survey meter.

12. Upon arrival at destination, a radiographer will check the device to determine that levels are to usual values.

13. In event of an accident, emergency procedures will be followed.

ATTACHMENT H - EMERGENCY PROCEDURES

1. Emergency in Vicinity of Source:

   a. In the event of an emergency situation in the vicinity of an exposed source, it should immediately be retracted and secured per operating instructions, if possible to do so without risk of injury.

   b. No more than the minimum number of personnel necessary to return the source to its container should remain in the emergency area.

   c. In the event the source cannot be retracted, this information should be made available to emergency personnel who may be in the area. The area is already restricted and posted, but a resurvey should be made, if necessary, and the area kept under surveillance.

#8 d. If the source is located in other than a radiography bay, the projector should be moved to a safe area, if this can be accomplished without risk of injury.

#8 e. When the source is being used in a radiography bay, it is possible that the source would be in a safer position there than if attempts were made to move it. This is a decision that must be made by the radiographer at the scene.

   f. Follow Emergency Notification Procedure, Section VIII, Page 18.

#1 2. Emergency Involving An Explosion in 3A-100, 3A-05-2, 3-10 or 2-10 Building

Evacuation of personnel and saving of life is the primary objective. This should be accomplished immediately. Evacuate to Change House.

3. Following are Some Possible Conditions With Action to be Taken:

   a. Source and controls are undamaged.
   Radiographer will retract source, then evacuate the area.
   Do not open radiography bay door.

ATTACHMENT H: Cont'd

3. Cont'd

b. Radiography bay walls are undamaged and source probably unaffected. Control unit damaged.
Do not attempt to retract source. Inform emergency personnel that source is still exposed. Do not allow entrance to radiography bay. Make survey when safe to do so.

c. Radiography bay walls damaged, allowing radiation to penetrate to other areas of building.
Retract source, if possible. If not possible, evacuate and inform emergency personnel that source is still exposed. Do not allow entrance to building except to save life. Make survey when safe to do so.

d. Explosive in radiography bay has possibly ruptured source with consequent possible spread of radioactive material.

Evacuate personnel to Change House. Keep personnel together and in one spot to minimize spread of radiocative contamination. Use survey meter to monitor personnel and segregate those showing contamination. Make survey around area. Do not allow emergency personnel to enter area except to save life. These efforts should be taken with a survey instrument to indicate radiation levels.

In all cases, follow emergency notification procedure. The emergency situation activities will be directed by the Safety Department. It is the responsibility of the building foreman to account for all personnel.

4. Emergency or Malfunction Involving Source Projector or Associated Safety Equipment:

a. Return source to projector, if possible. Secure.
b. Notify the Radiation Protection Officer (RPO) for advice on procedures to be followed.

ATTACHMENT H: Cont'd

4. Cont'd

c. If source cannot be retracted or sticks at some point in tube, initiate immediately the following procedure:

1. Survey area to determine if restricted area as set up previously is still sufficient.
2. Inform personnel in area of situation and require them to move to safe area.
3. Restrict entrance to the area by means of whatever barriers, additional signs, posted guards, etc. are necessary.
4. A radiographer will keep the area under direct surveillance.
5. Follow Emergency Notification Procedure.

NOTE: No attempt should be made to deal with an exposed or stuck source, nor should any action be taken which would result in radiation exposure other than that necessary to warn personnel in a danger area or to prevent injury or save lives.

6. Meet the Emergency personnel and inform them of the conditions as they exist.

#8 7. The Radiation Protection Officer (RPO) or his representative will determine the necessary action to be taken to retrieve the source with minimum exposure to personnel.

5. Personnel Accidently Exposed to Radiation:

a. Obtain names of all personnel.
b. Hold these persons at scene for interview.
c. Take steps to immediately correct the situation which resulted in the exposure.
d. Follow Emergency Notification Procedure.

