ARMY NATIONAL GUARD

NON-DESTRUCTIVE TEST EQUIPMENT (NDTE)

RADIATION SAFETY OFFICER HANDBOOK

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U.S. Army National Guard
Non-Destructive Test Equipment (NDTE)
Radiation Safety Officer Handbook

INTRODUCTION

1. *Purpose and Scope*. This handbook provides a quick reference for U.S. Army National Guard (ARNG) Local Radiation Safety Officers (LRSO) responsible for the implementation of a Radiation Safety Program (RSP) to support the LORAD Model LPX 160 portable industrial X-ray device fielded by the U.S. Army Aviation and Missile Command (AMCOM).

2. *Contents*.

Chapter 1. Establishing your RSP

How do I establish a RSP for the LORAD X-ray device?

- Ensure a formal RSP is established, in writing that meets the requirements of TM 1-1500-335-23 and Army Radiation Authorization (ARA) A45-0129-NGB.
- Appoint trained/qualified personnel as LRSO and ALRSO.
- Establish a personnel dosimetry program.
- Establish a Radiation Safety Committee (RSC) and institute administrative procedures for its operations. (*This committee is composed of the Commander, (or designee), senior radiographer, the LRSO, and the ALRSO. This committee should meet, at a minimum, semi-annually).*
- Develop Standard Operating Procedures (SOP) to include radiological incident/accident response procedures.
- Designate a qualified radiographer as "Radiography Supervisor" to oversee radiography operations and assure compliance with the RSP.

Note: *Do not conduct radiography operations on non-Army, i.e., non-federal property, without verification that such operation is in full compliance with applicable state and local regulations and requirements.*

What are the duties of the LRSO/ALRSO?

- Provide advice and assistance to the Commander in formulating policies, programs and procedures pertaining to radiation protection.
- Evaluate and document hazards. Radiation level surveys will be performed at least annually in conjunction with an audit of the local RSP.
- Assure that only qualified radiographers (ASI "N2" indicator) operate radiography devices.

- Assure that a sufficient amount of the appropriate RADIAC instrumentation, i.e., SM 400A, is made available and calibrated for "Active Health & Safety" use.

- Conduct, and document in writing, an annual quality assurance/self-assessment of the Local RSP.

- Develop emergency procedures and assure that all actual or suspected overexposures to ionizing radiation are investigated and reported.

- Instruct personnel annually, on safe work practices, emergency procedures, effects of radiation exposures and other appropriate radiation safety topics, as required. Records of these instructions will include a brief outline of the topics and a list of persons who received them.

- Maintain the personnel dosimetry program. Appoint a dosimetry custodian, on orders, to administer the TLD program.

- Calculate the collective, highest, and average exposure to ionizing radiation for all persons maintained on the dosimetry program. Report these results quarterly to the RCC.

What are the duties of the designated "Radiography Supervisor"?

- Control and maintain all radiography equipment to include assuring that equipment is properly checked and inspected prior to each use.

- Develop and maintain safe operating and emergency procedures. Copies are to be maintained with the equipment during all operations.

***Note**: Operating procedures will include checklists for periodic inspections and testing of safety devices (interlocks, visual warnings), use of radiation monitoring equipment, and daily pre-op, operational, and post-op checks or surveys (i.e., ensuring that warning signs and*

notices are properly posted and safety switches are functioning properly). Emergency procedures must include individuals to be contacted (to include name, telephone number and title), notifications required by AR 385-40, where to take individual for treatment, how to approximate the degree of exposure, what to do with the dosimetry devices.)

- Assure proper use and storage of dosimetry devices.
- Assure the availability, calibration and proper maintenance of radiation survey instruments.
- Maintain utilization logs to include annotation of when interlocks or other warning devices are bypassed or overridden.
- Assume control and institute corrective action in emergency situations.
- Investigate, in coordination with the LRSO, the cause of accidents/incidents.
- Verify the competency of industrial radiographers and ensure that only qualified personnel perform radiographic operations.

What are the qualifications for the LRSO?

- An LRSO and ALRSO shall be appointed by the Commander of each organization utilizing the LORAD X-ray device. The authority of the LRSO to immediately halt unsafe operations and his direct access to the Commander shall be clearly stated. It is not desirable that the LRSO be an operator, supervisor of operators, or under the supervision of such individuals.
- The training and experience of the LRSO will be commensurate with the hazards and will include a basic understanding of radiation protection principles and practices.
- The formal training of the LRSO will be successful completion of the 3-week Radiological Safety Course

presented by the U.S. Army Chemical School at Fort McClellan, or its equivalent. Equivalent courses that have been approved by AMCOM in the past include an X-ray Radiation Safety Officer Course offered by the Navy and a special 2-week course offered by AMCOM, the proponent for the LORAD. AMCOM has also approved the CECOM 40-hour LORAD LRSO Course to certify LRSOs within the Army National Guard.

What are the qualifications for an industrial radiographer?

- Operators must possess an Additional Skill Identifier (ASI) of N2.
- Initial training is through the USAF/ITRO Non-destructive Inspection Course, the U.S. Navy Radiographic Operator Course, or equivalent training courses. Equivalency must be approved by TRADOC or the Army NDI Program Manager.
- Annual retraining consisting of an 8-hour block of instruction is required. In addition, retraining is required any time there is a change in equipment, operating procedures, or regulations. Annual retraining shall be conducted or arranged by the LRSO or his designated representative and documented.

What topics must be included in the annual retraining?

- Topics include proper use of radiation-producing devices; instruction in precautions or procedures to minimize radiation exposure; purpose and functions of protective equipment; instruction in their responsibility to report any condition which may result in unnecessary radiation exposure; and actions to take in the event of any unplanned/accidental exposure.
- Deficiencies identified during annual quality audits of the RSP.
- Review of accidents and unusual events.

- Review of dosimetry results.
- Review of basic radiation safety principles, equipment operations, emergency procedures, new safety regulations, license requirements and other pertinent information.

What are the requirements for an internal training inspection program?

- If a radiographer and radiographer's assistant have not participated in a radiographic operation for more than three months since the last training inspection, that individual's performance must be observed and recorded the next time the individual participates in a radiographic operation.

- Training inspection records on the performance of radiographer and radiographer's assistants shall be retained for 3 years.

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Chapter 2. Operational Requirements

What are the requirements for operating the LORAD X-ray unit in an unshielded (open) area? *(this includes usage inside buildings such as a hangar bay)*

- The X-ray tube head and all objects being examined shall be within a conspicuously posted perimeter that limits the area in which the exposure can exceed 100 mR in any one hour. This area will be conspicuously posted with "DANGER, HIGH RADIATION AREA" or "CAUTION, HIGH RADIATION AREA" signs. No person shall have access to the "HIGH RADIATION AREA" within this perimeter during "X-ray ON time".

NOTE: *High Radiation Area boundaries shall be calculated only. Verification surveys shall not be performed unless such surveys can be accomplished without unnecessary exposure to personnel.*

- A second perimeter delineating a "Radiation Area" shall be established and posted with sufficient "CAUTION, RADIATION AREA" placards so as to be conspicuous from any direction of approach. Radiation dose rates shall be verified by radiation surveys. Such radiation surveys shall be documented in operating logs and shall include a minimum of two readings for each side of the radiation boundary.

