

# DEPARTMENT OF THE NAVY

PHILADELPHIA NAVAL SHIPYARD PHILADELPHIA, PA 19112 5087

IN REPLY REFER TO

PHILANAVSHIPYDINST 5100.34G Code 135.2 28 October 1985

# PHILANAVSHIPYD INSTRUCTION 5100.34G

From: Commander, Philadelphia Naval Shipyard

Subj: IONIZING RADIATION CONTROL FOR INDUSTRIAL RADIOGRAPHY

- (a) Code of Federal Regulations Title 10, Chapter 1, Parts 19, 20, 21 Ref: and 34
  - (b) U. S. Nuclear Regulatory Commission Byproduct Materials License No. 37-00314-06
  - (c) NAVMED P-5055 Radiation Health Protection Manual
- Encl: (1) Management Control of Industrial Radiography (2) Operating and Emergency Procedures for Industrial Radiography

1. Purpose. To establish management control of the industrial radiography program, assign responsibilities and provide operating procedures necessary to comply to the requirements of references (a), (b), and (c).

2. Cancellation. This Instruction is a complete revision which cancels PHILANAVSHIPYDINST 5100.34F of 6 April 1979.

3. Scope. Enclosures (1) and (2) apply to all industrial radiographic operations and associated work involving ionizing radiation for performance of radiography by the Nondestructive Test Branch, Quality Assurance Office.

KERR, JR

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#### MANAGEMENT CONTROL OF INDUSTRIAL RADIOGRAPHY

### 1. Responsibilities

a. <u>Commander</u>, <u>Philadelphia Naval Shipyard</u> is responsible for conformance to both Nuclear Regulatory Commission and Navy Department regulations pertaining to the use of licensed by-product material and X-ray machines in the industrial radiography program. To insure compliance to requirements of references (a), (b), and (c) responsibilities are assigned to the following personnel:

(1) <u>Safety Manager - Code 106.2</u> is designated "Radiation Safety Officer" and assigned the following:

(a) Control the administrative and technical aspects of the radiation safety program.

(b) Review and approve application for by-product material license of reference (b).

(c) Review and approve procurement and disposal of licensed byproduct material and X-ray machines.

(d) Review and approve operating and emergency procedures for the industrial radiography program.

(e) Assure that leak testing of licensed by-product material is properly conducted, evaluated and documented.

(f) Insure conduct of quarterly inventory of licensed by-product material.

(g) Assume control and institute corrective action in radiation emergency situations.

(h) Investigate cause of incidents and determine necessary preventive action.

(i) Establish and maintain the licensee's internal inspection system.

(j) Periodically measure radiation levels associated with radiographic operations utilizing both sealed sources and X-ray machines to assure radiation safety in their use.

(k) Review and insure maintenance of all records required by references (a), (b), and (c).

(1) Assure that the industrial radiography safety program is conducted in compliance to current regulations. Provide cognizant personnel with copies of current regulations and requirements pertinent to the program.

(m) Carry out the notification and reporting requirements of references (a) and (c).

(2) <u>Industrial Hygienist</u> - Occupational and Environmental Health Services, Code C-15, Naval Hospital, Phila., Pa. as an additional duty is designated "Radiation Health Officer" and assigned the following;

(a) Provide technical expertise, advice and assistance to the Radiation Safety Officer, Code 106.2.

(b) Act in advisory capacity to licensee's management and radiography personnel.

(c) Establish and maintain adequate personnel monitoring system.

(d) Establish and maintain adequate personnel exposure records.

(e) Assist in training program for radiographic personnel.

(f) Assist in the control and initiation of corrective action in radiation emergency situations.

(g) Assist in the investigation of radiation incidents and in the development of necessary preventive action.

(h) Assist in the development and maintenance of up-to-date administrative and operating and emergency procedures for the radiography program.

(3) Quality Assurance Office - Code 130

(a) <u>Quality Assurance Specialist, Code 135.2</u> is designated "Assistant Radiation Safety Officer" and assigned the following:

1. Prepare license application of reference (b).

 $\underline{2}$ . Control the procurement and disposal of licensed by-product material.

<u>3</u>. Develop and maintain up-to-date operating and emergency procedures for the industrial radiography program.

4. Establish and conduct the training program for radiographers and radiographers' assistants.

5. Examine and determine competency of radiography personnel.

6. Examine adequate storage facilities for by-product

material.

7. Establish and maintain the leak testing program.

8. Establish t's program for inspection and maintenance of gamma ray equipment.

9. Perform source replacement operations.

10. Establish and maintain licensee's record keeping system.

11. Assist in the control and initiation of corrective action in radiation emergency situations.

12. Assist in the investigation of incidents and help determine necessary preventative measures.

13. Conduct monthly audits of radiography field sites, facilities, equipment and records to ensure compliance to references (a), (b), and (c) and enclosure (2) requirements.

14. Maintain the licensee's Shore Radiac Equipment Allowance Inventory for Operational use (Radiography).

(b) Head, Nondestructive Test Branch (Code 135)

<u>1</u>. Direct production radiography to assure safe usage of radiation sources within the requirements of references (a), (b), and (c) and enclosure (2).

2. Assist in developing and maintaining up-to-date operating radioactive material storage facilities.

3. Assist in the establishment and maintenance of adequate radioactive material storage facilities.

4. Assist in the control and initiation of corrective action in emergency situations.

5. Assist in determining cause of incidents and necessary preventive measures.

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(c) Metals Inspector General Foreman - (Code 135-1)

1. Assist in on the job training, examination and intermination of competency of radiography personnel.

2. Maintain exposure devices, radiographic facilities and

3. Assist in establishing control and initiating corrective action in emergency situations.

(d) Metals Inspector Foreman - (Code 135.1)

1. Conduct radiographic operations per requirements of references (a), (b), (c), and enclosure (2).

2. Assign a radiographer to each radiographic area to assume responsibility to direct and personally supervise field and shipboard operations. He shall ensure that the radiographic operations are conducted in ucmpliance to enclosure (2) requirements.

3. Ferform daily inspections of radiography personnel to ensure compliance to enclosure (2) requirements.

4. Assist in the on-job-training of radiographer

assistants.

5. Assist in establishing control and initiating corrective

(e) Equipment Specialist (MDT) - (Code 135.1)

1. Perform inspection, maintanance and repair of radiographic equipment.

2. Perform those scaled source replacement operations associated with gamma-ray equipment service/repair.

3. Ensure currently calibrated and operable survey meters are available for use.

4. Maintain records of inspection, maintenance, repair and calibration of radiographic equipment.

(f) Radiographor Cods 135.1: Is the individual who performs or who, in attendance at the site where sealed source is being used, personally supervises radiographic operations and who is responsible to the license for

assuring compliance with the requirements of Nuclear Regulatory Commission regulations and conditions of the license. His responsibilities are as follows:

1. Perform equipment check, SPI, guide tube, sealed source container, collimators, and radiation survey meters to be used at source site.

form.

2. Maintenance of all entries to be made on the NRC record

3. Be physically present at the site where source is to be exposed to assure that sealed source exposures and surveys are conducted in compliance to requirements contained in enclosure (2). The radiographer may perform this function himself or to be able to watch an assistant radiographer or a radiographer acting as an assistant radiographer do it. He must be able to render immediate assistance at source site when required.

4. Maintain communications with personnel monitoring the restricted area perimeter accesses.

5. The radiographer shall retract or have source retracted upon warnings of violations from any member of the work crew or when he has the slightest doubt that something is wrong that will endanger himself or other personnel to ionizing radiation.

 $\underline{6}$ . Protect himself and others from the hazards involved in the use of licensed source material and X-ray machines.

(g) <u>Radiographer Assistants Code 135.1</u>: Any individual who, under the personal supervision of the radiographer, uses radiographic exposure devices, sealed sources, related handling tools, or radiation survey instruments.

(4) Production Department - Radiac Repair Facility, (RRF) (Code 967)

- (a) Perform leak test procedure per reference (b).
- (b) Conduct a survey meter calibration program.
- (c) Conduct a pocket dosimeter calibration program.

(5) Supply Department (Code 500)

(a) Assure that packing, labeling, shipping or storage of radioactive material under the Supply Department's cognizance is in accordance with applicable regulations.

(6) Administrative Department (Codes 1710 and 1740)

(a) Provide for security of temporary restricted areas during radiation emergencies upon request of Code 135.1.

(b) Make appropriate prefire planning surveys to evaluate potential hazards from a fire and prepare best possible fire protection principles of operation.

# OPERATING AND EMERGENCY PROCEDURES

FOR

### INDUSTRIAL RADIOGRAPHY

# Philadelphia Naval Shipyard

# Section 1

HANDLING AND USE OF LICENSED SEALED SOURCES, RADIOGRAPHIC EXPOSURE DEVICES, SOURCE CHANGERS AND X-RAY MACHINES.

- 1.1 Radiation Exposure Devices
- 1.2 Source Changers
- 1.3 X-Ray Machines

1. Handling and Use of Licensed Sealed Sources, Radiographic Exposure Devices, Source Changers and X-Ray Machines

#### 1.1 Radiographic Exposure Devices

a. General Instructions

(1) Survey the shielded head whenever it is removed from or placed into storage; following completion of each sealed source exposure; and whenever it is moved from one location to another. Perform applicable surveys per Section 3.6.