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ATTACHMENT H: Cont'd

6. Vehicular Emergency:

In the event of an accident to the truck transporting the projector, the radiographer in charge of the shipment will immediately do the following:

a. Approach truck carefully with functioning survey meter to determine radiation levels.
b. Take steps to render or obtain whatever first aid is necessary.
c. If radiation levels are normal and vehicle is roadable, continue trip as planned.
d. Notify Radiation Protection Officer (RPO) of incident, who will check source before it is again used.
e. If vehicle is not roadable and radiation levels are normal, make arrangements to set up whatever signs, etc. that are necessary for traffic safety in the area. Follow Emergency Notification Procedure.
f. If radiation levels indicate the source has been dislodged from its container, the radiographer in charge will:

    1. Set up restricted area around vehicle per Attachment D.
    2. Remain at scene and keep area under direct surveillance.
    3. Call (or delegate calling) the numbers in Emergency Notification Procedure.

7. Emergency Procedures for Leaking Source:

a. Upon notification from the Safety Department that the source capsule is leaking, immediately retract source.

ATTACHMENT H: Cont'd

7. Cont'd

b. A check of the area will be made. If radioactive contamination is found, the following procedures will be followed:

1. Immediately restrict entrance to the source projector area.
2. Persons having access to the source area will be interviewed and checked to determine if radioactive contamination has been carried from the area.
3. The area will be checked and swiped for contamination.
4. Area will be cleaned up by Safety Department.
5. Arrangements will be made with vendor for exchange of source.

c. A report will be filed by the Radiation Protection Officer (RPO) to the NRC, per 10 CFR Part 34, 34.25 (d) and, if applicable, 10 CFR Part 20.

8. Emergency Notification Procedure:

The radiographer in charge of operations when an emergency occurs will immediately call the following in order, giving full and complete details of the incident, i.e., (1) location; (2) type of incident; (3) personnel injuries or exposures, if any; (4) specific requests for additional meters, personnel, vehicles, ambulance, etc.

			Office	Home
#1	a.	J. E. Shannan	7308 or 7318	754-8954
		Alternate		
#1		Paul Cross	7434 or 7013	392-8213 (Danville)

NOTE: If neither of the above is available, give message to whoever in the Safety Department answers the telephone.

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ATTACHMENT H: Cont'd

			Office	Home
#1	b.	R. R. Reid	7500	754-5303
		Alternate		
#1		John Gipple	7500	523-3111 (Wapello)

#1 c. Mr. Shannan or Mr. Cross will, in turn, call the following:

#6	1.	R. O. Haines	7859	754-5907
#1	2.	J. E. Jamison	7005	392-8128 (Danville)
#6	3.	C. W. Beaird	7500	524-6801 (Keokuk)

NOTE 1: If "a" and "b" are not available, the radiographer will then call the numbers listed in "c".

#6 NOTE 2: R. Reid, J. Gipple, R. Haines and J. Jamison are notified for administration purposes only.

d. Calling out from restricted telephone, the radiographer will:

1. Call the Guard Headquarters.
2. Give his name to the person who answers.
3. Inform the person who answers that emergency situation exists.
4. Request the persons listed above be notified, giving the name and home phone number of each person to be notified.

ATTACHMENT I - MAINTENANCE AND INSPECTION OF RADIOGRAPHIC EQUIPMENT

1. Inspections:

#8

a. Daily inspections of equipment and its operation are required by the radiographer when equipment is in use. A check list is provided (see Pages 21, 22 and 23) which radiographer shall follow in inspecting his equipment. Any defective equipment must be reported to Supervisor of Radiography, who in turn will notify Radiation Protection Officer (RPO).

b. A detailed inspection of equipment shall be performed by Safety Department every three (3) months along with source inspection.

c. The daily inspection check list shall be reviewed by the Radiation Protection Officer (RPO) at the time of the monthly X-ray survey. Area safeguards shall also be checked at this time.

d. A thorough inspection shall take place at the time of source replacement and all or any preventive and/or corrective maintenance shall take place at this time.