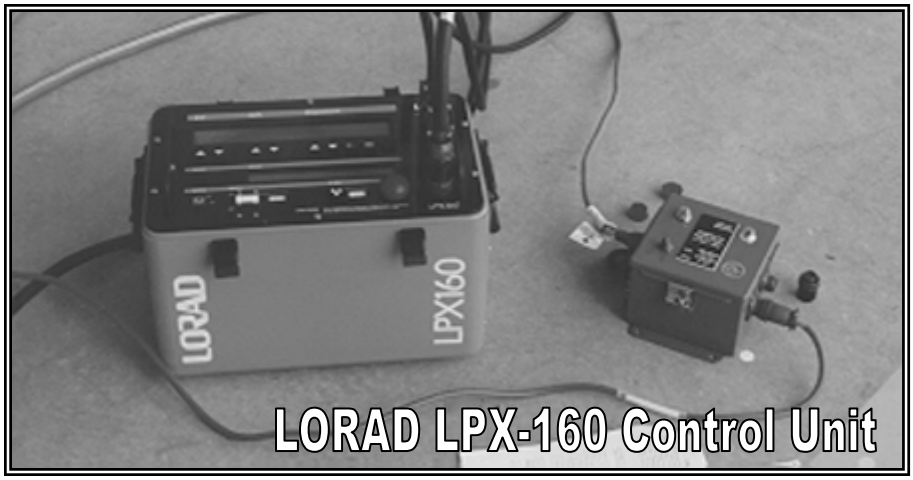
NOTE: *A "Radiation Area" is defined as any area, accessible to individuals, in which ionizing radiation dose rate levels could result in an individual receiving a dose equivalent in excess of 5 mRem (50 uSv) in one hour at 30 centimeters (one foot) from the radiation source or from any source that the radiation penetrates.*

- Compliance with radiation exposure limits applicable to the general public and to occasionally exposed individuals requires that access to areas in which radiation doses could exceed 2 mRem (20 uSv) in any one hour, or 100 mRem (1 mSv) in a year must be restricted. "Radiation Area" postings shall be extended out from the X-ray tube such as to encompass such areas or alternative arrangements made to restrict access to these areas.

- If the beam orientation or technique factors change between exposures, the radiation area and high radiation area boundaries must be reestablished and re-verified by calculation/measurement.

- A rotating/flashing strobe type red warning light shall be positioned near the x-ray tube at the 100 mR/hr boundry line when the source is energized. As an added precaution, rotating/flashing strobe type red warning lights can be used on the perimeter, where feasible.

- An X-ray interlock (NSN 6635-00-292-7637 or equivalent) shall be installed between the control unit and the rotating/flashing strobe type light. The interlock assembly enables electrical power to the "X-ray ON" power circuits only after the rotating/flashing strobe type “X-ray ON" warning light is attached. Each day that the X-ray is used, interlocks shall be inspected to verify their proper operation. Interlocks shall routinely be tested to ensure the X-ray tube head is de-energized when tripped and shall be subjected to detailed testing at intervals not to exceed six months.



LORAD LPX-160 Control Unit

- If the perimeter is arranged that the operator cannot readily determine whether the radiation area is unoccupied, a sufficient number of radiographers and/or radiation safety monitors shall be strategically located to provide adequate visual surveillance over the entire area. These personnel shall have available an adequate supply of calibrated/operable survey meters. This requirement for additional monitors may not be necessary if the radiographic procedures are to be accomplished in

a fenced-in area to which access is controlled by the radiographer and one radiation safety monitor. (Additional monitors should be placed so that all monitors of the entire perimeter of the barrier can be seen and heard by the radiographer. Use of walkie-talkie devices may be warranted).

- The X-ray tube head shall be inaccessible to unauthorized use, tampering or removal when not in use. This shall be accomplished by such means as a locked enclosure or cabinet.

- At least two qualified radiographers, or one qualified radiographer and a qualified safety monitor, as well as a sufficient number of radiation safety monitor assistants, must be present during radiographic operations to prevent unauthorized personnel from accessing the area.

- When entering the area after turning the X-ray "OFF", radiographers shall use a suitable calibrated survey meter to confirm that X-rays are no longer being produced.

What are the mandatory requirements that must be adhered to when performing radiographic operations in unshielded areas?

a. Equipment. In addition to the X-ray-producing equipment, the following equipment must be readily available for use at the site selected for radiographic operations.

☑ At least two serviceable, properly calibrated, radiation survey meters authorized for use with radiography operations. One instrument shall be placed by the operator's console and the other utilized for surveys of the perimeter, as appropriate. Each radiation survey meter shall be checked for acceptable response to radiation using the provided check source prior to the first operation of the day or shift, and after any suspected damage, such as would occur if the instrument was dropped.

☑ A minimum of one personal alarming dosimeter, and one TLD badge for each radiographer involved in radiography operations.

☑ An interlock assembly designed to prevent X-ray operation unless a properly functioning warning light is connected in the circuit.

☑ At least two 250-foot coils of rope with sufficient supporting stands.

☑ Radiation warning signs (10 of each required type). (i.e. CAUTION - RADIATION AREA" and "CAUTION (or DANGER) - HIGH RADIATION AREA."

Note: *A minimum of 500 feet (150 meters) of commercially available barrier material which states "CAUTION - RADIATION AREA" (bright yellow background with magenta letters and radiation symbol) and self supporting stands may be used to cordon off the affected area in lieu of materials specified in the two paragraphs above.*

☑ An adequate length power cable and coolant hose as recommended by the equipment manufacturer.

☑ A radiation warning sign with a rotating/flashing strobe type red light or warning sign stating "**X-RAY ON**" when lit. The sign shall be as close to the radiation source as possible and still be visible from all angles of approach. In addition, it shall be connected to the control circuit in such a manner that the sign is on when the radiation source is activated.

☑ For night radiographic operations, sufficient lighting equipment shall be available to illuminate the area.

b. Determination of Maximum Exposure Rate at the Barrier. Radiographic operations in unshielded facilities require that an initial evaluation of the exposure area be conducted in order to determine the extent of area to be restricted during operations.

☑ "Restricted Area" means any area to which personnel access is controlled for the purpose of protecting individuals from exposure to radiation and radioactive materials. This implies that a restricted area is one that requires control of access, occupancy, and working conditions for radiation protection purposes.

☑ The dose limit in any unrestricted area from external radiation sources shall not exceed 2 mRem (0.02 mSv) in any one hour. In addition, operations shall be conducted such that radiation exposure to individual members of the public shall not exceed 100 mRem (1 mSv) in a year.

NOTE: *This definition does not limit the radiation exposure to a particular rate, but permits higher exposure rates providing that the total quantity of radiation in any unrestricted area during any one hour does not exceed 2 mRem (20 uSv) and during any calendar year does not exceed 100 mRem (1 mSv) to any single individual. (See table below.)*

Maximum Permissible Dose Rate vs Hourly Duty Cycle	
Measured Exposure Rate (mR/hr)	Total Time X-ray Unit is Operated during a One Hour Period (in minutes)
60	2
40	3
30	4
24	5
20	6
17	7
15	8
13	9
12	10
8	15
6	20
5	24
4	30

☑ Special consideration must be given to assuring that restricted areas are of sufficient size in order to prevent any potential adverse impact on adjacent operations. If in doubt, assure that qualified experts are consulted prior to initiation of any radiographic operations.

c. Operations.

☑ Once the restricted area is identified, it shall be adequately posted to assure against inadvertent entry. In larger facilities it may be feasible to lock appropriate doors or limit access to very large work areas as a simple means to controlling the radiation area. In other locations it may be necessary to establish boundaries by roping off or barricading passageways in appropriate areas. In any event, sufficient control in the form of posting, use of safety monitors and use of access limiting devices shall be in place to ensure that individuals cannot enter the area inadvertently.

☑ In general, when X-radiographic operations are conducted without the benefit of shielding it is necessary to erect rope barriers around the X-ray tube head at a distance of 70 meters (230 feet) or more for vertical beam orientations. For exposures requiring near horizontal or horizontal beam, the barrier may have to be extended in the direction of the beam for several hundred meters downrange to achieve the desired maximum exposure rates.

For practical purposes, if radiographs can be performed within an isolated area of the flight line and no unauthorized entry into the radiation area is possible, establishment of physical barriers can be relaxed. However, all access to the isolated area must be safeguarded and posted and any uncontrolled area must not contain exposure rates that would allow personnel to receive in excess of 2 mRem (20 uSv) in any one hour. All positions around the barrier must be in view of one of the radiographers or radiation monitors during exposures.

NOTE: *Radiation protection criteria applicable to members of the public limit exposure to 100 mRem (1.0 mSv) per year. This equates to about 2 mRem (20 uSv) per week. All personnel performing radiography must assure that restricted areas are sufficiently large as to assure compliance with these limits for all personnel not involved with radiography operations. Further, all exposures, to include those to members of the public, must be maintained "As Low As Reasonably Achievable".*

☑ Position radiation warning signs along the barrier in order that they may be seen from any direction of approach.