(2) Do not move an assembled radiographic exposure device from one location to another. After performing the required survey, lock the shielded head, remove the key, disassemble the source guide tube and the source (SPI) (drive cable assembly) and return the shipping plugs/caps to the shielded head before moving it.

(3) Utilize collimators whenever possible to reduce unnecessary radiation.

(4) Immediately prior to exposing the sealed source, physically search the restricted area or exposure room to ensure that no unauthorized personnel are in the area.

(5) Obtain and return keys to the sealed source storage areas from/to the Shift Supervisor. The storage areas are to be kept locked except when in use.

(6) Remove the shielded head from storage, ensure that it is locked and the shipping plugs/caps are in place.

(7) Survey the shielded head per Section 3.6a.

(8) Enter all required information in the "Source Utilization and Source Survey" section of the NRC Record Form. (See Section 8.1).

(9) Check all gamma ray equipment before use, for physical and mechanical condition per Section 9.

(10) Position the shielded head on a flat and easily accessible solid surface. Physically secure it to a support structure with rope, cable or chain if it must be placed in a position where it could fall or be knocked over.

(11) Run the source guide tube as straight as possible from the shielded head to the exposure site. Avoid any turns or bends in the tube that are less than a 20 inch radius.

(12) Straighten out the SPI to its full length. Position the crank handle of the SPI so as to utilize the most effective available radiation shielding for operator radiation protection. Avoid forming bends and turns of less than 36 inch radius in the SPI housing cables during positioning or use.

(13) Insert the key and unlock the shielded head immediately prior to each shield source exposure. Lock the shielded head and remove the key immediately following each Source Shielded Position Survey.

#### b. Srecific Instructions Tech/OPS Model 660 and 680

(1) Remove plug from exit port of the shielded head and thread source guide tube into place. Never operate the system with more than three guide tube sections (including the master).

(2) Unlock the shielded head and turn the selector from the LOCK position to the CONNECT position. When the ring is in the CONNECT position, the storage cover will disengage from the shielded head.

(3) Slide the connector collar of the SPI back and open the jaws of the connector. This exposes the male portion of the swivel drive cable connector.

(4) Engage the male portion of the swivel drive cable connector to the female portion of sealed source swivel connector by depressing the springloaded locking pin of the sealed source connector toward the shielded head with the thumbnail. Release the locking pin and test the connection.

(5) Close the jaws of the connector over the swivel connector. Slide the connector collar over the connector jaws. Hold the collar flush against the control unit connector and rotate from the CONNECT position to the LOCK position. Keep the shielded head locked until operation is ready to start.

(6) Ensure that the restricted area is properly posted; contains no unauthorized personnel; and is under proper surveillance.

(7) Unlock the shielded head and rotate the selector ring to the operate position. The source is now free to move.

(8) Return to the SPI and adjust the odometer reset knob to obtain a 000 reading on the odometer.

(9) Rapidly rotate the crank in the expose (counter clockwise) direction to move the source to the radiographic focal position.

(10) When the source reaches the source stop, the hand crank will stop turning. Never exert more than 5 ft-lbs of torque on the hand crank, as this may cause damage to the control unit or drive cable. The odometer reading will indicate the total distance the source has traveled (approximately 7 ft. for one source guide tube section, 14 ft. for two source guide tube sections, and 21 ft. for three sections). Set the brake to on to prevent movement of the source during the exposure.

(11) To return the source to the exposure device after the desired exposure time has elapsed, turn the brake to off and rapidly turn the crank in the retract (clockwise) direction until the crank will no longer move. The odometer should read 000.

(12) Perform a source shielded position survey per Section 3.6b. Do Not Depend on Dial Indicator of SPI.

(13) When the source is properly stored in the shielded head, rotate the selector ring from the operate position to the LOCK position. If the selector ring cannot be rotated to the LOCK position the source has not been full retracted. It should be 000 turn the hand crank to the full clockwise (retract) direction.

(14) Lock the shielded head and remove key from lockbox.

(15) Upon completion of Radiography, unlock the shielded head. Rotate the selector ring from LOCK to CONNECT position the control unit connector will partially disengage. Slide connector collar back and open jaws disengage male and female portions of the swivel connector by depressing the spring-loaded locking pin and disconnect.

(16) Replace the storage cover in the control unit connector and rotate the selector ring to the LOCK position. Engage lock and remove key.

(17) Unscrew source guide tube and insert storage plug into guide tube connector and tighten. Dissemble guide tubes and place plastic caps on tubes to eliminate dust and dirt from entering tubes.

(18) Perform a source shielded position survey per Section 3.6b.

c. Specific Instructions - Iriditron 520

(1) Remove plug from exit port of shielded head and thread source guide tube in place.

(2) Remove cap from fitting behind lock box on the shielded head to reveal the sealed source disconnect fitting.

(3) Attach SPI connect-disconnect fitting to the sealed source connect-disconnect fitting by placing the spline on sealed fitting into hole in SPI fitting (90 degree angle). Turn SPI fitting past 90 degree until projection on spline of source connect-disconnect fitting enters groove in SPI connectdisconnect fitting, then straighten fittings. Do not use force to straighten fittings.

(4) Attach SPI housing to the lock box assembly of shielded head. Screw swivel fitting in until it fits snug in the lockbox barrel.

(5) Ensure that the restricted area is properly posted; contains no unauthorized personnel; and is under proper surveillance.

(6) Insert Key and unlock the shielded head. Expose the sealed source by turning the control handle of SPI clockwise until it stops. <u>DO NOT</u> FORCE HANDLE.

(7) Following completion of exposure, return sealed source to shielded head by turning the control handle of SPI counter-clockwise until it stops. The sealed source position indicator dial should read zero feet.

(8) Perform a source shielded position survey per Section 3.6B. Do No Depend on Dial Indicator of SPI.

(9) Lock the shielded head and remove key from lockbox.

d. Specific Instructions - Multitron 51B

(1) Remove plug from exit port of shielded head and thread source guide tube in place.

(2) Remove plug from fitting behind lockbox of shielded head.

(3) With the shielded head LOCKED, pull the sealed source cable out 1/4 inch to expose the disconnect fitting. <u>NOTE</u>: Pulling the sealed source cable out with the lockbox unlocked may result in the sealed source coming completely out of the shielded head.

(4) Attach the SPI disconnect fitting to the sealed source disconnect fitting with the Allen Head screw provided. Double check this connection to determine if properly made before attaching SPI housing to shielded head.

(5) Attach the SPI housing to the lockbox assembly of shielded head. Screw swivel fitting in until it fits snug in the lockbox.

(6) Ensure that the restricted area is properly posted; contains no unauthorized personnel; and is under proper surveillance.

(7) Insert key and unlock the shielded head. Expose the sealed source by turning the control handle of SPI clockwise until it stops. <u>DO NOT</u> FORCE HANDLE.

(8) Following completion of exposure, return sealed source to shielded head by turning the control handle of SPI counter-clockwise until it stops. The sealed source position indicator dial should read zero feet.

(9) Perform a source shielded position survey per Section 3.6B. Do Not Depend on Dial Indicator of SPI.

(10) Lock the shielded head and remove key from lockbox.

#### 1.2 Handling and Use of Source Changers

a. General Instructions

(1) Source changers shall be used only by the NDT Equipment Specialist, Code 135.1 or the Assistant Radiation Safety Officer, Code 135.2.

(2) Source changers shall be locked and posted to indicate their current use status at all times. The exterior of the source changer shall be posted with a tag or label containing the following information as applicable:

(a) MT (EMPTY) date and signature of last user.

(b) Sealed source I.D., curie strength, date and signature of person placing the sealed source into the source changer.

(3) Perform routine sealed source replacement and service operation in the IR-192 Room, or Cobalt 60 room, building 20 as applicable.

(4) Survey the source changer with an approved and currently calibrated survey instrument, AN/PDR 27 survey meter or equivalent, before and after all operations to ensure safe housing of the sealed source. Radiation levels are not to exceed 200 MR/HR at the surface and 10 MR/HR at three feet from any exterior surface of the source changer.

#### b. Specific Instructions

#### (1) From Shielded Head to Source Changer

(a) Survey the source changer to ensure the source is in the proper storage position.

(b) Position the source changer and shielded head close together so that one section of source guide tube will connect them with no sharp turns or bends. (Use short transfer tube when provided with changer.)

(c) Remove the outlet plug from the shielded head and connect source guide tube.

(d) Remove cover from source changer by breaking seal wire and unbolting.

(e) Remove source holddown cap by breaking seal wire and unthreading cap from <u>empty</u> chamber.

(f) Connect source guide tube to empty chamber of changer.

(g) Attach drive cable assembly (SPI) to shielded head according to the procedure for that shielded head.

(h) Unlock shielded head, leave exposure room, secure door and crank the sealed source into the source chamber until it stops.

(i) Return to exposure room, approach the shielded head with the survey meter. Survey the shielded head on all sides, survey the guide tube, and survey the source changer on all sides to ensure the source has been properly transferred.

(j) Disconnect drive cable (SPI) from sealed source and unthread source guide tube. On some changers this operation is reversed.

(k) Replace source holddown cap.

(1) Remove sealed source I.D. tag from the shielded head and secure it with seal wire to holddown cap.

