

POGUE INDUSTRIES INCORPORATED

5200 Manchester
St. Louis, Mo. 63110

Radiation Safety and Control Program

10.4.B

Operating and Emergency Procedures

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0	President <i>Herbert Pogue</i>	7/08/85:
0	Q.A. Manager <i>James H. Bergert</i>	6/24/85:
0	prepared by <i>Herbert Pogue</i>	3/04/85:

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OPERATING AND EMERGENCY PROCEDURES

1.0 INTRODUCTION

- 1.1 The Operating and Emergency Procedures is your guide to safe operation when working with radioactive sources. Have an Operating and Emergency Procedure available whenever you are using a source of radiation.

The Operating and Emergency Procedures include detailed instruction on performing your job in a safe manner, the rules you must follow in your work and useful bits of reference information.

1.2 Scope Of Your Authority

Federal and/or Agreement State law specifies the tasks a person is allowed to perform when working with radioactive sources. The complexity of tasks allowed are based on the radiation safety training and experience and/or authority as used by Pogue Industries Incorporated are identified as Trainee Radiographer, Assistant Radiographer, Radiographer Radiation Safety Monitor, Assistant Radiation Safety Officer, and Radiation Safety Officer (RSO).

- 1.2.1 Trainee Radiographer - A trainee Radiographer is an employee of Pogue Industries Incorporated who is in training for the position of Assistant Radiographer. During this period of training, he shall not act in the capacity of handling and/or using sources.
- 1.2.2 Assistant Radiographer - An employee who uses radiographic exposure devices, sealed sources, x-ray equipment, survey instruments and related equipment while under the personnel (direct) supervision of a Radiographer. The radiographer may not delegate his responsibility to the Assistant Radiographer. Any person who assists the radiographer by manipulating radiographic exposure devices, sealed sources, x-ray equipment, survey instruments, and related equipment, is acting as an Assistant Radiographer and must have been certified to that level by the RSO.

- 1.2.3 Radiographer - An employee who performs radiography or is in attendance at the radiographic site to personally supervise radiographic operations. The radiographer is directly responsible for assuring the job is performed in accordance with the safety requirements of the Operating and Emergency Procedures. In case of an emergency, he shall report the details of the situation to the Radiation Safety Monitor and then to the RSO.
- 1.2.4 Radiation Safety Monitor - An Employee with extensive experience and training in radiation safety who has been appointed to maintaining a high standard of radiation safety in each facility. On matters of radiation safety, they report to an Assistant Radiation Safety Officer and/or to the RSO.
- 1.2.5 Assistant Radiation Safety Officer - Management Representative responsible for all phases of the Radiation Safety Program in the absence of the RSO, and will report directly to the RSO. His job shall include training and recommendations for qualification for all levels of radiation safety certifications.
- 1.2.6 Radiation Safety Officer - The member of the management of Pogue Industries Incorporated with full authority and responsibility to administer and enforce the Radiation Safety Program. He shall have the authority to stop radiographic activity until safety requirements have been satisfied, and to discharge or suspend any individual who violates the rules and regulations in matters relative to radiation safety. He reports directly to the President or Vice President of the Company.

2.0 QUARTERLY SAFETY MEETINGS/REFRESHER TRAINING

- 2.1 Radiation Safety Monitor shall be Responsible for conducting refresher training for all Radiographers and Radiographer's Assistant under their supervision at intervals not to exceed quarterly.

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2.1.2 Such Training shall include, but not be limited to at least 3 items from list below:

- (a) Agreement States or USNRC Rules and Regulations, Parts 19, 20, 21, and 34.
- (b) Agreement states or USNRC Radioactive Material license.
- (c) Radiographic equipment and detection instrumentation to be used.
- (d) Fundamentals of radiation safety.
- (e) Prevention of overexposures to personnel.
- (f) NRC case histories.

2.2 Radiation Safety Monitors shall maintain, available for inspection, records of safety meeting/refresher training including:

- (a) Name(s) of Instructor(s)
- (b) Names of individuals attending
- (c) Dates of training
- (d) Topic(s) discussed

3.0 PERSONNEL MONITORING

3.1 Your personal safety depends on the use of radiation monitoring devices. Before working with a radioactive source, you must have:

- (a) Current Radiation Safety Certification
- (b) Operating and Emergency Procedures
- (c) Dosimeter
- (d) Film Badge or TLD
- (e) Calibrated operating survey meter

3.1.1 Dosimeter - The dosimeter measures total accumulated dose from zero to at least 200 milliroentgens. It can show you when your accumulated dose is abnormally high. Prior to each day or job, zero your dosimeter using your dosimeter Charger.

Record this reading on Form 14 (Figure 1) or Form RSC 15 (Figure 2), (Form RSC24) (Figure 3). Check your dosimeter frequently to assure you are operating in a safe manner.

A saturated (off-scale) reading means Danger - stop work immediately and contact your Radiation Safety Monitor. If your dosimeter is lost, stop work immediately and contact your Radiation Safety Monitor for a replacement. DO NOT work without your dosimeter.

3.1.2 Film or TLD Badge - Your bi-weekly film or TLD badge is the most accurate record of your total radiation exposure. Wear it on the trunk of your body. Do not let anyone wear your badge. The badge will be processed by a qualified film/TLD badge service and the exposure date reviewed by the RSO. The data shall include:

3.1.2.1 Frequency of processing.

3.1.2.2 Starting date of badge use and processing date.

3.1.2.3 Reporting date.

3.1.2.4 Employee name, social security number, and date of birth.

3.1.2.5 Current dose (millirems).

3.1.2.6 Cumulative dose (millirems).

3.1.2.7 The badge is to be stored during non-working in a location where accidental exposure cannot occur. If your badge is lost - stop work immediately and call your Radiation Safety Monitor for replacement.

3.1.2.8 Film or TLD badges lost or not returned by individuals shall be investigated by the Radiation Safety Monitor. A report shall be made as to the reason for the badge not being returned, along with the individual corrective action for the prevention of its

reoccurrence and a copy forwarded to the RSO. Individuals dosimeter readings for the period of use, taken from Form RSC 14, RSC 15 or RSC 24 will be used for the exposure received during that period. Dosimeter report will be forwarded to the badge processing facility in place of the lost badge, with a copy to the RSO.

3.3 Permissible Dose Levels

3.3.1 An individual, 18 years of age or over, may receive a dose to the whole body of 3 rems per calendar quarter provided that:

- (a) Pogue Industries Incorporated has on file the individual's history of accumulated occupational dose to the whole body.
- (b) The individual's dose to the whole body, when added to the previously accumulated dose to the whole body, shall not exceed 5 (N-18) rems where "N" equals the individual's age in years at his last birthday.

3.3.2 Individuals may receive a dose to the whole body of only 1.250 rems per calendar quarter when the requirements of Paragraph 3.3.1 are not met.

3.3.3 Individuals who receive a dose in excess of 3 rems or 1.25 rems per calendar quarter, when applicable, will be notified of the amount of the exposure in writing by the RSO, who will require the individual to submit a written explanation of the circumstances of the over exposure.

3.4 Survey Meter - The survey meter measures the radiation field strength, and shall have a range such that two (2) milliroentgens per hour through one (1) roentgen per hour can be measured. Use this meter to:

- (a) Established the isodose lines (perimeters)
- (b) Assure source is in full retracted (safe) positions.
- (c) Assure source is in full exposure position when using a collimator. (Meter reading should fall noticeably as source enters collimator).
- (d) Locate the source (see Figure 4).

- (e) Predict the accumulated dose for several exposures. Check the survey meter each shift or job for normal functioning and current calibration date. Calibration is required every 90 days and after servicing. If functioning is abnormal or the date expired, do not use the meter - contact your Radiation Safety Monitor.

- 3.5 Use of the Monitoring Equipment - Film or TLD badges and dosimeters shall be used by anyone 18 years of age and over who is likely to receive a dose of 300 mrem per calendar quarter. A survey meter shall be used every time a person enters a "Radiation Area" or is required to work around a storage container or exposure device.