☑ Extend the power cable from the tube head to the controls so that the operator is located as far as possible from the radiation source (usually at least 75 feet (23 meters)). Position the control unit so that all radiation safety monitors and/or the entire perimeter of the barrier are within sight of the radiographer. If this is not possible, adequate means of communication shall be implemented. Adequate means of communication may include two-way radios, whistles, electronic/propellant activated noise alarm, ultrasonic infrared intrusion barriers, etc.

☑ Place the rotating strobe light or "**X-RAY ON** when lit" sign near the X-ray tube and connect to the X-ray interlock circuit.

☑ Illuminate the area for night operations.

☑ Insure that no individuals reside inside the aircraft when a component is being radiographed.

☑ Prior to making an exposure, the area shall be surveyed by the radiographers to establish the pattern of radiation fields that may be generated and to determine the adequacy of rope barrier placement.

☑ Upon completion of the survey and modification of the barrier, if needed, radiographic operations may proceed.

☑ If the barrier is penetrated by anyone during the exposure, the x-ray device shall be turned off immediately and the incident reported to the radiography supervisor.

☑ In the case of multiple exposures in an open area in which the beam direction, intensity (kVp, mA), or shielding is significantly altered, the barrier perimeter shall be re-established, as necessary. The location of the barrier will be determined by calculation or by survey meter reading.

☑ While in operation, the X-ray control panel **SHALL NOT** be left unattended at any time. In addition, the X-ray device **SHALL NOT,** at any time**,** be operated by unauthorized personnel. This equipment shall always be stored in a secure area. A key lock shall be installed on the x-ray control unit consoles. While in storage or unattended by an authorized radiographer, the power safety switch key shall be removed from the console and securely maintained

separate from the apparatus. Only radiographers authorized by the unit Commander shall have access to the industrial radiographic unit power safety switch key storage areas.

LORAD LPX-160 Console

☑ All required information from the utilization log shall be documented by the radiographer if a suspected overexposure has occurred. This will include the radiation levels identified within the area as well as at the rope barrier.

As the appointed LRSO, do I have to do everything myself?

No, radiation safety monitors can be appointed to assist the radiographer provided they receive radiation safety training that is commensurate with their assigned duties.

These duties include:

- Operating radiation survey meters.
- Establishing the location of the radiation barriers.
- Setting up personnel barriers.
- Preventing unauthorized personnel from entering a radiation area.
- Recording radiation dose levels at barriers.

- Recording personnel dosimeter readings.
- Performing other assignments as directed.

What if I need additional people to control the restricted area?

If more personnel are needed, additional radiation safety monitor assistants may be appointed. These personnel can assist in preventing unauthorized access into the radiographic inspection area. These individuals are not authorized inside the radiation barrier area during operations.

Assistants require no special radiation safety training and are not required to be issued TLD badges. They should be in direct contact (visual or by radio) with the monitors or radiographers to effect termination, if required.

What utilization logs do I need to maintain?

A daily utilization log for recording personal dosimeter results shall be maintained by the radiography supervisor. The Pocket Dosimeter Results Log, AFTO Form 115, or equivalent, shall be used. It must contain the radiographer’s name and the initial and final dosimeter readings for each day that radiography is performed.

The completion of the Industrial Radiography Utilization Log, ATFO Form 125, or equivalent, is mandatory when a suspected overexposure has taken place. The completed form will be permanently maintained on file along with any other documents generated during the subsequent investigation of the suspected overexposure. It is recommended that this log be used routinely as it provides important information concerning the operations conducted. The following information shall be recorded on the Utilization Log:

- kVp.
- mA.
- exposure duration.
- a sketch of the setup with the following identified:
- primary beam direction.
- X-ray tube position.
- control console position.
- film and component position.
- barrier position.
- exposure rates at the barrier (mR/hr).
- approximate location(s) of the individual during the exposure and the amount of time at that location.

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Chapter 3. Conducting Radiation Surveys

When are radiation surveys required?

Radiographers shall perform a sufficient radiation protection survey prior to each use. They shall also perform a survey prior to reentry into the restricted area to assure that the X-ray tube head has been de-energized. A comprehensive dose rate survey shall also be performed by the LRSO as a part of the annual quality assurance audit. These surveys will serve to verify the adequacy of operating procedures, the presence of warning signs and signals, and record radiation exposure measurements to establish and validate safe operating conditions. Records of surveys shall be maintained for a minimum period of three years.

What information should be contained in the radiation survey report?

- Identification of the radiation-producing device and location (building/room number).
- Radiation levels in R/hr at one meter at max kVp and mA.
- Identification of the survey instruments used (to include Serial Number, calibration date, and due date).
- Location of the X-ray tube head and orientation of the useful beam.
- Exposure rates in all adjacent areas accessible to personnel. The location of these measurements shall be identified on the survey form.
- A description of existing mechanical and electrical limiting and safety devices that restrict the orientation of the useful beam or otherwise support radiation protection efforts.

- A statement indicating the type of installation where the device is being used (i.e., unshielded).

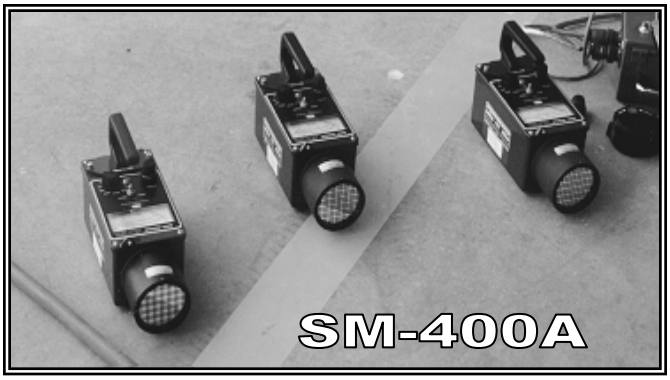
- A statement of the restrictions, if any, imposed on the weekly workload, the degree of occupancy of adjacent areas and the time that the useful beam is directed at any barrier.

- Identification of the individual conducting the survey and the date the survey was accomplished.

- A statement of facility compliance/non-compliance with required directives. If operations are found to be in non-compliance, state what action is required to insure the facility is brought into compliance.

What RADIAC meter do I use to perform a radiation survey?

Only properly calibrated ion chamber type RADIAC meters shall be used to perform surveys of the LORAD portable X-ray system. Geiger-Mueller (GM) type RADIAC meters, such as the AN/PDR-77 and the AN/VDR-2, **SHALL NOT** be used since they can indicate a severe over or under response. The NRC Corp. SM-400A RADIAC meter, fielded with the LORAD LPX-160, shall be your primary choice.



At least two operable radiation survey meters must be available during operation of the unit. Instruments shall be turned on and ready for immediate use. All instruments shall be checked with a radiation check source prior to the first monitoring operation of the day.

Care should be taken to ensure that the mylar window is not damaged and the meter is not subject to harsh conditions. It is acceptable to place the meter in a clear plastic bag if being used in a rainy or humid environment.

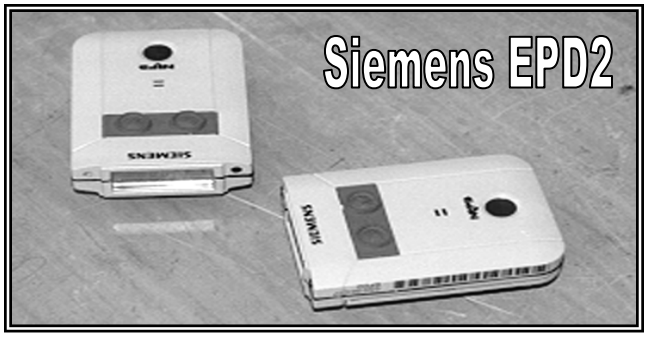
Remember that it may take several seconds for the meter to indicate the maximum exposure rate due to the response time of the electronic components. Refer to the instrument user manual for the specific amount of time required (typically on the order of 2-8 seconds).