(m) Replace cover on source changer. (Reseal if source changer is to be shipped.)

(n) Label or tag source changer per paragraph 1.2a(2).

(2) From Source Changer to Shielded Head

(a) Survey the source changer to ensure the source is in the proper storage position.

(b) Position the source changer and shielded head close together so that one section of source guide tube will connect them with no sharp turns or bends. (Use short transfer tube when provided with changer.)

(c) Remove the outlet plug from the shielded head and connect source guide tube.

(d) Remove cover from source changer by breaking seal wire and unbolting.

(e) Attach drive cable assembly (SPI) to shielded head according to the procedure for that shielded head.

(f) Remove source holddown cap by breaking seal wire and unthreading cap of chamber containing the sealed source.

CAUTION: When the source holddown cap is removed, the source connector is exposed. Care must be taken to ensure the source is not dislodged when handling the changer.

(g) Unlock empty shielded head and crank source drive cable thru shielded head and source guide tube until it extends approximately one inch from the open end of the tube. Connect the drive cable (SPI) disconnect fitting to the sealed source disconnect fitting. Connect source guide tube to changer. For changers having source guides, connect source guide tube prior to cranking out drive cable.

(h) Leave exposure room, secure door and withdraw the sealed source from the changer.

(i) Return to exposure room, approach the shielded head with the survey meter. Survey the shielded head on all sides. survey the guide tube, and survey the source changer on all sides to ensure the source has been properly transferred.

(j) Disconnect (SPI), lock shielded head and remove key.

(k) Disconnect source guide tube from shielded head and source changer. Replace outlet plug on shielded head.

(1) Replace source holddown cap on source changer.

(m) Replace cover on source changer. (Reseal if source changer is to be shipped.)

(n) Affix the identification plate of the new sealed source to the shielded head.

(o) Label or tag the source changer per paragraph 1.2a(2).

1.3 Use of X-Ray Machines

a. General Requirements

(1) Only certified radiographers are permitted to operate X-ray machines.

(2) X-ray machine control consoles are to be kept locked when not in use. Shift supervisors shall control the keys.

(3) X-ray machine cable components shall be visually checked before use of physical condition.

(4) Film badges and dosimeter requirements of Section 5, apply to X-ray machine usage, with the exception low energy dosimeter IM 235 PD must be used.

(5) Access door interlocks associated with X-ray machine operation shall be checked for proper operation per instructions posted at the control console of the machine.

(6) Area monitoring and alarm systems must be checked per Section9.2(6).

(7) X-ray machines shall be operated in strict conformance to safety requirements posted at the control console of each machine.

(8) A Utilization Log shall be maintained for each X-ray machine. Information, as specified in Section 8.3 shall be entered into the log for each X-ray machine's usage by the Radiographer.

b. <u>Operating Instructions</u>. Specific operating instructions for each X-ray machine are posted at the respective control consoles of the machines.

# OPERATING AND EMERGENCY PROCEDURES

FOR

# INDUSTRIAL RADIOGRAPHY

# Philadelphia Naval Shipyard

# Section 2

SECURITY OF RADIATION EXPOSURE DEVICES AND SEALED SOURCES

- 2.1 Radiation Exposure Devices (Shielded Heads)
- 2.2 Storage of Shielded Heads
- 2.3 Storage of Iridium 192 Source Changers
- 2.4 Storage of Cobalt 60 Source Changers

## 2. Security Radiation Exposure Devices and Source Changers

2.1 <u>Radiation Exposure Devices (Shielded Heads)</u>. The Radiographer, when assigned custody of a sealed source, shall provide for its security <u>at all</u> times. The following precautions must be covered:

a. Never leave the shielded head unattended after it is removed from storage or from the permanent radiographic work areas of Building 20. When radiography personnel leave the job site they must take the shielded head with them.

b. Lock and remove the key from the shielded head whenever an exposure is not being made.

c. Take all prudent precautionary measures to prevent either loss or damage to the sealed source and shielded head.

d. Never move the shielded head from one location to another without first:

(1) Performing a source shielded survey per paragraph 3.6b.

(2) Locking and removing the key from the shielded head.

(3) Replacing safety caps/plugs in shielded head.

e. Return the shielded head to proper storage following use.

2.2 Storage of Shielded Heads

a. Store all shielded heads in the permanent storage areas of Building 20.

(1) Store the Cobalt 60 Exposure Device in the Cobalt Room.

(2) Store the Iridium Exposure Devices in the IR-192 Vault located in the IR-192 Room.

2.3 <u>Storage of Iridium Source Changers</u>. Source changers shall be stored in the IR-192 Room of Building 20.

2.4 Storage of Cobalt 60 source changers in Cobalt 60 Room of Building 20.

Enclosure (2)

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#### OPERATING AND EMERGENCY PROCEDURES

### FOR

# INDUSTRIAL RADIOGRAPHY

# Section 3

SURVEY METERS AND PERFORMANCE OF SURVEYS

3.1 General Requirements for Survey Meters
3.2 Specific Instructions - AN/PDR-27 Survey Meter
3.3 Specific Instructions - AN/PDR-43 Survey Meter
3.4 Specific Instructions - Model 250B Survey Meter
3.5 Specific Instructions - Model RO-2 Survey Meter
3.6 Specific Instructions for Performing Surveys

#### 3. Survey Meters and Performance of Surveys

#### 3.1 General Requirements for Survey Meters

a. Operable and currently calibrated survey meters shall be available at all radiographic sites. Meters approved for use are:

(1) AN/PDR 27

(2) AN/PDR 43

NOTE: Whenever an AN/PDR 27 is used an AN/PDR 43 shall also be available at the site.

(3) Gamma Industries Model 250B

(4) Eberline Model RO-2

NOTE: Model RO-2 is required at X-ray sites.

b. Check each survey meter to ensure that it bears a calibration tag showing date of last calibration. If date is beyond 90 days replace with a freshly calibrated instrument.

c. Check each survey meter prior to use for battery and radiation response as specified in paragraphs 3.2, 3.3, 3.4 and 3.5.

d. Do not use any survey meter which is in an expired calibration period; has a low battery response; or is not in proper operating condition when checked out per paragraph 3.2, 3.3, 3.4, and 3.5. If, when using a survey meter, you have any indication or reason to suspect faulty operation, stop work immediately and replace it.

e. Record serial numbers of all survey meters checked out for use during each radiogrpahic assignments and results of the check of each survey meter in the daily checks of Gamma-ray Equipment Section of the NRC Record Form. (See Section 8.1).

3.2 Specific Instructions - AN/PDR-27 Survey Meter.

a. Turn range selector switch to BATT COND. Meter pointer should rest to right side of red line marked BATT. If it does not, the batteries need servicing. Discontinue meter check and tag it for repair.

b. After battery condition checks out properly, check radiation response of the meters using both natural background radiation and the shielded head as follows:

(1) Turn range switch to 0-0.5 mr/hr range. Connect the headset. Listen for clicks. Observe the meter closely. The meter pointer should swing irregularly at the low end of the scale whenever a click or a group of clicks is heard.

(2) Turn the range switch to 0-5 mr/hr range. The meter pointer swing should be greatly reduced from that of (1) above, but the clicks in the headset will continue at the same rate. When the pointer swings and clicks are heard at irregular intervals, the two low-range positions are operating properly.

(3) To test the upper ranges of the meter turn the range switch to 0-50 mr/hr range. Listen carefully for clicks. The clicks will be slow as one per minute or one per two minutes. Generally there will be no movement of the pointer, meter response is indicated by the clicks in the headset.

(4) When the survey meter checks out as described above, disconnect the headset and try all range positions when performing the initial survey of the shielded head, prior to removing the shielded head from storage.

c. When the meter readings and responses specified in steps a. and b. above are obtained, the survey meter is in proper operating condition.

d. When using the survey meter, make all readings using the high range first and work down to the appropriate range which gives a reading as near center of the scale as possible. <u>DO NOT ALLOW</u> a full sca (Pegged) reading to remain on the meter for any length of time.

e. In using 0-0.5 mr/hr and 0-5 mr/hr ranges, the external probe must be employed. On these ranges, removal of the aluminum shield from the end of the probe gives a combined <u>Beta - Gamma</u> reading. With shield covering end of probe, the meter indicates gamma radiation only. The shield <u>must</u> be in place when monitoring radiographic devices and sites.

f. In using 0-50 mr/hr and 0-500 mr/hr ranges the internal probe must be employed. Location of the probe is indicated on bottom of case by a dimple. The dimple is the detector for measuring radiation and is to be considered zero inches whenever a distance measurement is associated with monitoring operations using these two ranges. These two ranges measure gamma radiation only.

3.3 Specific Instructions - AN/PDR-43 Survey Meter

a. Turn range selector switch to BATT position. Meter pointer should read to right of battery mark. If it does not, the batteries need servicing. Discontinue meter check and tag it for repair.

b. After battery condition checks out properly, check radiation response of the meter as follows:

(1) Hold function selector knob in the CHECK position, this will place an internally located beta source sample in front of the mica window end of the GM detector tube for steps (2), (3) and (4) below.

(2) Turn range selector switch to 0-5 r/hr range. Meter should read 2.0 r/hr + 30%.

(3) Turn range selector switch to 0-50 r/hr range. Meter should read 2.0 r/hr  $\pm$  30%.