4.0 GETTING THE SOURCE TO THE JOB

- 4.1 Removal from Storage - Survey all perimeters of the storage area for abnormal radiation levels using the survey meter. Radiation levels at the perimeter of a storage area shall not exceed 2 mr per hour. Survey the exposure device for abnormal radiation levels before removing it from the storage area. Remove the exposure device and position the survey meter against the device on both sides and the port.

If no reading occurs on the survey meter or the readings exceed 200 mr/hr at the surface, return the exposure device to storage and contact your Radiation Safety Monitor. Do not work without a survey meter.

- 4.2 Daily Equipment Inspection - The daily inspection of the exposure device is for your safety. Equipment which is maintained in good working order seldom causes an emergency device by following the instructions on Form RCS 21, completing the Daily Maintenance Inspection portion on RSC 14 (Figure 1), Form RSC 15 (Figure 2) or Form RSC 24 (Figure 3).

All malfunctions or defects noted during the inspection shall be immediately reported to the Radiation Safety Monitor. The equipment is to be removed from service until repairs are made.

- 4.3 Carrying the Exposure Device - The total time an exposure device is hand-carried should be kept to a minimum. Remember, the radiation level on the exposure device's surface may be as high as 200 mr/hr. During hand-carrying, your legs can be exposed to this field. A good practice is to use a hand truck or cart whenever you are doing a lot of transporting.

5.0 CONTROLLING THE AREA

- 5.1 Responsibility of the Radiographer - The radiographer is responsible for establishing the controlled "Radiation" and "High Radiation" areas and assuring unauthorized personnel are not allowed to enter the area. The Assistant Radiographer may perform these duties only under the direct supervision of the Radiographer.
- 5.2 Preliminary Control - Prior to setting up the exposure device, the radiographer will establish preliminary controls by conspicuously posting an area that will prevent anyone at the perimeter of these areas from receiving a dose in excess of 2 mr in any one hour. The approximate perimeters of the radiographic area shall be established and posted with "Caution -- Radiation Area" or "Danger -- Radiation Area" signs by referring to the Radiation Intensities and Distance Charts (Figure 5) or by using the inverse square law. The approximate perimeter of the High Radiation Area (100 mr/hr or more) will be calculated from the Radiation Intensities and Distance Charts mentioned above, or the inverse square law. Conspicuous posting of this area will be accomplished by using, "Caution -- High Radiation Area" or "Danger -- High Radiation Area" signs. "Caution -- High Radiation" signs may not be used on the perimeters of the "radiation Area". These areas are defined in Paragraph 18.0 of this procedure. The signs shall be the conventional magenta and yellow colors used to indicate radiation areas. It is recommended that perimeters be established using radiation barrier tape or rope (magenta and yellow colors).

6.0 SETTING UP THE EXPOSURE

6.1 Remote type exposure devices.

- 6.1.1 Before using radiographic equipment, the radiographer and Assistant Radiographer shall be thoroughly familiar with procedures for restricting and posting of radiation areas and surveying of exposure devices.
- 6.1.2 With the exposure device locked and, with a calibrated and operating survey meter at hand, connect the drive cable to the pigtail. This step is extremely important. If the connection is not properly made, the source may not be able to be returned to the safe position at the end of the exposure.

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- 6.1.3 Remove the safety plug from the exposure port, connect the source guide tube, and source stop tip. Exercise care to keep the guide tube and control cable as straight as possible.
- 6.1.4 Unlock the exposure device and crank out the source.
- 6.1.5 During exposure(s), survey the radiation levels in accordance with 7.0 of this procedure.
- 6.1.6 At the end of the exposure, crank the source back into the exposure device. Survey the exposure device with a survey meter in accordance with 8.0 of this procedure.
- 6.1.7 Lock the exposure device.
- 6.1.8 After the last exposure, replace the safety plug in the exposure port.
- 6.1.9 Disconnect the control cable mechanism.

6.2 Pipelinier Type Exposure Devices

- 6.2.1 When performing radiography using a pipelinier type exposure device, the following steps shall be used as a guide.
- 6.2.2 This step and the following steps shall be done with a calibrated and operating survey meter at hand. To operate the pipelinier type exposure device with the remote control cable, remove the dust cap from the control adapter plate and connect the remote control cable; then proceed with steps 6.2.3 and 6.2.7. To operate the pipelinier type exposure device by hand (without the remote control cable), leave the dust cap on the control adapter plate; then proceed with steps 6.2.3 and 6.2.7.
- 6.2.3 Unlock the exposure device and expose the source by turning the rotor shaft one half turn. This may be done by turning the remote control cable to turn the shaft or by turning the dust cap to turn the shaft (if the remote control cable is not being used).
- 6.2.4 During exposure(s), survey the radiation levels in accordance with 7.0 of this procedure.

- 6.2.5 At the end of the exposure, return the source to the shielded position by turning the rotor shaft one half turn in the opposite direction as described in step 6.2.3. Lock the exposure device. (Note: The pipeliner is designed so that the source cannot be locked in the exposed condition.)
- 6.2.6 Survey the Pipeliner with a survey meter in accordance with 8.0 of this procedure.
- 6.2.7 After the last exposure, disconnect the remote control cable (when it is used) and replace the dust cap.

7.0 POSTING THE AREA

- 7.1 Final control - After the exposure device is readied for operation, the source is driven to the end of the source tube and a survey performed to establish the restricted area. Survey the perimeter of the area which was posted during the preliminary control and correct the positioning of the signs, as necessary, to reflect the 2 mr/hr field strength. Surveys shall be as required for each shift and/or when the source-target configuration is substantially different from that of the preceding exposure. Survey meter readings in excess of 2 mr/hr are permissible at perimeters of the restricted area when the total time during any one hour is less than 60 minutes.

Example: $\frac{\text{Any One Hour (60 Min.)}}{\text{Exposure in minutes}} \times 2 = \text{Maximum allowable mr/hr}$

The maximum allowable mr/hr at the perimeter of restricted area for a job requiring five exposures of four minutes, each would be figured as follows:

$$\frac{60}{5 \times 4} \times 2 = 6 \text{ mr/hr}$$

- 7.2 All signs shall be magenta or purple on yellow background and display the conventional three-bladed radiation safety symbol.
- ## 8.0 USE OF EXPOSURE DEVICE
- 8.1 The Radiographer is responsible for the safety of all personnel entering the restricted area. No one shall enter the area without the consent of the Radiographer for each

specified entry. If any one person persists in entering the posted area, secure the source until the person leaves. Report the problem to your Radiation Safety Supervisor. Note: When you warn persons of the danger of radiation, state the facts. Don't exaggerate. During an exposure all personnel shall stay outside the restricted area and the Radiographer and Assistant Radiographer (if used) shall act as guards. They must be alert at all times to prevent anyone from entering the area. Upon completion of an exposure, the Radiographer must:

- 8.1.1 Return the source to the radiographic exposure device by turning the control in the retract direction until a positive stop is encountered.
- 8.1.2 Upon assuring yourself the source has been returned to the safe position proceed toward the exposure device with survey meter in hand, carefully examining the meter readings.
- 8.1.3 When reaching the exposure device, immediately survey the area where the source tube connects to the device and the entire circumference of the device shall be surveyed to see that the source has been retracted to the safe position. If the radiographic exposure device has a source guide tube, the survey shall include the guide tube.
- 8.1.4 Upon assuring yourself the source is in a safe position, survey and lock the exposure device. This procedure shall be conducted after each exposure.
NOTE 1: When surveying device, remember Typical Surface Reading, as noted when the exposure device was removed from storage. NOTE 2: When using (for example) Gamma Industries, Gamma Century SA, exposure device, locking the source in the safe position. NOTE 3: When using (for example) Magnaflux Corporation MS-IC-100 exposure device, the source can be verified in the safe position by depressing in the lock plunger assembly.
 - 8.1.4.1 Radiographers and Radiographer's Assistants Assistants shall be required to remove keys from all locked exposure devices except during authorized use or when under the direct surveillance of said individuals.