***NOTE**: X-ray producing devices are not licensed by the Nuclear Regulatory Commission (NRC), therefore; the required calibration interval will be specified by your State Department of Health or Bureau of Radiological Health. If your state requires a 90-day calibration interval, a one-year interval is not acceptable. You must specify the calibration frequency when returning your RADIAC to the CECOM DS RACL for calibration.*

Chapter 4. Radiation Exposure & Dosimetry

What personnel monitoring devices am I required to wear when conducting radiography operations?

Radiographers must wear a Thermoluminescent Dosimeter (TLD), and an alarming ratemeter/pocket dosimeter. The Siemens "electronic dosimeter" serves as a direct reading pocket dosimeter and an alarming ratemeter. The TLD is the official dosimeter to record radiation exposure for Army personnel. Since the TLD is sent out quarterly for analysis, the direct reading pocket dosimeter is used to provide an immediate indication of exposure.



The alarming ratemeter will sound an alarm when it is exposed to dose rates equal to a pre-set level. Refer to the user manual provided with the pocket dosimeter/ ratemeter for proper operation and care. *(To eliminate electromagnetic interference, the Siemens EPD2 should only be used in conjunction with a radiofrequency (RF) protective pouch). The MGP DMC 2000X has been determined by AMCOM to be a suitable replacement for the EPD2 and PD10i.*

The alarm ratemeter shall be checked to ensure that the alarm functions properly prior to the start of each operation. An annual calibration is required of this unit. The ratemeter should be pre-set to alarm at a low threshold (i.e., 10-20 mR/hr).

Pocket dosimeters shall be read-out and the doses recorded daily in the utilization log. This log will record the radiographer's name and the initial and final dosimeter readings (in mRem) for each day radiography operations are performed.

TLDs and pocket dosimeters shall be stored in a low background area, in an environment free from excessive heat, temperature, moisture, and humidity. All dosimetry should be returned to this designated storage area after each work period.

What are the responsibilities of the dosimeter custodian?

The dosimetry custodian, designated in writing, is responsible for maintaining the records of occupational exposure to ionizing radiation. This person is responsible for the dissemination and collection of the TLDs; for reviewing and signing the quarterly Automated Dosimetry Reports (ADRs) received from the U.S. Army Dosimetry Center (ADC), Redstone Arsenal, AL; for providing exposure reports to personnel annually and following termination, and for ensuring annual radiation safety refresher training is provided to all personnel issued dosimetry.

What are the occupational radiation dose limits?

Radiography operations shall be conducted such that radiation exposure is maintained As Low As is Reasonably Achievable (ALARA). This means that every radiography exposure must be planned and conducted so as to minimize unnecessary exposure both to radiographic personnel and to individuals not involved in the radiography operation. Dose rates and accumulated doses will be monitored as necessary to assure compliance with limits specified in DA Pam 40-18 and to maintain an effective ALARA program.

Occupational radiation exposure limits are as follows:

TYPE DOSE	ANNUAL LIMIT (REM)*
Whole Body(TEDE)	5
Lens of the eye	15
Skin or extremities	50
Embryo/fetus	0.5**

* Dose to individuals under age of 18 shall not exceed 10% of these limits.
** Limits for embryo/fetus are for the entire pregnancy for declared pregnant females.

Radiation exposure limits to members of the general public are as follows:

TYPE DOSE	ANNUAL LIMIT* (mRem)
Whole body	100

* In addition to limiting exposure to 100 mRem/yr, the dose rate at the unrestricted area boundary shall be such that an individual shall not receive a dose exceeding 2 mRem in any one hour.

What shall I do if a suspected overexposure has occurred?

- Immediately cease all radiography operations and report the incident to the unit commander.
- Obtain the name, Social Security Number, and organization of all personnel suspected of receiving an overexposure.
- Notify the LRSO and turn in the individual's TLD badge and the control badge to ADC for immediate processing. The OHN, in consultation with the LRSO, will determine the need for medical treatment.
- Record personal dosimeter readings.
- Complete the Industrial Radiography Utilization Log, AFTO Form 125, or equivalent (see section b, Operational Requirements, What Utilization Logs do I need to maintain?).
- Determine and record exact position and duration of exposure.
- Make a detailed sketch of the area indicating position of the x-ray device, tube head characteristics (kVp and mA settings), direction of primary beam, object being radiographed, any barriers in place, and the position of personnel suspected of being overexposed. Record any other pertinent data about the incident.
- Obtain a signed statement from the exposed individual of actions resulting in the exposure.

- Assure that a new control badge is obtained/designated as a replacement for the control badge that was submitted for analysis.

What actions do I take if a dosimeter reads in excess of the limits in Table 4-1 of DA PAM 40-18?

- Conduct an immediate investigation.

- Determine the cause, timeframe, and circumstances surrounding the apparent overexposure.

- Correct or recommend to the commander corrective actions to prevent recurrence of the situation.

- Determine as to whether or not the dosimeter was actually worn by the individual during the dosimeter wear period.

- Report the overexposure in accordance with DA Pam 40-18 and DA Pam 385-40 (as applicable) if it was determined that the badge was actually worn.

- Fully document the investigation and maintain these records as a permanent file IAW AR 25-400-2. Copies of the final investigation report including any revisions to the individual's dose will also be provided to the individual concerned and to the individual's medical records custodian for inclusion in the individual's health or medical records. The written investigation report shall contain:

(a) A copy of the individual's ADR covering the previous 12 months of exposure, if available.

(b) Result of any bioassays and medical examinations.

(c) Statements from supervisors or other knowledgeable personnel witnessing the event.

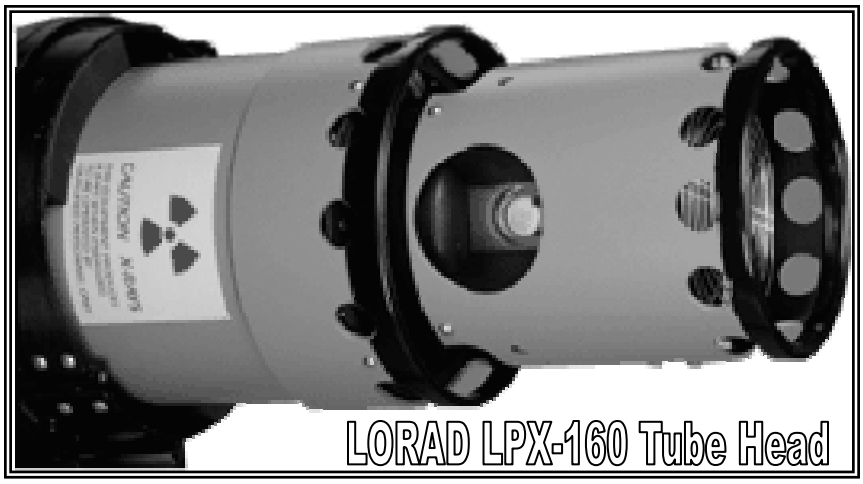
(d) A statement from the individual stating: "To the best of my knowledge and belief I (did) (did not) receive this dose because_____."

(e) Procedures describing corrective actions.

- Review the ALARA program to reduce the likelihood of recurrence and minimize future radiation doses.

- Remove suspected overexposed individuals from duties that could lead to additional radiation exposures pending completion of the overdose investigation.

- Refer any occupationally-exposed individual who sustains an actual overexposure to the supporting occupational health physician. (The occupational health physician, in consultation with the LRSO, will determine the appropriate medical examinations, if any, and plan appropriate medical care).



Chapter 5. Administrative Storage

How do I place my equipment in administrative storage?

As mission dictates, flight facilities may opt to place their equipment in cold storage. This is advantageous to turning the system in. By placing your system into "administrative storage" you can keep the system onsite, discontinue your radiation safety program for the LORAD, and avoid having to reestablish your RSP from scratch if/when the equipment is once again needed.

Here then are the steps to take to place your LORAD LPX-160 X-ray system into administrative storage:

- At the next Radiation Safety Committee (RSC) meeting discuss and document in the minutes that the device will be placed into administrative storage. Be sure to inform the facility commander that if the system is to be brought back online that all RSP requirements must be verified by the State RSO prior to set-up and use.

- Contact the U.S. Army Dosimetry Center, at Redstone Arsenal, AL, to suspend the dosimetry program.