(4) Turn range selector switch to 0-500 r/hr range. Meter needle should deflect.

c. When the meter reading and responses specified in steps a. and b. above are obtained, the survey meter is in proper operating condition.

d. To measure GAMMA radiation

(1) Check that function switch is in GAMMA position.

(2) Turn range selector switch to 500, 50 or 5 r/hr range position, whichever gives highest on-scale reading. Read gamma intensity directly from scale in Roentgens per hour.

e. When using the survey meter, make all readings using high range first and work down to the appropriate range which gives a reading as near center of the scale as possible. <u>DO NOT ALLOW</u> a full scale (Pegged) reading to remain on the meter for any length of time.

f. <u>WARNING</u>. The AN/PDR-43 contains a small Beta emitting radioactive source (Kr-85) which is built into the instrument. <u>This instrument is not to</u> be opened by Nondestructive Test Division personnel.

3.4 Specific Instructions - Gamma Industries, Model 250B

a. The 250B is powered by 2 "D" cell (flashlight) batteries. It is capable of detecting ionizing radiation ranging from 2 mr/hr to 1 r/hr. Selection switch provides ranges for 0-10 mr/hr (X1), 0-100 mr/hr (X10), 0-1000 mr/hr (X100).

b. Check instrument for physical damage. Open case, make visual inspection, ensure that batteries are securely in place.

c. Turn switch to battery check (circuit check) position. The meter should indicate above the check position (to the right). Allow 10 to 30 seconds for energy to travel through circuits.

d. Select the desired range. The scales are marked 0-10 mr/hr with a multiplier as selected by the selection switch. Read the measurements indicated on the linear scale and multiply by the selected numbers.

e. The geiger tube is mounted at the extreme front centerline of the meter, and is the detector for measuring radiation. Hold the instrument level and perpendicular to the source of radiation.

f. All meters shall be checked against the sealed source that is to be used for the operation prior to removing the source from the RT facility or prior to using in the permanent facility.

g. Perform this check in conjunction with conducting survey of shielded head <u>out</u> of storage. Use high range first and work down to appropriate range.

#### 3.5 Specific Instructions - Eberline Model RO-2

a. The Model RO-2 is powered by three NEDA 160A, 9V type, 10 to 5.4V per battery. It is capable of detecting Beta(b) Gamma(Y) and X-Ray radiation ranging from 2 mr/hr to 5 r/h. Selection switch provides ranges from 0-5 mr/h, 0-500 mr/h and 0-5000 mr/h.

b. Check instrument for physical damage. Open case and make visual inspection, ensure that batteries are securely in place.

c. Check condition of batteries by turning the function switch to BATT 1 and then to BATT 2 positions. The meter should read above the BATT-CUT-OFF line in both cases.

d. Turn the function switch to zero position. Check that the meter reads zero. If not, set it to zero with the zero knob.

e. Set the function switch to the desired range of operation. The switch position selected is full scale reading of that range.

f. When measuring B, low energy Y, or X-ray emissions, open the sliding B shield on the bottom of the case, and face the bottom of the instrument toward the radiation source. To open or close the shield, depress the friction release button on the left side of the case and manually move the slide, or let it fall due to gravity. When shield is open, protect the thin face against puncture damage.

#### NOTES:

1. The zero setting of the instrument may be checked in any radiation field by merely selecting the zero position.

2. When selecting the most sensitive range (5 mr/h), switching transient noise may cause a temporary deflection of the meter. This can be avoided by first selecting 50 mr/h, letting the needle settle, and then switching to 5 mr/h.

3. The effective center of the ion chamber is marked by dimples, and is the detector for measuring radiation, the dimples are located at the front and sides of the instrument case.

#### 3.6 Specific Instructions for Performing Surveys

a. <u>Survey of Shielded Head In and Out of Storage</u>. Survey the shielded head to ensure that the sealed source is in the proper shielded position whenever the shielded head is placed into or removed from storage. Ensure shielded head is locked with key removed and shipping plugs/caps in place. All survey meters shall be as required in paragraph 3.1 of this section. Survey the perimeter of IR 192 shielded head at a distance of six inches from the shielded head. When using the AN/PDR-27 survey meter, or the Eberline Model RO-2 survey meter, set on the 0-50 mr/hr range. When using Gamma Industries, Model 250B survey meter, set it on the 0-100 mr/hr range. The radiation levels should not exceed 50 mr/hr. Survey at contact all accessible surfaces of the CO60 shielded head. When using the AN/PDR-27 survey meter, or the Eberline Model RO-2 survey meter, set on the 0-100 mr/hr range. Radiation levels should not exceed 200 mr/hr. Enter survey results in the "Storage Survey" section of the NCR Record Form. (See Section 8.1)

b. <u>Source Shielded Position Survey</u>. Perform this survey immediately following each individual sealed source exposure to ensure that the sealed source has been returned to the shielded position within the shielded head. Survey the perimeter of the shielded head; the length of the source guide tube; and the perimeter of the collimator. Perform surveys of source guide tube and collimator with meters set on ranges as directed in paragraph 3.6(a) above. <u>NOTE</u>: Perform surveys sequentially: (1) ensure that the radiation level of the shielded head being used is normal (based on initial survey results when removed from storage) and (2) that radiation levels of source guide tube and collimator do not exceed background radiation levels. Record each survey performed in the "Source Shielded Position Survey" section of the NRC record form. (See Section 8.1).

NOTE: Do not allow full scale (Pegged) reading to remain on the meter for any length of time.

c. <u>Temporary Restricted Area Surveys</u>. Conduct surveys of temporary restricted areas as follows:

(1) Survey the perimeter of the restricted area, with a AN/PDR-27 or Model RO-2 set on the O-5 mr/hr range or the Model 250B set on the O-10

mr/hr range, during the initial sealed source exposure period and whenever the source - target configuration for a following exposure is substantially different from the previous exposure.

less.

(2) Adjust the boundaries as necessary to conform to 2 mr/hr or

(3) To prevent needless radiation exposure do not survey the posted boundaries of high radiation areas contained in the restricted area.

(4) In addition to surveying the posted boundaries of the restricted area, survey all accessible areas on piers, in dock or on marine railways adjacent to the point of shipboard radiography. The established restricted area will be expanded to include any additional adjacent areas found to have radiation levels greater than 2 mr/hr.

(5) Record all survey results in the "Area Survey" Section of the NRC Record Form. (See Section 8.1).

#### d. Sealed Source Transportation Vehicle Surveys

(1) Survey the shielded head per paragraph 3.6a above, before placing it aboard the vehicle.

(2) Survey the perimeter of the vehicle and the passenger compartment after securing the shielded head in the vehicle. Use the AN/PDR-27 or Eberline Model RO-2 survey meter set on the O-5 mr/hr range or the Model 250B survey meter set on the O-10 mr/hr range. Maximum permissible radiation level at 18 inches from the exterior surface of the vehicle and in the passenger compartment of the vehicle is 2 mr/hr.

(3) Add additional shielding around the shielded head if necessary to reduce radiation levels to 2 mr/hr.

# OPERATING AND EMERGENCY PROCEDURES

FOR

# INDUSTRIAL RADIOGRAPHY

# Philadelphia Naval Shipyard

#### Section 4

CONTROLLING ACCESS TO RADIATION AREAS

4.1 Temporary Restricted Areas

4.2 Permanent Radiographic Work Area - Bldg. 20

4.3 Unauthorized Entry Into Radiation Area

#### 4. Controlling Access to Radiation Areas

4.1 <u>Temporary Restricted Areas</u>: The Radiographer assigned to direct the radiographic operation shall maintain control of temporary restricted area by ensuring the following is adhered to:

a. Determine maximum boundary distances to the 2 mr/hr isodose line from Table I of Attachment (1). Rope off and post the 2 mr/hr isodose line at straight locations with "Danger-Radiation Area" warning signs.

b. Determine the maximum boundary distances to the 100 mr/hr isodose line from Table I of Attachment (1). Post the perimeter of the 100 mr/hr isodose line at conspicuous locations with "Danger-High Radiation Area" warning signs.

c. Thoroughly search the confines of the restricted area and ensure that all unauthorized personnel are evacuated from the area. Only qualified radiography personnel equipped with film badges, dosimeters and survey meters are authorized to enter or be in the restricted area when the sealed source is exposed.

d. Post radiographer's assistants so that direct full time surveillance of all accesses into the restricted area is properly maintained. Whenever it is physically practical, one individual may be assigned to maintain surveillance of more than one access.

e. When the radiographer is assured that the restricted area is properly secured, he shall expose the source, or have an assistant radiographer expose the source.

f. Upon initial exposure of the sealed source, survey the restricted area boundaries per Section 3.6c. Adjust the boundaries as necessary to conform to 2 mr or less per hour. Adjust the boundaries of the 100 mr/hr isocose line as required. NOTE: Do not perform physical surveys of the 100 mr/nr isodose line.