- 8.1.5 Upon completion of the scheduled radiographic operations in the established restricted area, the following procedure will be observed.
- (a) Lock the control, as specified in Paragraph 8.1.4.
 - (b) Remove the source tube and insert the safety plug.
 - (c) Dismantle the setup and remove barricades.
 - (d) After moving the exposure device from the site of radiographic operations and prior to storage, another survey of the device will be conducted to assure that readings are within those outlined in Paragraph 4.1.
- 8.1.6 An exposure device that is not returned to the storage area, and will be left unattended, must be locked and physically secured to prevent tampering or removal by unauthorized personnel. The device left in this condition must be barricaded and posted to a 2 mr/hr level.
- 8.1.7 Notification Prior to Using Exposure Devices at Temporary Jobsites (include X-ray Units) - States required licenses to notify the agency, by phone and/or in writing, three (3) days (if possible) prior to engaging in unauthorized temporary radiographic operations within their state. Notification is for locations other than those specifically listed on state licenses of registrations; for non-agreement states. Radiographers are required to contact the RSO and/or Radiation Safety Monitor, prior to engaging in unauthorized temporary radiographic operations, who in turn will notify the proper agency.
- 8.1.7.1 The following information is required when notifying the RSO and/or Radiation Safety Monitor:
- (a) Location of operations (state, city, company, etc.)
 - (b) Make, model, and S/N or exposure device
 - (c) Specific time period (date, time off-shift, etc.)

(d) Individual (or the customer) who will be contacted.

8.1.7.2 Radiographers shall contact the RSO and /or Radiation Safety Monitor as soon practical so that the required notice, in writing, can be sent to the appropriate agency.

8.1.7.3 Radiographers are required to have a current copy of each of the following documents prior to engaging in temporary radiographic operations.

(a) Respective NRC or Agreement State License

(b) NRC or Agreement State Regulations, if applicable.

(c) Operating and Emergency Procedures.

9.0 STORAGE OF EXPOSURE DEVICES

9.1 When not in use, radiographic exposure devices will be placed in the storage areas provided. All storage areas shall have a sign bearing the words, "Caution -- Radioactive Material" or "Danger - Radioactive Material" with the radiation symbol (magenta on yellow background). These signs shall be posted on the outside of the storage area.

9.2 A survey of the storage area containing the exposure devices shall be made on the outside perimeters and the reading shall not exceed 2 mr per hour.

9.2.1 Survey storage areas shall be made each time an exposure device is removed or returned to storage. A record of that survey shall be kept.

9.2.1.1 Survey of temporary Field trailer storage areas shall be made when an exposure device (additional or new source) is added.

9.2.1.2 Survey of temporary field storage areas shall be made at the start of each field job requiring storage. A record of that survey shall be kept.

- 9.3 Storage areas shall be kept locked at all times except when in use.
- 9.4 In the event radiographic operations are being conducted at a distance remote from the permanent storage area provided for the exposure device, the vehicle transporting the device may be used for storage by complying with Paragraphs 14.3 14.4 14.5 14.6 14.7 and 14.8 of this procedure.

10.0 USE OF X-RAY EQUIPMENT

Safety procedures of this section shall apply to operations with x-ray producing machines, where applicable.

- 10.1 Survey meters shall be used in the same manner as when utilizing radioactive material. They shall be used to determine that the x-ray unit is off except in cases where the main power source is disconnected.
- 10.2 No x-ray unit shall be left unattended whereby unauthorized personnel could cause the unit to be energized, resulting in a hazard. The control panel and/or power cables shall be stored or locked if unit is to be left unattended.
- 10.3 It will be the Radiographer's responsibility to complete Radiation Safety Report Form RSC15. Form RSC 15 will have instructions for completion printed on the reverse side.
- 10.4 No individual shall operate an x-ray machine until such individual has received a copy of, instruction in, and demonstrates an understanding of the operating procedures for said unit.
- 10.5 The X-ray Equipment Procedure, although brief, does not relieve the Radiographer and/or Assistant Radiographer of any of the other detailed requirements of the Operating and Emergency Procedures, which does not pertain directly with the operation or use of an exposure device.

11.0 PERMANENT RADIOGRAPHIC INSTALLATION

Safety procedures of this section shall apply to radiographic operations using radiographic installation (shielded radiation exposure rooms). Requirements shall be in addition to those detailed in the Operating and Emergency Procedures.

- 11.1 Exposure rooms shall be used only with those sources of radiation authorized by licenses.
- 11.2 Sources of radiation to be exposed only in areas as authorized for each particular room.

11.3 Exposure rooms having special requirements (other than listed in this section) as required by the RSO, shall be complied with.

11.3.1 Those requirements shall be posted at the radiographic installation.

11.3.2 The RSO shall maintain a record of those special requirements.

11.4 Exposure rooms utilizing gamma radiation of xray (without interlock to de energize tube head when entry to the high radiation area is attempted) shall be equipped with a visible and audible alarm signal. The visible alarm shall be actuated when the source of radiation is exposed (or x-ray tube energized). The audible alarm shall be actuated when entry to the high radiation area is attempted.

11.4.1 Alarm shall be generated so that an individual attempting to enter the area would be aware of the hazard during an exposure.

11.4.2 Alarm shall be generated so that the radiographer would be aware of any unauthorized entry during an exposure.

11.4.3 Equipment inoperable shall be repaired or replaced by complying with the field radiography requirements of the Operating and Emergency Procedures.

11.5 Exposure room shall have available a functioning and current calibrated survey meter.

11.6 Exposure rooms shall be checked, prior to each exposure, to assure the area is cleared of personnel.

11.7 If and exposure device is to be left unattended, the device shall be returned to the shielded and locked position. The key shall be removed from the exposure device locking mechanism.

11.8 Upon completion of the scheduled radiographic operation, or the radiographic operations, or the radiographer's shift, the exposure device shall be returned to the storage condition.

12.0 COMPLETING THE RECORDS

12.1 Records are your evidence of compliance with the procedures of the Operating and Emergency Procedures. Your Radiation

Safety officer (RSO) shall insists that you properly document your work.

12.2 It shall be the Radiographer's responsibility to complete the following records:

- (a) Radiation Safety Reports - Form RSC 14, Figure 1 (Field Gamma)
- (b) Radiation Survey Reports - Form RSC 24, Figure 3 (Lab Gamma)
- (c) Radiation Survey Reports - Form RSC 15, Figure 2 (X-ray Machine)
- (d) Utilization Log - Form RSC 13

12.3 Each form (except RSC 13) you use will have the instructions for completion printed on the reverse side. These instructions are self-explanatory and eliminate your remembering each detail.

Complete the record and distribute the copies per the instructions. Make sure your signature and the date are legible.

13.0 RADIATION SAFETY RECORDS MAINTAINED AT EACH LAB/PROJECT

13.1 The following records, as applicable, shall be maintained at the Lab/Project which are necessary for inspections by company, agreement state, or NRC auditors.

- (a) Film Badge Reports
- (b) Radiographer Approval and Training Certification Form RSC 4 or RSC 5 (as applicable for level of certification)
- (c) Assistant Radiographer Approval and Training Certification Form RSC 6 (as Applicable)
- (d) Occupational Radiation Exposure History Form RSC 1 (as applicable)
- (e) Receipt of Procedures Form RSC 1 (as applicable)
- (f) Quarterly Radiographer Audit Form RSC 8
- (g) Quarterly Assistant Radiographer Audit Form (RSC 25)
- (h) Quarterly Safety Meetings Form RSC 9

- (i) Termination Exposure Report Form RSC 2 (as applicable)
- (j) Radioactive Material Receipt Form RSC 10
- (k) Decay Charts
- (l) Leak Test Performance Record Form RSC 11
- (m) Leak Test Analysis Report
- (n) Radioactive Material Transfer/Disposal Report Form RSC 12
- (o) Utilization Logs Form RSC 13
- (p) Radiation Survey Reports Forms RSC 14, RSC 15, RSC 24
- (q) Radioactive Material Quarterly Inventory Form RSC 3
- (r) Type B Package Certificates (as applicable)
- (s) Survey Meter Calibration Certificates
- (t) Annual Inspection of Shielded Room X-ray Cabinets Form RSC 18
- (u) Gamma Exposure Device Inspection (Quarterly and Special) Form RSC 19
- (v) X-ray Equipment Inspection (Quarterly and Special) Form RSC 20
- (w) Dosimeter Checks Forms RSC 22

13.2 Records for call-out jobs and projects with less than nine (9) months duration (Temporary Locations) shall be maintained in the office of the location where the call-out is originated.