- Store the LORAD LPX-160 in a secure indoor location. We recommend the keys that operate the LORAD console be controlled by the SRSO.

- Place all the RADIACs, i.e., SM400As, electronic dosimeters, etc. in "Calibration Before Use" (CBU) status. Coordinate this action with personnel located at your Combined Support Maintenance Shop.

APPENDIX A

Standing Operating Procedure for the Safe Operation of the LORAD LPX-160 Industrial Radiography System

1. **PURPOSE:** The purpose of this procedure is to provide guidance for the safe operation of the LORAD LPX-160 Radiographic Test Unit (RTU).

2. **REFERENCES**: AR 385-10, The Army Safety Program; DA Pam 385-24, The Army Radiation Safety Program; NGR 385-11, Ionizing and Nonionizing Radiation Protection; DA Pam 40-18, Personnel Dosimetry Guidance and Dose Recording Procedures for Personnel Occupational Exposed to Ionizing Radiation; TM 1-1500-335-23, Nondestructive Inspection Methods, Basic Theory; U.S. Army Radiation Dosimetry Program, Customer Handbook, Version 3.1; Army Radiation Authorization (ARA) A45-0129-NGB; 10 CFR Parts 19, 20 & 21.

3. **SCOPE:** This procedure applies to all personnel assigned to the XXXXX Army National Guard involved in the operation, use, storage and management of the LORAD LPX-160 RTU.

4. **DUTIES and RESPONSIBILITIES:**

a. Unit Commander. The unit Commander maintains overall responsibility for assuring that industrial radiography is in full compliance with federal laws, Army regulations and applicable technical publications to include the provisions of Technical Order 1-1500-335-23. Specifically, the commander will:

1. Designate, in writing, a qualified Radiation Safety Office (RSO), Alternate (ARSO); a Radiography Supervisor, and a Dosimetry Records Custodian.

2. Appoint a Radiation Safety Committee (RSC). This committee will consist of a representative of the Unit Commander, the Unit Safety Officer, the Radiographic Supervisor and the RSO.

3. Implement a dosimetry program for x-ray operations.

4. Assure the performance of annual self-assessment quality assurance (QA) audits of the Radiation Safety Program (RSP) to verify full compliance with all applicable regulations.

b. Radiation Safety Officer (RSO). The RSO shall establish and manage the RSP. Specifically he/she will:

1. Provide advice and assistance to the Commander on all matters pertaining to the Local RSP.

2. Conduct required radiation safety instruction as outlined in paragraph 5.b.

3. Establish and maintain the personnel dosimetry program (to include a medical surveillance program, as determined by the State Surgeon) and assure proper use and storage of personnel monitoring devices. Assure that all radiation exposures are “as low as is reasonably achievable” (ALARA). The RSO will review all substantial changes in operational procedures pursuant to his implementation of an effective ALARA program.

4. Evaluate and document radiation hazards and corrective actions. Radiation surveys to verify known radiation levels will be performed at least annually in conjunction with self-audits as an integral part of radiation evaluations. An internal QA audit/self-assessment will be conducted by the RSO at least annually.

5. Investigate radiological accidents/incidents and recommend corrective actions to prevent recurrence.

c. The Radiography Supervisor (RADSUP) shall:

1. Control and assure proper maintenance of all industrial radiographic equipment to include ensuring that all safety devices are functional and are properly utilized and that only qualified, competent radiographers perform radiography operations.

2. Develop and maintain current radiography operating procedures and emergency procedures and otherwise assist the RSO on technical and safety issues pertaining to radiography.

3. Assure that radiography operators utilize personnel monitoring devices as required and assure proper storage of monitoring devices.

4. Assure the availability, proper calibration, and maintenance of required RADIAC equipment.

d. Radiography Operators (RADOP) shall comply fully with procedures for conducting nondestructive examinations to include all associated safety requirements as outlined in applicable technical manuals and technical orders in this SOP. Special emphasis will be placed on assuring that all exposures to radiation are maintained ALARA.

5. **TRAINING REQUIREMENTS:**

a. RSO/Alternate RSO must have successfully completed a radiation safety course approved by the U.S. Army Aviation and Missile Command (AMCOM) RSO.

b. RADOPs must have successfully completed a nondestructive examiners or radiographer training course leading to ANSI level II qualification. In addition, each RADOP will receive annual refresher training of at least eight hours. The RSO, his/her designated representative, or other qualified individual shall present this refresher training. Refresher training will be documented and include the following subjects:

1. Review of basic radiation safety principles and x-ray safety to include:

a. Proper storage and use of the industrial RTU.

b. Biological effects and other health considerations associated with use of the industrial RTU.

c. Precautions and procedures to minimize radiation exposures.

d. Purpose and function of personnel protective and monitoring devices. Use of RADIAC instrumentation.

e. Reporting unsafe conditions and prevention of equipment malfunctions.

2. Review of findings identified during QA assessments and inspections.

3. Review of any radiological incidents and/or accidents.

4. Review of personnel dosimetry results.

c. All personnel working in or frequenting any portion of the radiation controlled area to include RADOP, safety monitors and ancillary personnel, who are subject to receive a radiation dose equal to 10% of the annual limits, will receive initial and annual radiation

safety refresher training. U.S. Nuclear Regulatory Commission (USNRC) Regulatory Guide (RG) 8.29 entitled "Instruction Concerning Risk from Occupational Radiation Exposure" may be used to supplement this training. In addition, this training will include purposes and functions of protective devices and appropriate response to warning lights or alarms. Females will be instructed in the risk associated with radiation exposure to the embryo/fetus. USNRC RG 8.13, entitled "Effects on the Embryo/Fetus of exposure to Radiation and Other Environmental Hazards" may be used to supplement this instruction.

6. **RADIATION EXPOSURE LIMITS:**

a. Radiography operations will be conducted such that radiation exposure is maintained ALARA. This means that every radiography exposure must be planned and conducted so as to minimize unnecessary exposure both to radiographic personnel and to individuals not involved in the radiography operation. Dose rates and accumulated doses will be monitored as necessary to assure compliance with limits specified in DA Pam 385-24 and DA Pam 40-18 and to maintain an effective ALARA program.

b. Specific individual exposure limits are listed in the tables below. Dose limits for deep dose equivalent (Whole body dose), shallow dose equivalent (skin dose) and eye dose equivalent have different limits and are based on radiation exposure at tissue depths of 1.0, 0.007, and 0.3 centimeters and must be separately assessed.

OCCUPATIONAL DOSE LIMITS	
TYPE DOSE	ANNUAL LIMIT (REM)*
Whole Body(TEDE)	5
Lens of the eye	15
Skin or extremities	50
Embryo/fetus	0.5**
*Dose to individuals under age of 18 shall not exceed 10% of these limits. **Limits for embryo/fetus are for the entire pregnancy for declared pregnant females.	

DOSE LIMITS TO MEMBERS OF THE PUBLIC	
TYPE DOSE	ANNUAL LIMIT*
Whole body	100 mrem
* In addition to limiting exposure to 100 mrem/yr., the dose rate at the unrestricted area boundary shall be such that an individual would not receive a dose exceeding 2 mrem in any one hour.	

c. The RSO will conduct a comprehensive investigation in accordance with DA Pam 40-18 if results of radiation dosimetry indicate exposures exceeding the criteria specified in Table 2-1, DA Pam 40-18. These dose levels are:

INVESTIGATION LEVELS (mrem) – QUARTERLY MONITORING*		
TYPE DOSE	LEVEL I	LEVEL II
Whole Body	125	375
Lens of the eye	375	1125
Other	1250	3750
*Quarterly monitoring is the normal frequency that thermoluminescent dosimeters (TLD) are submitted for evaluation. All radiography involving pregnant females and minors will utilize monthly monitoring.		