4.2 Permanent Radiographic Work Area-Bldg. 20

a. Perform X-ray and Iridium 192 radiography in the X-Ray, IR-192 or Cobalt Room.

b. Use X-ray machines per requirements of Sections 1.3 and the specific operating instructions posted at each control console.

c. Perform all cobalt 60 radiography in the Cobalt Room.

d. Do not position sealed sources within four feet of any wall or within ten feet of the door of any room.

e. Test the radiation monitoring and alarm system and interlocking door to the exposure room being used for proper operation per Section 9.2a. (6) prior to performing radiography.

f. Search the exposure room to ensure that it is unoccupied immediately prior to each closure of the entrance door to the room.

g. Immediately take actions specified in paragraphs 4.3 in event of unauthorized entry into the radiation area.

h. Allow no one but qualified radiographic personnel wearing both a film badge and a dosimeter to be in the radiographic work area when radiographic operations are in progress.

i. Perform and record applicable surveys as specified in Section 3.6 and 3.6b.

4.3 <u>Unauthorized Entry into Radiation Areas</u>. The following immediate actions shall be taken by radiography personnel should unauthorized entry into a radiation area occur:

a. Retract the sealed source to the shielded head. Perform a source shielded survey per paragraph 3.6.b., lock the shielded head and remove the key.

b. Obtain complete identification of the individual(s) involved.

c. Record distance from the source of radiation, duration of time in radiation area and the type and thickness of shielding material between the individual(s) and the sealed source.

d. Record sealed source type, number of curies, type collimator used and direction of radiation beam relative to the individual(s).

(1) Record all circumstances relative to the unauthorized entry.

(2) Notify the Shift Supervisor.

(3) The Shift Supervisor shall immediately investigate the incidents and submit a written report of his findings including information supplied by the radiographer to the Assistant Radiation Safety Officer.

### OPERATING AND EMERGENCY PROCEDURES

FOR

### INDUSTRIAL RADIOGRAPHY

# Philadelphia Naval Shipyard

# Section 5

# PERSONNEL MONITORING

- 5.1 Film Badge Requirements
- 5.2 Pocket Dusimeter Requirements
- 5.3 Operating Instructions for Dosimeter Charger

5. <u>Personnel Monitoring</u>. All radiographic personnel shall wear a film badge and a pocket dosimeter during radiographic operations.

#### 5.1 Film Badge Requirements

a. Wear the film badge in the open, clipped to the outside of your clothing.

b. Wear only the film badge specifically assigned to you.

c. Return the film badge after use or at the end of each work shift to the Film Badge Control Rack in Building 20.

d. Immediately report a lost, damaged or inadvertently exposed file badge to the Shift Supervisor. Do not resume work until you are issued a replacement film badge.

e. The Shift Supervisor shall investigate the reported mishap to the film badge and report via memo to the Assistant Radiation Safety Officer.

#### 5.2 Pocket Dosimeter Requirements

a. Wear the pocket dosimeter in the pocket of your outermost garment.

b. Charge (Zero) the pocket dosimeter at the start of each work shift.

c. Read the pocket dosimeter frequently during radiographic operations. Read it at the completion of each sealed source exposure. Make a final reading at the end of each work shift. Enter the total daily dose in your "Daily Dosimeter Log". (See Section 8.2).

d. Should you find that your pocket dosimeter is off-scale, stop work immediately. Provide for the security of the shielded head and notify your Shift Supervisor of the off-scale condition.

e. The Shift Supervisor shall investigate possible reasons for the off-scale reading. He shall forward a report of his investigation together with the individual's film badge to the Assistant Radiation Safety Officer for processing. The individual is not to perform any radiographic duties and is not to be issued a replacement film badge pending evaluation of the exposure.

5.3 Operating Instructions for Dosimeter Charger Model PP-4276C PD and Model 2000A

a. Turn charger on clockwise.

b. Insert dosimeter into charging socket.

c. Fress dosimeter down firmly and hold it in contact against spring pressure of the internal connectors.

d. While looking through dosimeter turn knob to adjust hairline to zero.

e. Remove dosimeter from charger and check hairline position by looking thru dosimeter at a light source.

f. If dosimeter fails to zero properly, turn it in to the Shift Supervisor for replacement.

# OPERATING AND EMERGENCY PROCEDURES

FOR

INDUSTRIAL RADIOGRAPHY

Philadelphia Naval Shipyard

Section 6

TRANSPORTATION OF SEALED SOURCE TO FIELD SITES

6. Transportation of Sealed Source to Field Sites

Transport sealed sources by vehicle only between storage areas and field sites; only in those vehicles assigned to the Nondestructive Test Division only within the confines of the Naval Base. The Radiographer shall ensure the following actions are taken when transporting sealed sources.

(a) Survey the shielded head per Section 3.6a and place it in the lead lined steel box which is bolted in the rear of the vehicle.

(b) Survey both the perimeter and the passenger compartment of the vehicle per Section 3.6d.

(c) Post the front and rear of the vehicle and the cover of the lead lined steel box in the rear of the vehicle with "Caution-Radio-Active Material" warning signs.

(d) Post all four sides of the vehicle with "RADIOACTIVE" warning signs. NOTE TO (3) and (4) above: Signs are available in Building 20. The signs shall be removed or covered when the vehicle is not being used for sealed source transport.

(e) At least one currently calibrated and operable survey meter shall be carried in the passenger compartment of the vehicle during transport.

(f) After removal of source from lead lined box, survey per section 3.6a. and inspect for possible damage.

(g) All personnel aboard the vehicle shall wear film badges and dosimeters.

(h) In event of vehicular accident immediately initiate emergency procedures specified in Section 7.1.

# OPERATING AND EMERGENCY PROCEDURES

FOR

### INDUSTRIAL RADIOGRAPHY

# Philadelphia Naval Shipyard

# Section 7

### EMERGENCY PROCEDURES

- 7.1 Vehicular Accident
- 7.2 Fire
- 7.3 Damaged or Inoperable Devices
- 7.4 Loss or Theft of Sealed Source
- 7.5 Individuals to be Notified in Case of Emergency

#### 7. Emergency Procedures

#### 7.1 Vehicular Accident

a. Check survey meters to determine if they are operational.

b. Survey the shielded head per Section 3.6a. to ensure security of the sealed source. If the sealed source is in the proper shielded position and the vehicle has been made inoperable by the accident, remove the shielded head from vehicle and return it to its assigned storage area in Building 20. NOTE: <u>Do not leave</u> the shielded head unguarded at any time during the confusion following the accident.

c. If the survey indicates the sealed source is out of its shielded position, establish and post the radiation area at the 2 mr/hr isodose line. Provide adequate guard(s) to prevent unauthorized entry into the radiation area. Notify your Shift Supervisor. (Ext. 3053).

d. If survey meters are not operational assume that the sealed source is exposed and that a radiation hazard exists. Establish a circular restricted area of approximately a 500 foot radius around the shielded head. Post and provide adequate guard(s) at perimeter of this area to prevent unauthorized entry. Notify your Shift Supervisor. (Ext. 3053). He will deliver replacement survey meters to evaluate the radiation status.

e. The Shift Supervisor shall, after confirming that a radiation hazard exists, notify emergency personnel listed in 7.5a., b., d., e. and g.

7.2 Fire

a. In event of a fire in or near the radiography area, immediately retract the sealed source into the shielded head. Perform a source shielded position survey per Section 3.6b., lock the shielded head, install the safety plugs/caps and remove the shielded head from the fire area.

b. After removing the shielded head from the fire area, remain at the scene and immediately notify the Ship's Fire Party and the Fire Protection Branch (Ext. 3333) that the sealed source is secure and removed from the fire area. Additionally, the Shipyard Watch Officer (Ext. 3350) shall also be notified during off-shift hours and on weekends and holidays that the sealed source is secure and removed from the fire area.

c. If the sealed source cannot be returned to its shielded position and/or recovered due to the fire hazard, remain at the scene, maintain the restricted radiation area as necessary and notify Ships Fire Party/Fire Protection Branch personnel upon their arrival of the extent and location of the radiation hazard. Then notify your Shift Supervisor, (Ext. 3053).

d. The Shift Supervisor shall notify emergency personnel listed in 7.5a., b., d., e., and f.

#### 7.3 Damaged or Inoperable Devices

a. In event damaged or inoperable device results in loss of control of the sealed source and it cannot be returned to its shielded position do not attempt to regain control of the sealed source. Leave the radiation area immediately.

b. Insure the restricted radiation area is adequately posted and kept under surveillance to prevent unauthorized entry.

c. Notify the Shift Supervisor (Ext. 3053).

d. The Shift Supervisor shall evaluate the situation and assure the security of the restricted radiation area. He shall then notify emergency personnel listed in 7.5a., b., d., e., and g.

#### 7.4 Loss of Theft of Sealed Source

a. In event of loss or theft of the sealed source immediately notify the Shift Supervisor (Ext. 3053).

b. The Shift Supervisor shall start an immediate investigation as to the whereabouts of the sealed source. He shall then notify emergency personnel listed in 7.5a., b., d., and e.

#### 7.5 Individuals to be Notified in Case of Emergency

Nat	ne	PNSY Telephone No.	Home Telephone No.
a.	J. Kennedy	4301/2	609-493-4500
b.	V. Cocco	4412	215-789-8948
Ċ,	J. Lieberman	8145 or 8147	215-567-0439
d.	J. Stea	3053/3239	215-271-7762
e.	J. Dobrowalski	3053/3239	215-365-5180
f.	Fire Chief	3333/3329	
g.	Shipyard Watch Officer	3350	

NOTE: Sealed source recovery service in emergency situations is provided for by contract with Tech/Ops Inc. 40 North Ave. Burlington, Mass. 01803.