2. Maintenance:

a. Maintenance shall be performed on a preventive and corrective basis:

1. Preventive maintenance shall be performed at three (3) month intervals and shall coincide with Safety Department inventory and inspection performed at this time. Lubrication and replacement of worn parts shall also take place then.
2. Corrective maintenance shall be performed on an as needed basis based primarily on the daily inspections performed by the radiographer.

MASON & HANGER - SILAS MASON CO., INC.
IOWA ARMY AMMUNITION PLANT - Middletown, Iowa

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ATTACHMENT I: Cont'd

DAILY CHECK LIST

Items to be checked (good or bad)

Date	Cables	Collimators	Crank	Indicating Lights, Alarms & Signs	Source Container	Name	Action taken on items not passing inspection

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3. Items to be check on daily check list:

a. Cables

1. Check for damaged or worn source and drive cable tube and connector wear and damage.
2. Look for dirt, rust or sludge build-up in the source tube.
3. Insure proper connection of all mating components.

b. Collimeters

1. Check for damage to the device which may impair its operation.
2. Inspect for changes in the operating characteristics of the device.
3. Look for rust, dirt or sludge build-up where source enters collimeter.

c. Crank

1. Check for proper operation of the crank mechanism.
2. Look for source and drive cable wear or damage.
3. Check proper operation of source position indicator mechanism.
4. Inspect the locking mechanism for damage or wear.
5. Check box for proper labeling.

d. Indicating Lights, Alarms and Signs

1. Assure that all lights are in working order and are not burned out.
2. Check that lights indicate proper source position and that lights are labeled properly.

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ATTACHMENT I: Cont'd

3. d. Cont'd

3. Audio alarms should be checked to assure that they function when tripped manually and at the proper time when tripped automatically.
4. Signs should be clear to understand, easy to read and in good physical condition.

e. Source Storage Container

1. Check for possible shielding defects in container, using survey instrument.
2. Assure proper positioning of source within the container (Using survey instrument).
3. Inspect for damage to the container which may impair its use.
4. The locking mechanism must operate properly and be in good condition.
5. Container must be labeled properly.
6. Inspect connection of guide tube for wear or damage.

Any defective equipment must be reported immediately to your Supervisor.

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#5 ATTACHMENT J: PREPARING RADIOGRAPHIC SOURCES FOR MOVEMENT

A. Preparing Gamma Industries Model 180 Projector for Transporting

1. Survey shield to assure no surface contamination.

2. Insert plug in bottom of shield.

3. Remove electric and air connections from shield.

4. Remove four (4) screws in plastic cover.

5. Attach cable retainer to secure cable (pigtail) at top end of tube for local movement; tube is to be removed and cable retainer installed at the cable entrance port to the main shield for off-area movements.

6. Remove top roll pin in connector coupling on main drive rod.

7. Disconnect bolts holding cylinder support and remove support.

8. Shield is ready for movement in accordance with Section VIII, Attachment G, SOP No. 455.

9. For off-area shipments, acquire an NRC approved Type B package container and transfer to projector site. Assure compliance with Quality Assurance Program 10 CFR, Part 71, Appendix E.

B. Preparing Tech Ops Model 520 Projector for Transporting

1. Survey projector to assure no surface contamination.

2. Physically lock plug in projector with a padlock.

3. Projector is ready for intraplant movement in accordance with Section VIII, Attachment G, SOP No. 455.

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#5 B. Cont'd

4. For off-area shipments:

a. Acquire an NRC approved Type B package container and transfer to projector site. Assure compliance with Quality Assurance Program 10 CFR, Part 71, Appendix E.

b. Remove projector from stand and install eyebolt plate on appropriate mounting surface.

c. Disassemble package container, place projector in base of container and reassemble package.

d. Transfer container to Building 11-37-6 for off-area shipment per Section VIII, Attachment G, SOP No. 455.