7. **PERSONNEL DOSIMETRY:** Individuals expected to receive a dose in excess of 10 percent of the annual exposure limits are required to be issued and properly use dosimetric devices. The following establishes the personnel dosimetry for this unit.

a. The RSO, ARSO, RADSUP and RADOP are designated radiation workers (RW) and will be provided dosimetric devices. The official dosimetric device for the military is the thermoluminescent dosimeter (TLD) obtained from the U.S. Army Ionizing Radiation Dosimetry Center (ADC), Redstone Arsenal, AL.

b. Each RW will be assigned a TLD to be worn only by that person and only during radiographic operations. The TLDs will be exchanged and evaluated quarterly, except for pregnant females and minors whose TLDs will be exchanged monthly.

c. The RSO will appoint a dosimetry custodian, on orders, to administer the dosimetry program. The RSO will select and approve, in writing, the TLD storage location and assure that the TLDs are stored with the control TLD when not worn during radiographic operations.

d. Personnel will wear in addition to the TLD electronic personal dosimeters (EPD) specifically designed for x-ray monitoring. The EPD alarms to provide an immediate indication of radiation exposure exceeding the preset level and provides interim radiation dose information pending the TLD evaluation.

1. Radiation dose information from the EPD will be maintained in a logbook maintained by the RSO or RADSUP as documentation of personnel exposure for the current TLD wearing period.

2. These results will be used by the RSO and RADSUP to track radiation exposures.

3. In addition to re-settable readouts. EPDs have a second, accumulation function that provides a readout of all radiation exposure received since their last calibration. To maximize use of the accumulated dose feature, the same EPDs will

be worn by each RW.

e. The RSO will prepare individual record folders for each RW. This folder will contain the DD Form 1952, and the Automated Dosimetry Reports (ADR) received from ADC. The ADR will be reviewed for accuracy when received and the RSO will date and initial the ADR to indicate this review.

f. The RSO will cause each RW's medical file to be flagged to indicate that radiation exposure records are maintained in a separate location. These radiation exposure records will be available for persons performing an audit of the RSP.

8. **RTU SAFETY PROCEDURES:**

a. GENERAL:

1. The RTU will usually be operated in the unshielded (open) class installation. This means that due to lack of shielding, all operations must be followed to ensure safety of workers and of the general public.

2. The RTU may be used in another country/area (e.g., deployment) provided that all procedures in this SOP and other applicable regulations are followed. Prior to use the JAG, Civil Affairs, and the installation RSO shall be consulted, as applicable, to verify state/country legality, and the SRSO is notified of the transportation of the RTU.

3. The RTU shall never be used as a weapon or to intimidate or interrogate enemy soldiers. Its use will be strictly limited to legitimate radiographic nondestructive inspection requirements or for surveys to verify safe operating conditions.

4. The RTU should be used after duty hours when ever possible to minimize exposure to other personnel and impact on other unit operations. Use during normal duty hours is not precluded.

5. Radiographic operations will be conducted with a minimum of two qualified personnel in attendance at all times.

6. Radiographic operations will not be initiated until all safety requirements are fully implemented, required radiation warning signs are in place, and radiation safety monitors properly placed to assure that personnel cannot enter the radiation restricted area.

b. REQUIRED EQUIPMENT:

1. Two serviceable and calibrated RADIAC meters authorized for use in monitoring x-ray radiographic operations. Although these RADIAC survey meters

can accurately measure other gamma and x-ray fields, their use should be limited to the radiographic energy for which they are calibrated.

2. Personnel dosimetric devices are required for each RW. These will include one Pocket Dosimeter and/or Electronic Personal Dosimeter and an assigned TLD.

3. Interlock and radiation warning strobe light as described in TM 1-1500-335-23, Chapter 5.

4. One five-hundred foot roll of yellow and magenta barrier tape or rope containing the words “Caution-Radiation Area” with sufficient number of stands.

5. Twenty each: “Caution-Radiation Area,” “Danger-High Radiation Area,” and “Danger Very High Radiation Area” signs, as applicable.

6. Sufficient lighting equipment for night operations (if applicable).

7. Seventy-five feet of power cable and cooling hose or as recommended by the manufacturer.

8. Other safety related equipment provided by the manufacturer.

c. RADIATION PROTECTION SURVEYS and REPORTS.

1. A radiation protection survey of all new protective and enclosed x-ray installations shall be made by a qualified expert

2. The RSO will conduct a thorough radiation protection survey and prepare a radiation protection survey report in accordance with TM 1-1500-335-23 for the following situations.

a. Prior to beginning radiographic operations in order to establish safe operating conditions.

b. Anytime the useful beam direction is to be changed.

c. When radiographic operations are to be conducted in areas not previously surveyed.

d. When a different RTU is used.

e. At least annually as a part of the annual internal QA self-assessment.

3. The radiation protection survey report will be valid for three years and updated at least annually. This report will be valid only for the location(s) and operating conditions(s) specified in the report.

4. The RSO or his designated alternate, RADSUP or RADOP will conduct a comprehensive informal radiation protection survey prior to each radiographic operation. This survey shall include the following:

a. Verification of proper operation of all interlocks, “ON-OFF” beam control mechanisms, safety and warning devices, remote monitoring systems, and survey instruments.

b. Verification that the High Radiation Area and Radiation Area boundaries are secure and posted with a sufficient number of signs so as to be conspicuous in all directions. The locations of the two boundaries will be verified with the written radiation protection survey report.

c. Visual confirmation that all personnel have been evacuated from all aircraft, shop sets and other structures within the radiation controlled area. Personnel will be directed to vacate the area.

d. Verification with Production Control that no maintenance or other personnel are on the roof of the hanger, if applicable.

e. Notification of all personnel over the hanger loudspeaker system (if available) by the RSO or his designated representative that RTU testing is being conducted.

f. Documentation of radiation levels (radiation survey) by the RSO or his designated representative as follows:

1. The RTU will be positioned as it will be for radiographic exposure (including the object to be x-rayed) with voltage and current set to the levels to be used.

2. Survey meters will be positioned at the operating controls and at the area expected to receive the highest levels of radiation. This will generally be the area closest downrange from the RTU and that has little or no inherent radiation shielding such as walls, doors, etc.

3. The radiation controlled area will be cleared of all personnel. Safety monitors will be posted within eyesight of each other along the controlled area boundary. The RSO should have two-way radios for communication with safety monitors with whom he/she is not in visual contact.

4. With the rotating flashing strobe warning light on, the RTU will be activated for a period of time as specified by the RADOP. Dose rate readings will be recorded by the RADOP, or the radiographic monitor, using x-ray survey meters. This step will be repeated as required until all required dose rate information is obtained.

5. After the RTU is turned off and the Control Unit safety key is removed, the RADOP will proceed toward the x-ray tube head with a survey meter to verify that the power has been shut off and that a safe configuration exists.

6. The comprehensive informal radiation survey will be valid until an operating condition change or until the radiation restricted area boundary is not secured by safety monitors.

d. RADIOGRAPHIC OPERATIONS:

1. If the comprehensive informal radiation protection survey indicates that safe operating conditions exist, the radiographer will put the x-ray film in place and prepare the target for the actual radiographic procedure.

2. If the operating conditions (voltage, current, beam orientation etc.) are changed, a new informal radiation survey must be completed.

3. The RSO or his designated representative for each radiographic operation will complete a daily utilization log. This form will be maintained on file for three years.

4. Upon conclusion of radiographic operations all x-ray equipment will be secured to prevent unauthorized access and the required to initiate x-ray will be returned to the key control custodian for proper control.

9. **ADMINISTRATIVE STORAGE:** Should mission requirements warrant it, the LORAD LPX-160 RTU can be placed in administrative storage. Placing the X-ray system into administrative storage allows you to maintain the system onsite while temporarily discontinuing the local radiation safety program for the LORAD until the system is needed again. To place the RTU into administrative storage:

a. At the next Radiation Safety Council (RSC) meeting document in the minutes that the device will be placed into administrative storage. Inform the RCC members and the facility commander that if the system is to be brought back online that all RSP requirements must be verified by the State RSO prior to set-up and use. The semi-annual RCC meeting requirement can be suspended at this time.

b. Contact the U.S. Army Dosimetry Center, at Redstone Arsenal, AL, to suspend the dosimetry program until further notice.

c. Store the LORAD LPX-160 tube head and control unit in an environmentally sound and secure location. It is recommended that the keys to operate the LORAD be controlled by the SRSO.

d. Place all RADIACs, i.e., SM400As, EPD-2s, etc. in “Calibration Before Use” (CBU) status. Remove batteries from all SM400A ion chambers. Coordinate “CBU”

status with the Combined Support Maintenance Shop Calibration Section.

e. Archive all radiation safety records and utilization logs accordingly.