Services will be provided within four hours of telephone request on a 24 hour basis, seven days a week. The following telephone number is provided to emergency personnel to obtain this service: 1-800-225-1383. Emergency Personnel will arrange to have someone meet the company respondee at the Pass Office, Main Gate, PNSY and escort him to Building 20 or Field Area as required.

# OPERATING AND EMERGENCY PROCEDURES

FOR

INDUSTRIAL RADIOGRAPHY

# Philadelphia Naval Shipyard

# Section 8

RECORDS

8.1 Nuclear Regulatory Commission (NRC) Record Form (4ND-PNSY-11080/2)

8.2 Daily Dosimeter Log

8.3 X-Ray Utilization Log

#### 8. Records

8.1 <u>NRC Record Form (4ND-PNSY-11080/2)</u>. This form comprises all radiographer required NRC records other than the Daily Dosimeter Record. The Radiographer shall initiate and ensure currency, completeness and accuracy of an NRC Record Form for each radiographic assignment utilizing sealed sources. The form is to be utilized and completed sequentially as follows:

### a. General Instructions for Utilizing the Form

(1) Detach the form set to be used from the pad of forms prior to recording any information in order to avoid transcribing the other forms in the pad.

(2) Complete and keep the record form updated in a progressive manner. Enter required information following completion of the respective task during the job assignment.

(3) Separate the two copies of the form after signing off the Source Utilization, Storage Survey and Daily Inspection of Radiographic Equipment. Place the top (paper) copy in the designated bin located in the Exposure Room Access Area. Record all other required information on the hardback copy of the form for the remainder of the job assignment. Following completion of the job assignment place the hardback copy in the designated bin alongside the Film Badge Storage Rack located in the Supervisor's Office.

#### b. Specific Instructions for Completing Form

#### Source Utilization Record

<u>Site of Use</u>: General Shipyard area which sealed source is to be used, i.e., Pier, Drydock, Building, Marine Rail No., etc. (Ship's name not to be used).

Shielded Head Ser. No.: Serial Number of shielded head used.

<u>Curies</u>: Current curie activity of the sealed source contained in the shielded head used. Obtain this information from the respective Sealed Source Decay Chart or as posted on the Sealed Source Curie Board.

Date of Use: Day, month and year sealed source is used.

Out Hr.: Time of day (use military standard method 0000 to 2400) shielded head is removed from storage.

In Hr.: Time of day shielded head is returned to storage. Complete on hardback copy upon return of shielded head to storage.

#### STORAGE SURVEYS

Out Mr/Hr: Results of survey of shielded head upon removal from storage.

In Mr/Hr: Results of survey of shielded head. (To be completed on hardback copy of form upon return of shielded head to storage.

#### DAILY INSPECTION OF RADIOGRPAHIC EQUIPMENT

Survey Meter Serial No.: Serial numbers of each meter used.

Shielded Head: Results of check made of the listed attributes.

<u>Control Assembly</u>: Serial No. of control assembly (SPI) used and results of check made of the listed attributes.

<u>Miscellaneous</u>: Identification number of source guide tube used and results of check of the listed attributes. Serial No. of source collimator (Beamer) and results of check of the listed attributes. Handy Andy indicate if used.

Monitor Alarm System: Results of operational check of the system.

No. Rad. Signs - No. High Rad. Signs: Number of each type of sign signed out for use associated with temporary restricted areas.

<u>NOTE</u>: All sections of the Daily Inspection of Radiographic Equipment record are to be filled in. Use NA for non-applicable items.

<u>Radiographer Sign</u>: Signature of the radiographer who has been assigned custody of the sealed source and has performed the equipment check listed above.

<u>RT Quality Control Number (QA No.)</u>: QA number of each "Nondestructive Test and Quality Control Record" (QA Form) associated with the RT performed. (List QA numbers in succeeding columns on the form.)

#### TEMPORARY RESTRICTED AREA RECORDS

The information required below for each temporary restricted area established is to be entered on the record form in the column beneath the respective QA No.(s) associated with the area restricted.

#### TEMPORARY RESTRICTED AREA - SHIPBOARD RADIOGRAPHY

Ship: Name of ship.

# Exposed Source Location:

<u>Compartment</u>: Name or number of ship's compartment associated with sealed source usage.

Inside/Outside Ship: Location of sealed source in relationship to the ship.

<u>Port/Starboard/CL</u>: Location of exposed sealed source relative to centerline of ship.

<u>Distance off CL</u>: Approximate measured distance off centerline of ship to exposed sealed source.

Frame No .: Nearest frame number to exposed sealed source location.

Deck/Level No.: Identity of the deck, platform or level from which the work is being performed.

### 2 Mr/Hr Boundary Limits:

Distance off CL Port/Stbd: Distance off centerline of ship to the port and starboard boundaries of the restricted area.

Frame No. Fwd/Aft: Frame numbers of the forward and after boundaries of the restricted area.

Deck/Level No.: Identity of the deck, platform or level of the upper and lower boundaries of the restricted area.

<u>Area Outside Ship</u>: X in for each respective restricted area established and describe/sketch on the back of the form (or attached sheets) each accessible area outside the ship adjacent to the area of shipboard radiography. Cite the highest, specific radiation level found by survey when areas are described (below 2 mr/hr). Provide a sketch for area greater than 2 mr/hr using the symbols provided on the back of the form to define the restricted area boundaries established. Key all descriptions/sketches to the respective QA number.

No. of Posted Entries: Number of accesses into each restricted area which are posted and guarded by surveillance.

#### 100 mr/hr Boundary Limits:

<u>Distance off CL Port/Stbd</u>: Distance off centerline of ship to the port and starboard boundaries of the posted 100 mr/hr area.

Frame No. Fwd/Aft: Frame numbers of the forward and after boundaries of the posted 100 mr/hr area.

<u>Deck/Level No.</u>: Identity of the deck, platform or level of the upper and lower boundaries of the posted 100 mr/hr area.

<u>Area Outside Ship</u>: X in under the applicable QA No. for each respective restricted area established in areas accessible to shipboard RT which contain high radiation area and ensure that such areas are depicted on the sketch of the restricted area. Where no high radiation areas exist outside the ship enter NONE.

No. of Posted Entries: Number of posted accesses into the high radiation area.

#### TEMPORARY RESTRICTED AREA - FIELD RADIOGRAPHY

Provide a sketch on the back of the form (or on attached sheets) for each restricted area established. Note: Field Radiography is defined as radiography performed in any location of the Shipyard other than aboard ship or in the permanent RT facilities of Bldg. 20. Correlate each sketch to the respective QA number and provide the following information on the sketch.

<u>Restricted Area Boundaries</u>: Location of the boundaries of the established restricted area relative to the sketched outlines of the radiographic site, i.e., building walls/columns, work slabs, field area roadways, etc.

<u>High Radiation Area Boundaries</u>: Approximate boundaries of the high radiation area relative to the exposed sealed source.

Exposed Sealed Source Location: Specific position (distances) of the exposed sealed source from the boundaries of the restricted area.

Posting: The number and location of posted accesses into both the restricted and high radiation areas.

<u>Adjacent Areas</u>: The location of and survey results of adjacent, accessible areas to the restricted area whenever all or part of the restricted area boundaries includes a building wall or other large structure which is accessible from the outside (or blind side) of the restricted area.

#### NUMBER AND DURATION OF EXPOSURES

1. Enter the total number of sealed source exposures and approximate time of each exposure period beneath the respective QA number.

2. Enter in the space above the "No. of Exposures", the use of Handy Andy by indicating yes or no for each exposure.

NOTE: This record is not intended to record the number of radiographs made per respective QA form. Its purpose is to record the number and length of time that the sealed sourced is exposed for whatever reason, i.e., original check of restricted area, operational check of gamma-key equipment, reshoots, etc.

#### SOURCE SHIELDED POSITION SURVEY RECORD

1. Record each source shielded position survey immediately following performance of the survey by circling the next succeeding number as appropriate. You must perform a source shielded position survey for each sealed source exposure recorded on the form.

2. After final exposure at worksite record results of survey (MR/HR) in comments section of form. This is to be done in addition to final survey prior to storage.

#### NAMES - RADIOGRAPHER'S ASSISTANTS

List the name of each individual utilized as Radiographer's Assistant. The Radiographer's signature in the comment section at the bottom of the form will verify that all surveys and equipment inspections are made and recorded. The signature will also verify that the boundaries of the restricted area were properly recorded and maintained.

#### COMMENTS

Enter comments, explanations or additional information relevant to radiation safety associated with the assignment.

8.2 Daily Dosimeter Log. Individual record forms issued in log form to all radiographic personnel on a monthly basis. Each record contains the name of the individual; the serial numbers of the assigned film badge and applicable control badges; the year and month of issue and provides a dated space for each day of the month. Each individual record to be kept current and completed as follows: Enter radiation exposure received, as read from your pocket dosimeter, at the end of each work day in which you participated in a radiographic assignment. Enter the reading in the applicable dated space on the report. Enter NA in all previous dated space back to date of last radiographic assignment.

8.3 <u>X-Ray Utilization Log</u>. The Radiographer shall enter the following information in the applicable X-Ray machine Utilization Log for each X-ray job assignment:

a. Date, time span and place of use.