14.0 TRANSPORTING THE SOURCE

14.0 Approved Vehicle - Vehicles approved by the RSO or Radiation Safety Supervisors of Pogue Industries Incorporated are the only approved vehicles to be used for transporting sealed sources.

14.2 Approved Drivers - Approved vehicles carrying sealed sources may be driven by any company employee with a current driver's license.

14.3 Preparation for Transport - Packaging of exposure devices and/or storage containers containing radioactive material shall be designated and selected to meet with all the requirements of the U.S. Department of Transportation (DOT) title 49 CFR, except when transported within the confines of the plant or other authorized location of use.

14.3.1 Procedure for the packaging requirements of exposure devices and/or storage containers can be found in procedure 10.3.F of this program (Source Shipping /receiving/transfer/disposal procedure).

14.3.2 Shipping containers shall be securely blocked or braced in vehicle to prevent shifting in transit. This may be done by utilizing a separate compartment the size of the shipping container or by using a removable 1 x 10 board the width of the shipping compartment secured by two 2 x 4 to prevent forward /backward movement and a 2 x 4 with a 1 x 10 "T" laid width-wise to prevent lateral shifting.

14.4 Securing the Vehicle - Close and lock the door to the storage area. This door must be kept locked until you arrive at the jobsite.

14.5 Posting - Placard all four sides of the vehicle with signs reading "Radioactive", if required. The radioactive placard must have the top portion yellow with the symbol black. The lower portion must be white with the inscription, "Radioactive", in black.

NOTE: Requirements for the placarding of vehicles is determined by the transport index (see Procedure 10.3.F of this program).

14.6 Surveying - Survey the exterior surfaces of the vehicle and the driver's compartment. No radiation field exceeding 2 mr/hr shall be permitted.

14.7 Overnight Stops - A radiation emergency could occur by:

- (a) Unauthorized persons tampering with your equipment.
- (b) Another vehicle striking your vehicle.

The chances of these emergencies occurring can be minimized by considering the following guidelines when you park:

- (a) Make sure your vehicle is locked

(b) Park in a well lit area.

(c) Do not park on streets carrying heavy traffic.

14.8 Key Control - The keys to the vehicle give you control over the radioactive source during transport. Do not loan your keys to persons other than:

(a) Pogue Industries Incorporated Certified Radiographer or Radiation Safety Monitor.

(b) Another employee of Pogue Industries Incorporated during the time you are personally with the vehicle.

NOTE: Do not hide a spare key in or around the vehicle.

15.0 HANDLING THE EMERGENCY

15.1 Introduction - This procedure is your instruction for handling an emergency involving a radioactive source. Follow the "Four Key Steps". The Radiation Safety Officer (RSO) will provide step-by-step procedures for elimination of the emergency. The objective of this plan is to minimize the radiation exposure of all personnel involved.

15.2 Application - These instructions apply to all field and laboratory operations of Pogue Industries Incorporated.

15.3 Responsibility - The Radiographer who has been assigned the equipment is responsible for the emergency action. The Assistant Radiographer shall follow the instruction of Radiographer.

15.4 Emergency - An emergency is a condition or potential condition which may cause one of the following:

- (a) Overexposure or potential overexposure of any person in excess of the regulations.
- (b) Malfunctioning, damaged, stolen, or missing survey instrument.
- (c) Malfunctioning, damaged, stolen, or missing exposure device.
- (d) Vehicle accidents, fires, or other relative situations. The above emergencies, will be handled using the relative steps listed in this section, Paragraphs 15.5, 15.6, 15.7 and 15.8.

15.5 Radiographer's Action - Follow the instructions listed below:

Step 1 - Assure all personnel are clear of radiation area.

Step 2 - Survey and post the area with "Caution - Radiation Area" or "Danger - Radiation Area" signs. (Refer to Paragraph 7.0 of this procedure - Posting the Area.) In the event the survey instrument is damaged or malfunctioning, the procedure described in Paragraph 5.2 (Preliminary Control) shall be followed and maintained. No one shall be allowed to enter this area until the location of the sealed source has been determined by the Radiographer. The safe position of the sealed source shall be determined by securing an operable survey instrument.

Step 3 - Maintain surveillance of the area until you can be relieved by a responsible person. Emphasize to your relief the importance of keeping all persons out of the posted area.

Step 4 - Contact the Radiation Safety Monitor for further instructions. Call the RSO at the telephone number (314) 892-4934. Additional telephone numbers are listed on Form RSC 23, Radiation Safety and control Personnel. DO NOT PROCEED WITHOUT SPECIFIC INSTRUCTIONS FROM YOUR RSO. The RSO will ask questions about the emergency to determine the safest method of correction. Carefully follow his instructions.

- 15.6 Personnel Involved - Personnel involved in the emergency are barred from further work or around radioactive sources until released by the RSO.
- 15.7 Equipment Involved - Equipment which may have been damaged as a result of the emergency shall not be used until released by the RSO.
- 15.8 Locating a Lost Source Using Your Survey Meter - In the event a source should become lost, immediately secure the suspected area of the loss by barricades, ropes and/or guards, to prevent overexposure to personnel and proceed with the technique for locating a lost source as described in Figure 4.
- 15.9 Any individual who believes that a violation of Company, Federal and/or State regulations has occurred or could possible occur, should notify the RSO of the Alleged violation.

6.0 AGREEMENTS STATES REQUIREMENTS

Agreement states are those states that have accepted the responsibility from the USNRC for control of radioactive materials within their boundaries. The regulations of governing radioactive materials within each agreements state parallel very closely to the regulations of the USNRC. They do impose some additional requirements, however, and each radiographer shall be required to be familiar with these additional requirements.

16.1 Instructions

Each Radiographer and Assistant Radiographer shall have available copies of the Agreement State Regulations for the particular state in which they are working, and when applicable, Agreement States License.

16.2 Conflicts

When the Agreements State and Operating and Emergency Procedures conflict, the most stringent requirements shall apply. If you are not sure which one to follow, contact the RSO.

17.0 INSPECTION AND MAINTENANCE PROCEDURE

Inspection and Maintenance Procedures are the daily actions taken by a Radiographer to assure his equipment is in good working condition.

17.1 Equipment shall be maintained in good condition by periodic inspection, test calibration, and maintenance.

17.2 A maintenance-calibration label, when applicable, shall be placed on equipment to identify the date for the next servicing/calibration.

17.3 Exposure Device.

17.3.1 Daily inspections shall be conducted by the Radiographer in the field per the instructions of Form RSC 21, Figure 6.

17.3.2 Field Maintenance.

(a) Servicing of the equipment to correct minor deficiencies uncovered by the inspection may be performed by the Monitor except when abnormal radiation levels are involved.

17.4 Special Inspection

Inspection shall be conducted whenever equipment is malfunctioning or has been subjected to severe damage or stress, such as dropping or submersion in water, etc. Exposure devices involved in emergencies shall be inspected per the instructions of the RSO. The report shall be identified "Special Inspection" and include a description of the abnormal situation encountered.

17.5 Survey Instrument

- (a) Inspect the survey instrument at the beginning of each shift for normal functioning and current calibration date.
- (b) Calibration is required each 90 days and/or after servicing (calibration tag on instrument)

NOTE: DO NOT use survey instrument with expired calibration dates.

17.6 Reject Tag

Any equipment found to be inoperable and/or out of calibration should have a reject tag affixed and shall be removed from service.

18.0 DEFINITIONS

Byproduct Material - Any radioactive material, except special nuclear material, yielded in, or made radioactive by exposure to radiation incident to the process of producing or utilizing special nuclear material. For example: Cobalt-60 and Iridium-192.

Curie (Ci) - The unit for measuring the quantity of radioactive material. One curie (Ci) is the amount of material which yields 3.7×10^{10} disintegrations per second, or the activity approximately equivalent to that of one gram of radium.

Dosimeter - A device for measuring the amount of exposure to ionizing radiation received by an individual.

Radiation Area - Any area accessible to personnel in which there exists radiation at such levels that a major portion of the body could receive, in any one hour, a dose in excess of 5 MR, or in any 5 consecutive days a dose in excess of 100 MR.