10. **EMERGENCY PROCEDURES:**

a. At any time during safety surveys or actual radiographic operations, if unsafe conditions exist (e.g. excessive radiation levels, failed interlocks, warning lights, etc.) the RADOP will immediately cease all radiographic operations.

b. If the RADOP suspects possible overexposure of if the failure occurred during RTU operation such that an overexposure may have occurred the RADOP will immediately cease operation, remove the RTU key, verify with a survey meter that the x-ray has ceased operation, and read each individual's EPD. In the event that any individual was not in possession of an EPD and TLD, action will be taken immediately to assess the dose received by the individual. If any individual's EPD indicates an overexposure the RADOP will immediately:

1. Notify the RSO, director of Safety, Aviation Maintenance Office (AMO), Facility Command and the ARNG Radiation Staff Safety Officer (RSSO) in the following order: RSO – Director of Safety – AMO – Installation Commander – RSSO.

2. Turn in the TLD and EPD through the RSO for immediate transmittal to ADC for evaluation using the most expeditious means available. TLDs that are suspected of having received a potential overexposure must be annotated as such, in writing, when they are sent to ADC for processing. In addition, ADC should be contacted telephonically to assure their immediate processing.

3. Record all events surrounding the potential overexposure to include operating parameters (voltage, current, time) and name, rank, organization of all individuals involved in the radiographic operation. Documentation will include:

a. Completion of the daily utilization log including a sketch of the RTU configuration and position of all personnel.

b. A signed statement from the potentially exposed individual detailing actions resulting in or contributing to the exposure.

c. All radiation accidents and incidents will be fully investigated and reported in accordance with AR 385-40 and corrective action shall be taken immediately to preclude recurrence prior to resumption of radiographic operations. In addition, lessons learned from radiation incidents will be widely disseminated through command channels and to the item manager at AMCOM to help preclude similar occurrence elsewhere.

d. Technical assistance and further guidance is available from the ARNG RSSO office; DSN: 987-7445; COM: 732-427-7445.

APPROVAL:

RSO Print	Sign	Date
Radiographic Supervisor Print	Sign	Date
State Radiation Safety Officer	Sign	Date
Unit Commander Print	Sign	Date

APPENDIX B
ACRONYMS AND DEFINITIONS

ADR	Automated Dosimetry Report
ADC	U.S. Army Dosimetry Center
AMO	Aviation Maintenance Officer
AMCOM	U.S. Army Aviation and Missile Command
ALRSO	Alternate Local Radiation Safety Officer
EPD	Electronic Personal Dosimeter
JAG	Judge Advocate General
LRSO	Local Radiation Safety Officer
MACOM	Major Army Command
RADOP	Radiographic Operator or Radiographer
RADSUP	Radiographic Supervisor
RCC	Radiation Control Committee
RSSO	Radiation Safety Staff Officer
RSO	Radiation Safety Officer
RSP	Radiation Safety Program
RTU	Radiographic Test Unit
RW	Radiation Worker
TLD	Thermoluminescent Dosimeter
Absorbed Dose	The radiation energy imparted per unit mass of material. The unit of absorbed dose is the **gray (Gy).**
ALARA	Acronym for “as low as is reasonably achievable” means making every reasonable effort to maintain radiation exposures to as far below regulatory dose limits as practical consistent with the purpose for which the radiation exposure is used, taking into account the state of technology, the economics of improvement relative to benefits to the public health and safety, and other social an socioeconomic considerations, and in relation to utilization of radiation in the public

	interest.
Dose	A generic term that means absorbed dose, dose equivalent, etc. and represents the total amount of radiation received during the exposure period.
Dose Equivalent (DE).	The product of absorbed dose in tissue, quality factor and other necessary modifying factors at the location of interest. The unit of dose equivalent is **Sievert (Sv)**.
Deep-Dose Equivalent (DDE)	Applies to whole-body exposure, is the dose equivalent at a tissue depth of 1.0 cm (1000 gm/cm^2).
Embryo/Fetus	The developing human organism from conception until time of birth.
External Dose	That portion of the dose equivalent received from sources outside the body.
Extremity	The hands, elbow, arms below the elbow, foot, knee and leg below the knee.
Eye Dose Equivalent	The external exposure to the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 cm (300 mg/cm^2).
Radiation controlled area	An area to which access is controlled for the purpose of radiation safety. This includes all of the area within the taped-off area.
Radiation Area	Any area accessible to personnel in which there exist radiation levels such that an individual could receive a dose equivalent in excess of 5 mRem in one hour at 30 centimeters from the radiation source or any surface that the radiation penetrates.
High Radiation Area	Any area accessible to personnel in which there exist radiation levels such that an individual could receive a dose equivalent in excess of 100 mRem in one hour at 30 centimeters from the radiation source or any surface that the radiation penetrates.
Very High Radiation Area	Any area accessible to personnel in which there exist radiation levels such that an individual could receive an absorbed dose in excess of 500 RADS in one hour at 1 meter from the radiation source or any surface that the radiation penetrates.
Whole body	For the purpose of radiation exposure, means the head, trunk (including male gonads), arms above the elbow, or legs above the knee.

APPENDIX C
Sample Radiation Safety Program Checklist

I. LORAD LPX-160 Industrial X-ray System RSP Administration.
Nondestructive test equipment, i.e., the LORAD Model LPX-160, is an air or water cooled x-ray unit with an operating potential of up to 160 kV and a tube current of up to 5 mA.

Y N NA 1. Has the organization/installation Commander established, in writing, a formal radiation safety program consistent with Federal and Army regulations? (DA PAM 385-24, 1-4l.(8)) (TM 1-1500-335-23, Section VIII, para 6.8.2.2.1a) Regulation _____

Y N NA 2. Does the owning organization retain a copy of the Department of the Army Radiation Authorization (ARA) number A45-0129-NGB and amendments? (DA Pam 385-24, 2-3)

Y N NA 3. Is a qualified RSO designated in writing by the local Commander? (TM 1-1500-335-23, Section VIII, para 6.8.2.2.1c)

Y N NA 4. Is a qualified Alternate RSO designated in writing by the local Commander? (ARA A45-0129-NGB) (TM 1-1500-335-23, Section VIII, para 6.8.2.2.1c)

Y N NA 5. Do the RSOs have the education and training required to work with radiation hazards that they may encounter? (TM 1-1500-335-23, Section VIII, para 6.8.2.2.1c)

Y N NA 6. Have all personnel performing radiography been school-trained and certified for Additional Skill Identifier “N2” or equivalent? (TM 1-1500-335-23, Section VIII, para 6.8.2.2.1h)

Y N NA 7. Has the Commander appointed in writing a qualified radiographer to serve as “Radiography Supervisor” and supervise overall operations and ensure compliance with all aspects of the RSP? (TM 1-1500-335-23, Section VIII, para 6.8.2.2.1k)

Y N NA 8. Implement dosimetry provisions of AR 11-9 and DA PAM 40-18? (TM 1-1500-335-23, Section VIII, para 6.8.2.2.1d)

Y N NA 9. Has the RSO or his designated alternate conducted and documented initial training and periodic retraining of all personnel (including support personnel such as radiation monitors) which is consistent with 10 CFR 19 and their assigned duties? (TM 1-1500-335-23, Section VIII, para 6.8.4)

Y N NA 10. Does the training program mandate and document annual retraining of at least eight hours duration for radiographer(s)? (TM 1-1500-335-23, Section VIII, para 6.8.3.3)

Y N NA 11. Is an internal training inspection program established and training evaluation documented within the unit to demonstrate that performance of each radiographer and each radiographer's assistant is routinely observed? (TM 1-1500-335-23, Section VIII, para 6.8)

Y N NA 12. Has the Commander appointed a Radiation Safety Committee (RSC)? (TM 1-1500-335-23, Section VIII, para 6.8.2.2.1e)

Y N NA 13. Does the RSC meet at least once in each six month period? (ARA A45-0129-NGB)

Y N NA 14. Does the RSO provide a copy of the RSC minutes to the installation RSO? (DA PAM 385-24, 1-9.c.)