- b. KV and MA settings.
- c. Number of exposures.
- d. Time per exposure.
- e. Signature of Radiographer.

# OPERATING AND EMERGENCY PROCEDURES

FOR

INDUSTRIAL RADIOGRAPHY

Philadelphia Naval Shipyard

# Section 9

INSPECTIONS AND MAINTENANCE OF RADIOGRAPHIC EQUIPMENT

9.1 General Requirements

9.2 Specific Instructions

9. Inspection and Maintenance of Radiographic Equipment

9.1 General Requirements

a. Daily Check of Equipment

(1) All radiographic equipment and its operation shall be checked by the radiographer before use, at least once each shift, for physical and mechanical condition.

(2) Any deficiency found, which could affect operation or safety shall be reported immediately to the Shift Supervisor, and the defective equipment tagged and removed from service until repaired.

(3) Each daily check of gamma ray equipment shall be recorded in the "Daily Check of Radiographic Equipment" section of the NRC Record Form. (See Section 8.1.)

b. Quarterly Inspection and Maintenance of Equipment

(1) Detailed inspection and routine maintenance of all radiographic equipment shall be performed by the Equipment Specialist (NDT) Code 135.1 at the following intervals:

(a) Each time a malfunction or equipment defect is reported by radiography personnel via the Shift Supervisor.

(b) On all active equipment at intervals not to exceed three months period.

(c) Whenever equipment has been subjected to severe or unusual conditions such as impact, submersion in water or prolonged use in a dirty environment.

(2) Equipment shall be disassembled as necessary, cleaned, inspected for wear or damage and serviced as required.

(3) Equipment shall be given a thorough operational check after inspection and maintenance has been completed.

(4) In-service (active) equipment shall be posted with a "Quarterly Inspection and Maintenance" label which shall contain the following information:

- (a) Model & Serial number of component.
- (b) Date inspected and serviced.
- (c) Due date of next inspection/service period.

(5) Equipment not in current use shall be posted with an "Inactive Status -Do Not Use" label.

(6) X-ray equipment shall be inspected and serviced per manufacturers procedures.

(7) Records of all repairs, inspections and maintenance performed on radiographic equipment shall be maintained by the Equipment Specialist (NDT), Code 135.1.

9.2 Specific Instructions

#### a. Daily Check of Equipment

(1) "Iriditron" Model 520 and Tech/OPS Inc. Model 660

(a) Perform physical survey per Section 3.6a.

(b) Check for damage to lock assembly, fittings, plugs and

housing.

(c) Check for radioactive material warning label, sealed source identification tag and current Quarterly Inspection and Maintenance label.

- (d) Check for cleanliness.
- (2) "Multitron" Model 51B and Tech/OPS Inc. Model 680
  - (a) Perform physical survey per Section 3.6a.
  - (b) Check for damage to lock assembly, fittings, plugs and

housing.

(c) Check for radioactive material warning label, sealed source identification tag and current Quarterly Inspection and Maintenance label.

- (d) Check for cleanliness.
- (3) Source Guide Tubes
  - (a) Inspect for broken or frayed exterior covering.
  - (b) Inspect for kinks or flat spots.
  - (c) Check fittings for damage.
  - (d) Check for general cleanliness.

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# (4) Drive Control Assembly (SPI) Source Position Indicator

(a) Inspect cable housings for cuts/breaks.

(b) Check fittings for tightness and physical damage.

(c) Flex cable housings by hand. Housings shall be flexible. Do not use those that feel stiff or "crunchy" when flexed.

(d) Check the connect/disconnect fitting on the inner drive cable for damage, looseness and alignment to the drive cable.

1. Model 520 and 51B: Do not use if disconnect fitting appears "cocked" (15 degrees or more) from the longitudinal axis of the drive cable.

2. Model 680 and 660: Using a model 550 no-go gauge, check the male connector of the drive cable. If the ball of the connector fits through the hole of the gauge or the ball shank fits into the slot in the gauge, the connector is worn and the cable must be replaced.

(e) Check that indicator dial is on zero when drive cable is fully retracted.

(f) Check crank assembly for looseness, physical damage and smooth operation.

(g) Check for current Quarterly Inspection and Maintenance

label.

- (5) Source Collimators (Beamers)
  - (a) Inspect housing for damage and loose components.
  - (b) Inspect source guide tube connection fittings for

damage.

(c) Tilt and shake beamer by hand to detect any movement of inner shielding casting. Unit must feel solid without any sign of play or looseness.

(d) Check alignment of source guide tube connection fitting with beamer source tube.

(e) Check for foreign material in beamer source tube.

(f) Check for current Quarterly Inspection and Maintenance

label.

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# (6) Radiation Monitoring and Alarm System

(a) Check that exposure room and access area control modules are energized and are indicating respective background radiation levels.

(b) Check that each control module is posted with a current Quarterly Inspection and Maintenance label.

(c) On initial sealed source exposure, check that the rotating red beacon at the respective exposure room dour is energized and the module readout meter indicates the radiation level of the exposure room.

(d) Following completion of the initial <u>and all subsequent</u> exposures ensure that the rotating red beacon is de-energized and the module readout meter returns to the background radiation level.

(e) Should the system not function as described above, secure it, tag it with an explanation of the problem and report it to the Shift Supervisor.

(f) The Shift Supervisor may authorize use of the exposure rooms pending repair of the monitoring and alarm system. He shall require that the exposure room be physically guarded during sealed source exposure periods to prevent entry.

(g) Record check of the monitor and alarm system and any actions taken on the NRC Form for that assignment. (See Section 8.1)

b. Quarterly Inspections and Maintenance

(1) Iriditron-Model 520 and Tech/OPS Inc. Model 660

(a) Perform physical survey per Section 3.6a.

(b) Remove sealed source from the shielded head and store in Iridium 192 source changer using procedures specified in Section 1.2.b(1).

(c) Check shielded head for loose, missing or damaged hardware. Replace or tighten as necessary.

(d) Inspect exit port threaded area.

(e) Check concentricity of internal "S" tube with exit port hole. Misalignment indicates that shielding within housing has shifted and will require repair by the manufacturer.

(f) Remove lock assembly, clean with solvent and dry thoroughly.

(g) Pass solvent damped wicking back and forth thru "S"

tube.

(h) Lubricate "S" tube and lock assembly with TSI 301

lubricant.

(i) Reassemble lock assembly and check its operation.

(j) Place a "dummy source", mated to a short length of drive cable, into the shielding head. Check operation of the lock mechanism and passage thru the internal "S" tube by passing the dummy source back and forth thru the shielded head.

(k) Clean exterior surfaces of shielded head.

(1) Check physical condition of the radioactive material warning label.

(m) Install new Quarterly Inspection and Maintenance label.

(n) Return sealed source to the Shielded Head using procedures specified in Section 1.2b.(2).

(o) Crank source back and forth several times to check operation of the shielded head.

(2) "Multitron Model 51B" and Tech/OPS Inc. Model 680

(a) Perform physical survey per Section 3.6a.

(b) Check for loose, missing or damaged hardware. Replace or tighten as necessary.

(c) Inspect exit port threaded area.

(d) Check concentricity of internal "S" tube with exit port hole. Misalignment indicates that shielding has shifted and will require repair by manufacturer.

(e) Connect and position source guide tube and SPI to Shielded Head. This is to be done taking all precautions required for actual radiography.

(f) Check operation of lock mechanism. Lubricate with TSI 301 lubricant as required.

(g) Crank source in and out several times to check operation of complete unit.

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(h) Perform survey per paragraph 3.6b.

(i) Clean external surfaces of Shielded Head.

(j) Check physical condition of the radioactive material warning label.

(k) Install new Quarterly Inspection and Maintenance label.

#### (3) Source Guide Tubes

(a) Inspect for broken or frayed exterior covering.

(b) Inspect for kinks, flat spots and internal cleanliness. An 11/32 inch diameter ball should pass cleanly thru the tube.

(c) Check fitting attachments to tube. A swelling of exterior sheathing of the tube adjacent to the fitting indicates that the inner flexible tubing may be broken.

(d) Inspect tube fittings for damage and tightness.

(e) Attach tube to empty shielded head and check operation and thread condition of flexible fittings.

- (4) Drive Control Assembly (SPI)
  - (a) Remove source drive cable from control.
  - (b) Disassemble crank and source position indicator

assembly.

- (c) Detach control cable housings from control casting.
- (d) Wash all parts in solvent and dry.

(e) Examine inside of control housing for evidence of wear (grooves) at points where drive cable contacts inner wall of housing. A groove depth in excess of 0.020" will require replacement of the housing.

(f) Check for excessive wear (over 0.005") in wheel and cable-ball bearing assembly.

(g) Examine drive teeth on wheel. Replace wheel if a tooth is missing or bent beyond repair.

(h) Check source position indicator drive assembly.

(i) Examine source drive cable for rust, kinks, broken strands and the helically wound drive wire for any looseness or damage. Minor bends may be straightened by hand (use no tools); light rust removed by hand wire brushing. Replace the drive cable whenever heavy rust spots, kinks, broken cable strands, or a loose or damaged helical drive wire is found.