Radiation Signs - Signs which warn of the presence of ionizing radiation or materials that emit radiation. They display the conventional three-bladed radiation symbol in magenta, or purple, on a yellow background.

Radiographer - Any individual who perform, or who is in attendance at the site and personally supervises radiographic testing operations, and who is responsible to the licensee for assuring compliance with the requirements of NRC Regulations, Regulations of Agreements States, the conditions of the license, and these procedures.

Assistant Radiographer - Any individual who, under the personal supervision of a Radiographer, uses exposure devices or survey instruments in radiography.

Radiographic Exposure Device - Any device, such as a projector containing a radiographic sealed source fastened therein, in which radiographic sealed source, or shielding thereof, may be moved or otherwise changed from a shielded to an unshielded position, with respect to the source, for purpose of making a radiographic exposure. Sealed sources may also be transported in these devices when appropriate conditions are met.

Radiography - The nondestructive testing of materials by the production of an image on a radiation-sensitive surface, such as a photographic film, by the use of sealed sources containing radioactive material, or a beam of x-rays.

Roentgen Equivalent Man (REM) - A REM is a measure of dose of any ionizing radiation to body tissue relative to the estimated biological effect of exposure of one roentgen of x-ray. For the purpose of this procedure, one "REM" and one "R" are identical for the reason that the sealed sources utilized in industrial radiography do not emit Alpha or Beta radiation outside of the stainless steel capsule.

Restricted Area - Any area access which is controlled for the purpose of protection of individuals from exposure to radiation.

Roentgen (R) - A roentgen is a measure of the ionizing radiation in the arc produced by X or Gamma radiation.

Sealed Source - Any radioactive material that is encased in a capsule designed to prevent leakage or escape of the radioactive material.

Shielding Material - Any material used to absorb radiation and thereby reduce its amount of intensity.

Storage or Shipping Container - A shielded device in which sealed sources are placed for storage or transportation.

Survey - The measurement and recording of radiation intensities at various locations in an area where ionizing radiation exists.

Personal Supervision - Of a Radiographer's Assistant by a Radiographer means supervision in which the Radiographer is physically present at the site where sealed sources are being used and watching the assistant when the assistant uses radiographic exposure devices, sealed sources, or related source handling tool, or radiation survey instruments in radiography.

19.0 FORMS AND FIGURES

<u>FIGURE NO.</u>	<u>FORM NO.</u>
1. Radiation Safety Report (Field)	RSC 14
2. Radiation Safety Report (Laboratory)	RSC 24
3. Radiation Safety Report (X-ray Machines)	RSC 15
4. Locating a Lost Source Using the Survey Meter	--
5. Radiation Intensities and Distance Charts	--
6. Exposure Device Maintenance Checklist Form	RSC 21

INSTRUCTIONS (SURVEY REPORT)

1. THIS FORM IS TO BE COMPLETED FOR EACH DAY OR JOB. THIS INCLUDES PERIODS THE EXPOSURE DEVICE IS REMOVED FROM STORAGE, BUT IS NOT USED TO PERFORM RADIOGRAPHY.
2. CUSTOMER - SELF EXPLANATORY
3. DATE - SELF EXPLANATORY
4. JOB LOCATION - SELF EXPLANATORY
5. TECHNICIAN - RADIOGRAPHER, ASSN'T RADIOGRAPHER AND OTHER MONITORED INDIVIDUALS NAMES.
6. FILM BADGE/TLD NO. - SELF EXPLANATORY
7. DOSIMETER NO. - SERIAL NUMBER OF YOUR DOSIMETER
8. DOSIMETER READING START-DOSIMETER READING AT START OF EACH DAY OR JOB. DOSIMETERS ARE TO BE ZEROED AT THE BEGINNING OF EACH DAY OR JOB.
9. DOSIMETER READING STOP - DOSIMETER READING AT THE END OF EACH DAY OR JOB.
10. SOURCE MATERIAL AND S/N - RECORD THE TYPE OF BYPRODUCT MATERIAL (IR 192, CO 60) AND THE SERIAL NUMBER OF THE CAPSULE.
11. EXPOSURE DEVICE MODEL AND S/N - SELF EXPLANATORY.
12. DAILY MAINTENANCE INSPECTION - PERFORM THE DAILY MAINTENANCE INSPECTION AS BY SECTION 10.4.8 NOTE THE CONDITION AS ACCEPTABLE OR UNACCEPTABLE. IF UNACCEPTABLE, THE ITEM SHOULD BE NOTED IN THE REMARKS COLUMN AND BROUGHT TO THE RADIATION SAFETY MONITORS ATTENTION. DO NOT USE THE EXPOSURE DEVICE UNTIL IT IS REPAIRED.
13. SURVEY METER MODEL, S/N, AND DATE CALIBRATED - RECORD THE MODEL OF THE SURVEY METER USED, THE SERIAL NUMBER, AND THE DATE THE SURVEY METER WAS CALIBRATED.
14. EXPOSURE DEVICE SURVEY WHEN REMOVED FROM STORAGE - RECORD THE HIGHEST READING IN MR/HR AT THE SURFACE OF THE DEVICE AND AT THE PORT.
15. EXPOSURE DEVICE SURVEY AT CONCLUSION OF LAST RADIOGRAPHIC EXPOSURE - RECORD THE HIGHEST READING IN MR/HR AT THE SURFACE OF THE DEVICE AND AT THE PORT. SURVEYS OF THE EXPOSURE DEVICE ARE PERFORMED EACH TIME THE SOURCE IS RETURNED TO THE SHIELDED POSITION AS DESCRIBED BY PROCEDURE 10.4.13 PARAGRAPH 8.1.5. THE SURVEY AT THE CONCLUSION OF THE LAST RADIOGRAPHIC EXPOSURE IS RECORDED.
16. EXPOSURE DEVICE SURVEY WHEN RETURNED TO STORAGE - RECORD THE HIGHEST READING IN MR/HR AT THE SURFACE OF THE DEVICE AND AT THE PORT. THE READINGS SHOULD BE THE SAME AS WHEN REMOVED FROM STORAGE. IF NOT, IT SHOULD BE SUSPECTED THE SOURCE IS NOT IN THE SAFE POSITION.
17. AREA RADIATION SURVEY - RECORD THE DISTANCES AND READINGS. WHEN THE CEDMETRY CHANGES MORE THAN 3 TIMES, ADDITIONAL REPORTS ARE TO BE USED.

INSTRUCTIONS (SHIPPING REPORT)

THIS RADIOACTIVE MATERIAL SHIPPING DOCUMENT IS DESIGNED TO FULFILL D.O.T. REQUIREMENTS. THIS FORM IS ORIENTED TOWARD COMPANY VEHICLES TRANSPORTING RADIOACTIVE MATERIAL TO FIELD SITES.

1. IF RADIOACTIVE MATERIALS WERE NOT TRANSPORTED, CHECK BOX "RADIOACTIVE MATERIALS WERE NOT TRANSPORTED".
2. SHIPPER AND COSIGNEE - ENTER THE NUMBER OF CURIES AS OF THE DAY BEING TRANSPORTED.
4. MR/HR @ SURFACE OF SHIPPING CONTAINER AND MR/HR @ 36". ENTER THE HIGHEST READING AT THE SURFACE OF THE SHIPPING CONTAINER AND THE HIGHEST READING @ 36" FROM THE CONTAINER, THE READING AT 36" IS THE TRANSPORT INDEX.
5. VEHICLE SURVEY - ENTER THE HIGHEST READING AT THE SURFACE OF THE VEHICLE AND THE HIGHEST READING AT THE DRIVER'S SEAT. NO RADIATION LEVEL IS TO EXCEED 2 MR/HR @ THESE AREAS.
6. CONTENTS - CIRCLE CONTENTS. IRIIDIUM 192 OR COBALT 60.
7. TYPE B SHIPPING CONTAINER INSPECTION - ENTER THE SERIAL NUMBER, CERTIFICATION NUMBER AND NOTE THE CONDITION OF THE SHIPPING CONTAINER.
8. PREPARATION FOR SHIPPING
 - A. PLACE EXPOSURE DEVICE IN SHIPPING CONTAINER
 - B. SHIPPING CONTAINER SHALL HAVE AFFIXED AN ADDRESS LABEL, (SAME AS USED FOR SHIPPER AND COSIGNEE)
 - C. SHIPPING CONTAINER SHALL HAVE AFFIXED, TWO "YELLOW II" LABELS. INFORMATION REQUIRED ON LABELS ARE AS FOLLOWS:

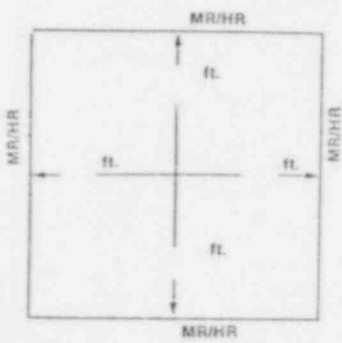
CONTENTS (SPELL OUT IRIIDIUM 192 OR COBALT 60) TRANSPORT INDEX - NOT OVER 1.