Y N NA 15. Were plans and specifications for construction of new facilities or modifications of other facilities reviewed by a qualified expert? (TM 1-1500-335-23, Section VIII, para 6.8.2.2.1f)

Y N NA 16. Assure that procedures to be followed when an accident or incident occurs are defined, that individuals are designated (in writing) to receive notice in the event of emergencies and that radiation accidents and incidents are reported as specified by AR 385-40 and 10 CFR. (TM 1-1500-335-23, Section VIII, para 6.8.2.2.1g)

Y N NA 17. Are only qualified operators allowed to operate radiography equipment? (TM 1-1500-335-23, Section VIII, para 6.8.2.2.1h)

Y N NA 18. Do operators perform "daily pre-operational/operational/post-perational" checks on the equipment and surveys to ensure radiation safety? (TM 1-1500-335-23, Section VIII, para 6.8.2.2.1h)

Y N NA 19. Is the RADIAC instrumentation adequate to properly perform routine radiation surveys? (TM 1-1500-335-23, Section VIII, para 6.8.5.8.6.2)

Y N NA 20. Is the RADIAC instrumentation properly calibrated for ACTIVE use? (TB 9-6665-285-15, 6a(5)(d) and 6b.) (TM 1-1500-335-23, Section VIII, para 6.8.2.2.1i)

Y N NA 21. Is a DA Label 80 with a current calibration date placed in a conspicuous location on the instrument? (AR 750-43, 6-31b(1))

Y N NA 22. Are adequate quantities of X-ray survey instruments on hand and

available for use? (TM 1-1500-335-23, Section VIII, para 6.8.5.8.6.2)

Y N NA 23. Are appropriate radiation check sources available to verify proper operation of survey instruments prior to their use? (TM 1-1500-335-23, Section VIII, para 6.8.5.8.5.1)

Y N NA 24. Does the Radiography Supervisor have and properly maintain a daily utilization log for recording dosimeter results? Do provisions exist for maintenance of dosimetry data during periods of absence of the Radiographer Supervisor? (NOTE: This log is the only source of radiation exposure information until TLDs are processed.) (TM 1-1500-335-23, Section VIII, para 6.8.5.4.5)

Y N NA 25. Instruct the RSO to report quarterly the collective exposure, the highest exposure and the average exposure to the RSC. (TM 1-1500-335-23, Section VIII, para 6.8.2.2.3d)

Y N NA 26. Does the Commander perform, or cause to be performed, an annual quality assurance audit/self-assessment of the Radiation Safety Program? (TM 1-1500-335-23, Section VIII, para 6.8.5.7.6)

Y N NA 27. Does the RSP assure that radiography operations are not conducted on non-Army property without verification that such operation is properly licensed by and in full compliance with applicable state and local regulations and laws? (TM 1-1500-335-23, Section VIII, para 6.8.2.2.1l)

28. Access to all high radiation areas generated by radiographic operations shall be controlled by: (TM 1-1500-335-23, Section VIII, para 6.8.7.7)

Y N NA a. Control devices that, upon entry into the area, causes the level of radiation to be reduced (below that level at which an individual might receive a deep dose equivalent of 100 rem (1 mSv) in 1 hour at 30 centimeters from the source (or the surface the radiation penetrates).

Y N NA b. Control devices that energizes a conspicuous visible or audible alarm so that the individual entering the area and the supervisor of the activity are made aware of the entry.

Y N NA c. Entryways that are locked, except during periods when access to the area is required, with positive control over each individual entry.

Y N NA d. Continuous direct or electronic surveillance that is capable of preventing unauthorized entry.

29. Implement the minimum mandatory requirements when performing radiographic inspection operations in unshielded areas, such as:

(TM 1-1500-335-23, Section VIII, para 6.8.8.3)

Y N NA a. Assure that at least two serviceable, properly calibrated radiation survey meters are in use during all unshielded radiography operations?

Y N NA b. A minimum of one pocket dosimeter and/or one personal alarming dosimeter, and one TLD badge for each radiographer involved in the radiography operations.

Y N NA c. An interlock assembly designed to prevent irradiation unless a properly functioning warning light is connected in the circuit.

Y N NA d. Sufficient amount of rope/cones or other personnel barriers.

Y N NA e. Sufficient quantity of Radiation Warning Signs.

Y N NA f. At least 75 feet of power cable and coolant hose; or as recommended by the manufacturer.

Y N NA g. A radiation warning sign with a rotating/flashing strobe type light properly emplaced and operational prior to X-ray production?

Y N NA h. A "X-RAY ON" label affixed to the warning beacon?

Y N NA i. For night radiographic operations, sufficient lighting equipment to illuminate the area.

Y N NA 30. Mandate recording of records of radiation surveys to document that radiation safety surveys are actually being performed prior to each radiography operation?
(TM 1-1500-335-23, Section VIII, para 6.8.5.7.5.1.1.)

Y N NA 31. Assure that x-ray equipment is adequately secured when not in use to preclude unauthorized use?
(TM 1-1500-335-23, Section VIII, para 6.8.8.3.4k)

II. Personnel Dosimetry Program.

DOSIMETRY RECORDS CUSTODIAN:_____

Y N NA 1. Is the Dosimetry Custodian designated in writing by the commander/SRSO? (DA Pam 40-18, 4-1)

Y N NA 2. Is there a dosimetry program for minors and declared pregnant women workers who may receive (in one year) greater than 100 mrem (TEDE)? (10 CFR 20.1502)

Y N NA 3. Does the dosimetry program incorporate special provisions to assure compliance with requirements (i.e., statements of pregnancy and frequency of TLD change) applicable to pregnant females and minors? (TM 1-1500-335-23, Section VIII, para 6.8.5.2.1.3)

Y N NA 4. Are Automated Dosimetry Records and DD Form 1952 prepared and maintained in separate files for each person occupationally exposed to ionizing radiation? (DA Pam 40-18, 4-2)

Y N NA 5. Are all previous/current occupational exposure data obtained from outside employment, previous organization, or administrative doses and forwarded to the Central Dosimetry Record Repository? (DA PAM 385-24, 5-1f.(2))

Y N NA 6. Has a Charge out Record (OF 23), or other flag, been placed in the individuals' health record or civilian employee medical file for Automated Dosimetry Records maintained separately from the health record or medical file? (AR 40-66)

Y N NA 7. Has the local medical authority addressed medical examinations for radiation workers under the health hazard surveillance program? (DA Pam 40-11, 5-2)

Y N NA 8. Is the TLD storage location approved in writing by the RSO? (DA Pam 40-18, 3-4e)

Y N NA 9. Do radiation workers (those on a dosimetry program) receive annual briefings regarding radiation hazards/biological effects? (10 CFR 19.12; NRC Reg. Guides 8.10, 8.13, and 8.29)

Y N NA 10. Is the annual summary of the Automated Dosimetry Records maintained permanently in the individuals' medical file? (DA PAM 385-24, 5-1f.(3))

Y N NA 11. Has the RSO provided the individual with an annual report of radiation dose? (10 CFR 19)

Y N NA 12. Does the RSO review, sign and date personnel Automated Dosimetry Records? (DA Pam 40-18, 4-3b))

Y N NA 13. Does each dosimeter display some temporary means of individual identification? (DA Pam 40-18, 3-4d)

Y N NA 14. Are dosimeters worn above the waist, below the shoulders and outside the clothing? (DA Pam 40-18, 3-4b)

Y N NA 15. Are adequate quantities and types of TLDs on hand and available for use (to include dosimetry for supporting personnel and visitors if applicable)? (TM 1-1500-335-23, Section VII, para 6.8.5.4.1)

Y N NA 16. Are visiting personnel briefed on the hazards of exposure to radiation and radioactive material prior to entry into the radiation-controlled area? (Presence of radiation, health hazards, minimizing exposure, appropriate response to warnings/alarms, report of exposure, use of protective clothing and equipment) (10 CFR 19.12)