(j) Examine source disconnect fitting for alignment to source drive cable, overall physical condition. No attempt shall ever be made to repair the disconnect fitting. Source drive cables shall be returned to the manufacturer for replacement of the disconnect fitting whenever:

1. Shows any evidence of damage.

2. Shows signs of excess wear.

and drive cable.

4. Whenever misalignment of disconnect fitting to drive

cable exceeds 15 degrees from longitudinal axis of the drive cable.

(k) Coat all metallic surfaces with TSI 301 lubricant.

(1) Reassemble entire SPI and check its operation by using a dummy source and an empty head test arrangement.

(m) Zero source position indicator dial.

(n) Place a temporary protective plastic cap over disconnect

3. There is any play or looseness between the fitting

fitting.

(o) Install new Quarterly Inspection and Maintenance label.

(5) Source Collimators (Beamers)

(a) Clean and inspect housing for damage and loose

components.

(b) Inspect source guide tube connection fitting for damage.

(c) Check alignment of source guide tube connector with beamer source tube.

(d) Tilt and shake by hand to detect any movement of inner shielding. Unit is to be returned to manufacturer if movement is detected.

(e) Check for foreign material in beamer source tube.

(f) Install new Quarterly Inspection and Maintenance label.

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(6) Monitor and Alarm System

(a) Check that the system is energized and all adjustable alarm levels are set on 5 mr/hr.

(b) With all radiation sources secured, check that the interlocking doors of the three exposure rooms can be opened from the inside both by the electrical "Emergency Push Button" and by the mechanical "lock release and winch assembly."

(c) Secure the door to the exposure room and expose the sealed source. The rotating red beacon above the door must operate continuously while the source is exposed. Check the respective readout meters for appropriate radiation level within the exposure room. Attempt to open the shielded door. The door must not open.

(d) Retract the sealed source, the rotating red beacon must cease operating and the readout meter return to background radiation levels. The dcor should now open.

(e) With the door slightly open (only to the point that the interlocks are disengaged) expose the sealed source to the degree necessary to obtain 5 mr/hr on the readout meter for that exposure room. The audible alarm horns must sound.

(f) With the door open hold camera up to inside radiation detector, inside rotating red light must come on.

exposure room.

(h) Attempt to energize the X-ray machine with the door to the X-ray Room open. The machine must not energize.

(g) Repeat (c), (d) and (e) above for each remaining

(i) Close the door to the X-ray Room and energize the X-ray machine. The rotating red beacon must operate continuously and the readout meter for the X-ray Room should indicate the appropriate radiation level existing at the detector within the room. Attempt to open the door. The door should not open.

(j) With all sources of radiation secured, depress the "Emergency Push Button" located in the Exposure Room Access Area. The audible alarm horns should sound.

(k) Post the control panel of the system with a current Quarterly Inspection and Maintenance Label per Section 9.1b(4).

(1) Should the monitor and alarm system or the shielded door operations not be as described above, secure the system, tag it with an explanation of the deficiency and advise supervision of same. Repair or have the deficiency repaired in a timely manner.

(m) Maintain records of the above inspection per Section

9.1b.(7).

# OPERATING AND EMERGENCY PROCEDURES

FOR

# INDUSTRIAL RADIOGRAPHY

# Philadelphia Naval Shipyard

# Section 10

RECEIVING AND SHIPPING OF SEALED SOURCES

10.1 General Requirements

10.2 Specific Instructions

10. Receiving and Shipment of Sealed Sources

10.1 General Requirements

a. Receiving Sealed Sources

(1) Sealed source shipments will be received by the Assistant Radiation Officer or an alternate designated by him.

(2) Shipment will be checked for radiation safety on arrival.

(3) The source changer and outer package will be checked for possible contamination.

(4) The source will be transferred in accordance with Section1.2b,

b. Shipment of Sealed Source

(1) The depleated sealed source will be repackaged by the Assistant Radiation Officer or an alternate designated by him.

10.2 Specific Instructions

a. Receiving Sealed Sources

(1) Sealed source shipments will be received by the Assistant Radiation Safety Officer or an alternate designated by him.

(2) Upon receipt, survey the outer package; radiation level should not exceed level indicated on the shipping label. If this level is exceeded, the container should be secured in a restricted area, and appropriate personnel notified.

(3) Do not accept shipment if lead seals are broken.

(4) Remove seal from outer packaging and open package, in Exposure Room 2.

(5) Remove source changer from outer package and perform survey of source changer; radiation level should not exceed level indicated by Transport Index Label. If these levels are exceeded, the source changer should be secured as in Step (2).

(6) Wipe the entire external surface of the source changer and the internal surface of the outer package with a paper towel and then survey the towel in an area of low background radiation with the most sensitive survey meter set to be the lowest scale range. If contamination is detected, contact the container shipper and the appropriate NRC regional office.

(7) If the source is not transferred upon receipt store source changer in storage area.

(8) The Assistant Radiation Safety Officer will remove the lock and lead seals from the source changer and transfer the source using the procedure outlined in Section 1.2b.

(9) Affix the identification plate of the new source to the exposure device. Place the identification plate for the old source on the seal wire and seal the hold down cap with seal provided. Close source changer cover and seal wire and lock cover in place.

#### b. Shipment of Sealed Sources

(1) Return the properly locked and sealed source changer to the original shipping container.

(2) Secure shipping container and wire seal.

(3) Survey container and affix proper radioactive shipping labels indicating the radioisotope, activity and transport index. The transport index is used only on Yellow II and Yellow III labels and is defined as the maximum radiation level in mr/hr measured at a distance of one meter from the surface of the package.

(4) The container should be marked "Inside Package Complies with Prescribed Specifications - Type B (U) USA/9006/B(U).

### NOTE: Radioactive Labels Maximum Radiation Level

		At Surface	At One Meter
Radioactive	White I	0.5 mr/hr	None
Radioactive	Yellow II	50 mr/hr	1.0 mr/hr
Radioactive	Yellow III	200 mr/hr	10 mr/hr

RADIATION BOUNDARY TABES

TABLE I

DISTANCE IN FEET FROM UN-SHIELDED SOURCE TO TENTATIVE 2 AND 100 MR /HR ISODOSE LINES.

344 49

I	RIDIU	M 192	COBA	LT 6Ø	IF	IDIUM	192
URIES	2MR	100MR	2MR	100MR	CURIES	2MR	100MR
1	55	8	84	12	41	348	50
2	77	11	119	17	42	352	50
3	95	14	145	21	43	357	51
4	109	16	168	24	44	361	51
5	122	18	188	27	45	365	52
6	133	19	205	29	46	369	53
7	144	21	222	32	47	373	53
8	154	22	237	34	48	377	54
9	163	23	251	36	49	381	54
10	172	25	265	38	50	385	55
11	181	26	278	40	51	388	55
12	189	27	290	41	52	392	56
13	196	28	302	43	53	396	56
14	204	29	313	45	54	400	57
15	211	30	324	46	55	403	57
16	218	31	335	48	56	407	58
17	224	32	345	49	57	411	58
18	231	33	355	51	58	414	59
19	237	34	365	52	59	418	59
20	243	35	375	53	60	421	60
21	249	36	384	55	61	425	60
22	255	36	393	56	62	428	61
23	261	37	402	57	63	432	61
24	267	38	410	58	64	435	62
25	272	39	419	60	65	438	62
26	277	40	427	61	66	442	63
27	283	40	435	62	67	445	63
28	288	41	443	63	68	448	64
29	293	42	451	64	69	452	64
30	298	43	459	65	70	455	65
31	303	43	466	66	71	458	65
32	308	44	474	67	72	461	66
33	312	45	481	68	73	465	66
34	317	45	488	69	74	468	67
35	322	46	495	70	75	471	67
36	326	47	502	71	76	474	67
37	331	47	509	72	77	477	68
38	335	48	516	73	78	480	68

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COBALT 60

100MR

2MR

TABLE I

DISTANCE IN FEET FROM UN-SHIELDED SOURCE TO TENTATIVE 2 AND 100 MR/HR ISODOSE LINES.

Attachment (1) to Encl. (2)

# RADIATION BOUNDARY TABES TABLE I

DISTANCE IN FEET FROM UN-SHIELDED SOURCE TO TENTATIVE 2 AND 100 MR/HR ISODOSE LINES.

	IRIDIUM	192	COBALT	60
CURIES	2MR 10	OMR	ZMR	100MR
81	489	70	753	107
82	492	70	758	108
83	495	70	763	108
84	498	71	767	109
85	501	71	772	110
86	504	72	776	110
87	507	72	781	111
88	510	73	785	111
89	513	73	790	112
90	516	73	794	113
91	519	74	799	113
92	521	74	803	114
93	524	75	807	115
94	527	75	812	115
95	530	75	816	116
96	533	76	820	116
97	535	76	824	117
98	538	76	829	118
99	541	77	533	118
100	544	77	877	119
101	546	78	841	119
102	549	78	845	120
103	552	78	850	121
104	554	79	854	121
105	557	79	858	122
106	560	80	862	122
107	562	80	866	123
108	565	80	870	123
109	568	81	874	124
110	570	81	878	125
111	573	81	882	125
112	575	82	886	126
113	578	82	890	126
114	580	82	894	127
115	583	83	898	127
116	595	83	902	128
117	588	84	905	128
118	590	84	909	129
119	593	84	913	130
120	595	85	917	130
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Attachment (1) to Encl. (2)