NOTE: DO NOT TRANSPORT IF TRANSPORT INDEX IS OVER 1 (1.0 MREM/HR @ 36") OR SURFACE READING IS OVER 50 MREM/HR. ADDITIONAL SHIELDING WILL BE REQUIRED.
9. CERTIFYING STATEMENTS AND SIGNATURE - SIGNING THIS DOCUMENT - VALIDATES THE STATEMENT TO INDICATE ALL APPLICABLE REGULATIONS, PROCEDURES WERE ADHERED TO IN THE PERFORMANCE OF RADIOGRAPHY AND THE PREPARATION OF THE SHIPPING PACKAGE.

Figure 1

POGUE INDUSTRIES INCORPORATED FORM RSC 14
RADIATION SAFETY SURVEY REPORT AND SHIPPING DOCUMENT (FIELD GAMMA)

CUSTOMER: _____		DATE: _____	
JOB LOCATION: _____			
TECHNICIAN	FILM BADGE TLD. NO.	DOSIMETER NUMBER	READING START READING STOP
SOURCE MATERIAL: _____ S/N _____			
EXPOSURE DEVICE MODEL _____ S/N _____			
DAILY MAINTENANCE INSPECTION			
<input type="checkbox"/> ACCEPTABLE REMARKS: _____ <input type="checkbox"/> UNACCEPTABLE _____			
SURVEY METER MAKE _____ MODEL _____ S/N _____			
DATE CALIBRATED _____			
EXPOSURE DEVICE SURVEY WHEN REMOVED FROM STORAGE			
MR/HR @ SURFACE OF DEVICE _____		MR/HR @ PORT _____	
EXPOSURE DEVICE SURVEY AT CONCLUSION OF LAST RADIOGRAPHIC EXPOSURE			
MR/HR @ SURFACE OF DEVICE _____		MR/HR @ PORT _____	
EXPOSURE DEVICE SURVEY WHEN RETURNED TO STORAGE			
MR/HR @ SURFACE OF DEVICE _____		MR/HR @ PORT _____	

AREA RADIATION SURVEY 	RADIOACTIVE MATERIALS SHIPPING DOCUMENT COMPANY VEHICLES <input type="checkbox"/> RADIOACTIVE MATERIALS WERE NOT TRANSPORTED SHIPPER: _____ CONSIGNEE: _____ NUMBER OF CURIES: _____ MR/HR @ SURFACE OF SHIPPING CONTAINER: _____ MR/HR @ 36": _____ VEHICLE SURVEY: MR/HR @ OUTSIDE SURFACES _____ MR/HR @ DRIVER'S SEAT _____ DESCRIPTION OF CONTENTS CONTENTS: IRIDIUM 192 COBALT 60 (CIRCLE ONE) 110 CURIES MAXIMUM RADIOACTIVE MATERIAL SPECIAL FORM N.O.S. UN2974 TRANSPORT INDEX: NOT OVER 1 NOTE: DO NOT TRANSPORT IF SURFACE OF CONTAINER IS OVER 50 MREM/HR AND/OR OVER 1.0 MREM/HR @ 36" (ADDITIONAL SHIELDING SHALL BE REQUIRED TO MEET SHIPPING REQUIREMENTS OF RADIOACTIVE YELLOW II LABEL.) TYPE B SHIPPING CONTAINER INSPECTION S/N _____ ACCEPTABLE <input type="checkbox"/> CERT. NO. _____ UNACCEPTABLE <input type="checkbox"/>
COMMENTS: _____ _____ _____	CERTIFYING STATEMENTS AND SIGNATURE THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED, LABELED AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE DEPARTMENT OF TRANSPORTATION AND THAT ALL RADIOGRAPHIC PROCEDURES AND PRECAUTIONS REQUIRED BY POGUE INDUSTRIES INCORPORATED RADIATION SAFETY AND CONTROL PROGRAM SECTION 10.4.B OPERATING AND EMERGENCY PROCEDURES WERE OBSERVED. THE PERIMETER OF THE SOURCE STORAGE AREA WAS SURVEYED PRIOR TO REMOVING THE EXPOSURE DEVICE FROM STORAGE AND IMMEDIATELY AFTER RETURNING THE EXPOSURE DEVICE TO STORAGE. THE MAXIMUM RADIATION LEVEL WAS NOT IN EXCESS OF 2MR/HR. SIGNED: _____

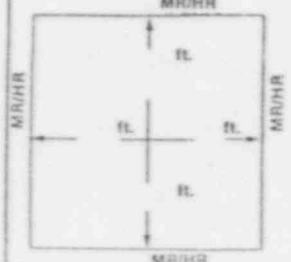
AREA RADIATION SURVEY 	COMMENTS: _____ _____ _____
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Figure 2

FORM RSC 15

POGUE INDUSTRIES INCORPORATED

RADIATION SAFETY AND CONTROL PROGRAM RADIATION SAFETY SURVEY REPORT (X-RAY FIELD)

CUSTOMER: _____ DATE _____
JOB LOCATION: _____

TECHNICIAN	FILM BADGE NUMBER	DOSIMETER NUMBER	DOSIMETER READING START	DOSIMETER READING STOP

Tube Head Make and Model _____ S/N _____
Control Panel Make: _____ S/N _____

Daily Maintenance Inspection: ☐ Acceptable Remarks: _____
☐ Unacceptable _____

Survey Meter Model: _____ S/N _____ Date Calibrated _____

AREA PHYSICAL RADIATION SAFETY

All Radiographic Procedures and precautions required by Pogue Industries Incorporated Radiation Safety and Control Program 10.4.B operating and emergency procedure were observed.

SIGNED: _____

1. This form is to be completed for each day or job x-ray equipment is used in the field.
2. Customer - Self explanatory
3. Date - self explanatory
4. Job Location - The location where radiography is to be performed. The description of the location is to be as complete and descriptive as possible.
5. Technical - Radiographers, Assistant Radiographers and other monitored individuals names.
6. Film badge number - self explanatory
7. Dosimeter Numbers - serial number of dosimeter
8. Dosimeter reading start - dosimeter reading in mr at start of each day or job. Dosimeters are to be zeroed before each day or job. Therefore this reading should be zero.
9. Dosimeter reading stop - dosimeter reading at the end of each day or job.
10. Tube head make, model, S/N - The manufacturer, model and serial number of the tube head.
11. Control panel make and S/N: The manufacturer and serial number of the control panel.
12. Daily maintenance inspection - perform the daily maintenance inspection as required by Pogue Industries Incorporated Radiation Safety and Control Program 10.4.B. Note the condition as acceptable or unacceptable. If unacceptable note the deficient item in the remarks column. Do not use the X-ray equipment until it is repaired.
13. Survey Meter model, S/N and date calibrated - Record the model of survey meter used, the serial number, and date instrument was calibrated.
14. Area Physical Radiation Survey - Record the distances and readings when the geometry changes more than once, additional reports are to be used. Use the comment section to note additional precautions.
15. Final compliance statement and signature - The responsible radiographer is to sign the report. Signing the report certifies all radiographic Procedures and Precaution required by Pogue Industries Incorporated Radiation Safety and Control Program Section 10.4.B Operating and Emergency Procedures were observed.

POGUE INDUSTRIES INCORPORATED

RADIATION SAFETY CONTROL PROGRAM

RADIATION SAFETY REPORT (LABORATORY GAMMA)

CUSTOMER: _____ DATE _____

POGUE INDUSTRIES INCORPORATED LOCATION: _____

TECHNICIAN	FILM BADGE/TLD NUMBER	DOSIMETER NUMBER	DOSIMETER READING START	DOSIMETER READING STOP

SOURCE MATERIAL: _____ S/N _____

EXPOSURE DEVICE MODEL _____ S/N _____

DAILY MAINTENANCE INSPECTION

___ ACCEPTABLE
 ___ UNACCEPTABLE

REMARKS: _____

SURVEY METER

MODEL: _____ S/N _____ DATE CALIBRATED: _____

EXPOSURE DEVICE SURVEY WHEN REMOVED FROM STORAGE:

_____ MR/HR @ SURFACE OF DEVICE _____ MR/HR @ PORT

EXPOSURE DEVICE SURVEY WHEN RETURNED TO STORAGE:

_____ MR/HR @ SURFACE OF DEVICE _____ MR/HR @ PORT

EXPOSURE ROOM DESIGNATION: _____

EXPOSURE ROOM INTERLOCK FUNCTION CHECK: _____

___ ACCEPTABLE
 ___ UNACCEPTABLE

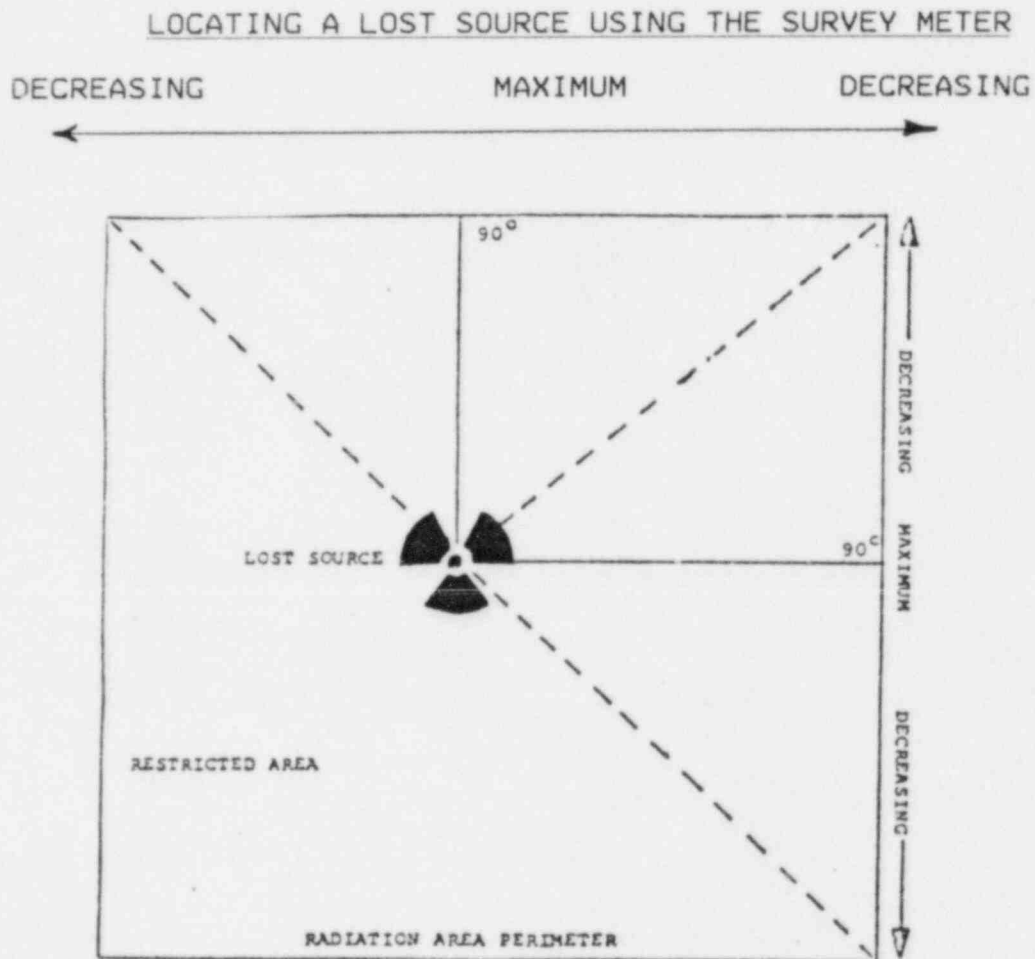
ALL RADIOGRAPHIC PROCEDURES AND PRECAUTIONS REQUIRED BY POGUE INDUSTRIES INCORPORATED RADIATION SAFETY AND CONTROL PROGRAM OPERATING AND EMERGENCY PROCEDURES WERE OBSERVED. THE PERIMETER OF THE SOURCE STORAGE AREA WAS SURVEYED PRIOR TO REMOVING THE EXPOSURE DEVICE FROM STORAGE AND IMMEDIATELY AFTER RETURNING THE EXPOSURE DEVICE TO STORAGE. THE MAXIMUM RADIATION LEVEL WAS NOT IN EXCESS OF 2 MR/HR.

SIGNED: _____

INSTRUCTIONS

1. This form is to be completed for each day or job Gamma sources are used in licensed lab exposure rooms.
2. Customer - Self explanatory
3. Date - Self explanatory
4. Pogue Industries Incorporated Location - enter the lab location.
5. Technician - Radiographers, Assistant Radiographers and other monitored individual names.
6. Film badge/TLD number - self explanatory
7. Dosimeter number - serial number of dosimeter
8. Dosimeter Reading Start - dosimeter reading in MR at the start of each day or job. Dosimeter are to be zeroed before each day or job therefore, this reading should be zero.
9. Dosimeter Reading Stop-Dosimeter reading at the end of each day or job.
10. Source material and S/N - Record the type of by-product material (IR 192,C060, etc.) and the serial number of the capsule.
11. Exposure Device Model and S/N - Self explanatory.
12. Daily maintenance inspection- Perform the daily maintenance inspection as by O & E procedures and note the condition as acceptable or unacceptable. If unacceptable, the item should be noted in the remarks column and brought to the Radiation Safety Monitor's attention. Do not use the exposure device until it is repaired.
13. Survey meter model, S/N and date calibrated - Record the model of the survey meter used, the serial number and the date the survey meter was calibrated.
14. Exposure device survey when removed from storage - Record the highest reading in MR/HR at the surface of the device and at the port.
15. Exposure device survey when returned to storage - Record the highest reading in MR/HR at the surface of the device and at the port. The readings should be the same as when removed from storage. If not, it should be suspected the source is not in the safe position.
16. Exposure Room Designated - If a lab has more than one exposure room, the room used should be designated.
17. Exposure Room Interlock Function Check - Check the exposure room interlocks and alarm system and note as acceptable or unacceptable. If the system is unacceptable the item should be brought to the Radiation Safety Monitors Attention and repaired. Do not use the exposure room if the alarm system and interlocks are not functional.
18. Certifying statement and signature - Signing this document validates the statement to indicate all applicable regulations, procedures were adhere to in the performance of radiography.

FIGURE 4



1. Survey the area in two straight paths that are 90 to each other.
2. Identify the location of maximum reading on each path.
3. Visually project a line at 90 to each path. The intersection of the projected lines will be the source location. Remember, these paths lead into the high radiation area.

FIGURE 5
RADIATION INTENSITIES
AT VARIOUS DISTANCES
FROM UNSHIELDED SOURCE

IRIDIUM 192

<u>10 Curries Strength</u>			<u>5 Curries Strength</u>		
EXPOSURE TIME IN ANY ONE HOUR	DISTANCE FROM PERIMETER OF RESTRICTED AREA	mr/hr LEVEL	EXPOSURE TIME IN ANY ONE HOUR	DISTANCE FROM PERIMETER OF RESTRICTED AREA	mr/hr LEVEL
60 min.	171.8 ft.	2 mr/hr	60 min.	121.5 ft.	2 mr/hr
30 min.	121.5 ft.	4 mr/hr	30 min.	85.9 ft.	4 mr/hr
10 min.	70.1 ft.	12 mr/hr	10 min.	49.6 ft.	12 mr/hr
5 min.	49.6 ft.	24 mr/hr	5 min.	35.1 ft.	24 mr/hr
1 min.	22.2 ft.	120 mr/hr	1 min.	15.7 ft.	120 mr/hr
<u>30 Curries Strength</u>			<u>20 Curries Strength</u>		
60 min.	297.5 ft.	2 mr/hr	60 min.	242.9 ft.	2 mr/hr
30 min.	210.4 ft.	4 mr/hr	30 min.	171.8 ft.	4 mr/hr
10 min.	121.5 ft.	12 mr/hr	10 min.	99.2 ft.	12 mr/hr
5 min.	85.9 ft.	24 mr/hr	5 min.	70.1 ft.	24 mr/hr
1 min.	39.4 ft.	120 mr/hr	1 min.	31.4 ft.	120 mr/hr
<u>60 Curries Strength</u>			<u>50 Curries Strength</u>		
60 min.	420.7 ft.	2 mr/hr	60 min.	384.1 ft.	2 mr/hr
30 min.	297.5 ft.	4 mr/hr	30 min.	271.4 ft.	4 mr/hr
10 min.	171.8 ft.	12 mr/hr	10 min.	156.8 ft.	12 mr/hr
5 min.	121.5 ft.	24 mr/hr	5 min.	110.9 ft.	24 mr/hr
1 min.	54.3 ft.	120 mr/hr	1 min.	49.6 ft.	120 mr/hr
<u>80 Curries Strength</u>			<u>70 Curries Strength</u>		
60 min.	485.8 ft.	2 mr/hr	60 min.	454.4 ft.	2 mr/hr
30 min.	343.5 ft.	4 mr/hr	30 min.	321.3 ft.	4 mr/hr
10 min.	198.3 ft.	12 mr/hr	10 min.	185.5 ft.	12 mr/hr
5 min.	140.2 ft.	24 mr/hr	5 min.	131.2 ft.	24 mr/hr
1 min.	62.7 ft.	120 mr/hr	1 min.	58.7 ft.	120 mr/hr
<u>100 Curries Strength</u>			<u>90 Curries Strength</u>		
60 min.	543.1 ft.	2 mr/hr	60 min.	515.3 ft.	2 mr/hr
30 min.	384.1 ft.	4 mr/hr	30 min.	364.4 ft.	4 mr/hr
10 min.	221.7 ft.	12 mr/hr	10 min.	210.4 ft.	12 mr/hr
5 min.	150.8 ft.	24 mr/hr	5 min.	148.7 ft.	24 mr/hr
1 min.	70.1 ft.	120 mr/hr	1 min.	66.5 ft.	120 mr/hr
1.35 R/hr from 1 currie at 1 meter			14.50 R/hr from 1 currie at 1 ft.		

FIGURE 5
RADIATION INTENSITIES
AT VARIOUS DISTANCES
FROM UNSHIELDED SOURCE

COBALT 60

5 Curies Strength			10 Curies Strength		
EXPOSURE TIME IN ANY ONE HOUR	DISTANCE FROM PERIMETER OF RESTRICTED AREAS	mr/hr LEVEL	EXPOSURE TIME IN ANY ONE HOUR	DISTANCE FROM PERIMETER OF RESTRICTED AREA	mr/hr LEVEL
60 min.	190 ft.	2 mr/hr	60 min.	270 ft.	2 mr/hr
30 min.	135 ft.	4 mr/hr	30 min.	190 ft.	4 mr/hr
10 min.	80 ft.	12 mr/hr	10 min.	110 ft.	12 mr/hr
5 min.	60 ft.	24 mr/hr	5 min.	80 ft.	24 mr/hr
1 min.	25 ft.	120 mr/hr	1 min.	35 ft.	120 mr/hr
20 Curies Strength			30 Curies Strength		
60 min.	335 ft.	2 mr/hr	60 min.	470 ft.	2 mr/hr
30 min.	270 ft.	4 mr/hr	30 min.	330 ft.	4 mr/hr
10 min.	160 ft.	12 mr/hr	10 min.	190 ft.	12 mr/hr
5 min.	110 ft.	24 mr/hr	5 min.	135 ft.	24 mr/hr
1 min.	50 ft.	120 mr/hr	1 min.	65 ft.	120 mr/hr
50 Curies Strength			60 Curies Strength		
60 min.	605 ft.	2 mr/hr	60 min.	659.5 ft.	2 mr/hr
30 min.	430 ft.	4 mr/hr	30 min.	466.4 ft.	4 mr/hr
10 min.	250 ft.	12 mr/hr	10 min.	269.3 ft.	12 mr/hr
5 min.	176 ft.	24 mr/hr	5 min.	190.4 ft.	24 mr/hr
1 min.	80 ft.	120 mr/hr	1 min.	85.1 ft.	120 mr/hr
70 Curies Strength			80 Curies Strength		
60 min.	712.4 ft.	2 mr/hr	60 min.	761.6 ft.	2 mr/hr
30 min.	503.7 ft.	4 mr/hr	30 min.	538.5 ft.	4 mr/hr
10 min.	290.8 ft.	12 mr/hr	10 min.	310.9 ft.	12 mr/hr
5 min.	205.6 ft.	24 mr/hr	5 min.	219.8 ft.	24 mr/hr
1 min.	92.0 ft.	120 mr/hr	1 min.	98.3 ft.	120 mr/hr
90 Curies Strength			100 Curies Strength		
60 min.	807.8 ft.	2 mr/hr	60 min.	851.5 ft.	2 mr/hr
30 min.	571.2 ft.	4 mr/hr	30 min.	602.1 ft.	4 mr/hr
10 min.	329.8 ft.	12 mr/hr	10 min.	347.6 ft.	12 mr/hr
5 min.	233.2 ft.	24 mr/hr	5 min.	245.8 ft.	24 mr/hr
1 min.	104.3 ft.	120 mr/hr	1 min.	109.9 ft.	120 mr/hr

14.50 R/hr from 1 curie at 1 ft.

1.35 R/hr from 1 curie at 1 meter

RADIATION INTENSITIES AT VARIOUS
DISTANCE FROM UNSHIELDED SOURCE

DISTANCE FROM	Co60 Milliroentgens per hour per curie	Ir192
1	14,500	5,400
5	580	216
10	145	54
15	65	25
20	36	15
25	23	9
30	16	6.5

FIGURE 5 (Continued)
 HALF AND TENTH VALUE THICKNESS
 (Inches)

	Ir192	Co60
Lead Half Tenth	.19 .64	.49 1.62
Steel Half Tenth	.53 1.8	.87 2.90
Concrete Half Tenth	1.9 6.2	2.7 9.0
Tungsten Half Tenth	.12 .40	.31 1.04
Half value thicknesses reduce radiation to 1/2-Tenth value thickness reduce radiation to 1/10		

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RADIATION SAFETY AND CONTROL PROGRAM

RADIOGRAPHIC EQUIPMENT - DAILY INSPECTION & MAINTENANCE LIST

Each radiographic exposure device and accessory must be inspected before each use. This inspection must be done when removing the item from the storage area. Equipment found to be unsatisfactory shall be reported to the radiation safety monitor and/or lab/project manager. Defective equipment shall be removed from service and repaired before use.

REMOTE TYPE GAMMA EXPOSURE DEVICE

UNIT - General exterior condition

Handle and feet identification
decals

Source tube and drive cable tube
connection

Locking mechanism

Source connector

CONTROLS - General exterior condition

Crank handle and drive mechanism

Drive cable to unit connection

Drive cable and cable tubes

Source connection

FIXTURES

SOURCE TUBES - General exterior condition

Source tube to unit connection

Source tube to source tip connection

Source tube to tube connections

Source tip

PIPELINER TYPE EXPOSURE DEVICE

UNIT - Handle and identification decals

Locking Mechanism

FIXTURES

CONTROLS - Remote Control Cable (when used)

Remote Control Cable to Control
Adapter Plate Connection

X-RAY EQUIPMENT

X-RAY TUBE - General exterior condition

Power Cord Connector

Label

CONTROL PANEL - General Exterior Condition

Power Cord Connectors

Meters

On-Off Controls

POWER AND CONTROL CABLES - Insulation Connectors

FIXTURES