



Radiation Protection Safety Guidelines

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Section A

Overview/Purpose

It has been well documented that ionizing radiation has the potential to cause biological changes in living cells. Therefore, it is imperative that all involved in the medical application of ionizing radiation have an accurate knowledge and understanding of the various safety guidelines in order to minimize the adverse effects of radiation exposure.

We at LaGuardia Community College, Department of Health Services, are committed to this endeavor.

This Radiation Safety Policy is designed to inform and make available to each radiologic technology student and staff member, the various radiation safety practices and regulations established to limit unnecessary radiation exposure to the patient, occupational radiation worker, student radiographer and general public.

ALARA Principle

"As low as is reasonably achievable" (ALARA) means making every reasonable effort to maintain exposures to radiation as far below the dose limits in these regulations as is practical, consistent with the purpose for which the licensed or registered activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economic of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed or registered sources of radiation in the public interest. N.Y.S. Sanitary Code, Chapter 1 Part 16.2 (11).

Radiation Safety Officer

Faculty and students shall be aware of the Radiation Safety Officer at LaGuardia Community College and or related Healthcare facilities associated with.

Additional information on state regulations for radiation safety can be obtained by contacting:

Radiological Health Specialist
NYS DPH BERP
547 River St., Room 530
Troy, NY 12180-2216
(518) 402-7580

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Section B

Radiation Monitoring Guidelines

1. **Who Needs a Dosimeter** – Because of the possible hazards when dealing with radiation, Federal and State Laws require all personnel to wear proper radiation monitoring devices at all times while using energized radiographic equipment or near radioactive sources.
2. **Proper Use of Dosimeter** – monitors are issued and must be worn in accordance with NYS Sanitary Code, Chapter 1, Part 16, Ionizing Radiation and are used to measure occupational exposure at clinical education sites.
3. **Where To Wear The Dosimeter** – badges should be clipped to an article of clothing at the collar level, however, when working in Fluoroscopy or on Portable procedures, the badge is to be worn outside the lead apron, clipped to the uniform collar, never on the lead apron.
4. **Misuse of the Dosimeter** – A badge that has been assigned to an individual may not be used by any other person. The participants' number is a lifetime assignment and is not transferable to another person. Badges must not be tampered with in any manner. Keep your badge away from radiation sources when not in use. Do not leave your badge on lab coats, uniforms or lead aprons. If badges are lost, misplaced or damaged, the Radiation Safety Officer (RSO) or designee must be notified promptly, and the individual will not be allowed to intern in a radiation area until a new badge is issued. See illustration #1
5. **Exposure Data** – Exposure results are received at quarterly intervals from Landauer Dosimetry Service. This report will be posted in a designated area, so that each individual is aware of his/her exposure each quarter. This report must be reviewed and initialed by each badge wearer in order to verify that the individual has seen their report, in compliance with New York State Regulations. Report any unusual exposure to self immediately to the Radiation Safety Officer/designee. **A radiation exposure report is kept on file for each wearer.**
6. **Replacement of Badge** – Every three months the badge must be returned and replaced with a new one). The changing of the dosimeter is the ultimate responsibility of the student and faculty. Late changing will make accurate dose determination impossible.

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Section C

Radiation Exposure Limits

Part 1: Occupational Dose Limits

The following occupational dose limits are referenced in the New York State Sanitary Code Chapter 1, Part 16 (April 18, 2001) and the Nuclear Regulatory Commissions (NRC) code of federal regulations 10 CFR 20, effective January 1, 1994

Annual Occupational Dose Limits

Adult

- Whole Body Deep Dose
Total Effective Dose Equivalent (TEDE) = 5 rem/year
- Total Organ Dose Equivalent = 50 rem/year (organs other than eye, gonads, and blood forming organs and extremities)
- Dose Equivalent for Lens of the Eye = 15 rem/year
- Extremities Dose Equivalent = 50 rem/year
- Shallow Dose Equivalent to skin 50 rem/year
- Embryo/Fetus: Total Dose Equivalent
 - .5 rem/gestation period: 0.05 rem/month
- Minors – (under 18 years) 100 mrem (1mSv)

NOTES: Total Effective Dose Equivalent (TEDE) is the sum of the deep dose equivalent (for external exposure) and the committed effective dose equivalent (for internal exposures)

Whole body is defined as the head and trunk, active blood forming organs, and gonads.

Embryo/fetus – (The developing human organism from conception until the time of birth) 10 NYCRR part 16.2, (42)

Deep Dose – dose to internal body parts at a depth of 1000 mg/cm²

Eye Dose – dose to the lens of the eye at a depth of 300 mg/cm²

Shallow Dose – dose to the skin at a depth of 7 mg/cm²



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Part 2: Student Exposure Limits Policy

New York State Department of Health recommends that student diagnostic radiographer's whole body deep dose exposure for a given month should not exceed 30 mR (Per NYS site visit 1982).

If the student's whole body exposure totals or exceeds 30 mR in a given month, the attached "Radiation Protection Safety Notification Warning" must be issued by the RSO/designee.

1993 Dose Limits Recommended by NCRP – **Education and Training Exposures (annual) students under age 18 yrs.**

Effective dose limit	1 mSv (100 mrem)
Equivalent dose limit for tissues and organs	
a. Lens of eye	15 mSv (1500 mrem)
b. Skin, hands, and feet	50 mSv (5000 mrem)

Part 3: Radiation Protection Safety Notification Warning

Overview

The Program in Radiologic Technology at LaGuardia Community College adheres to the New York State Department of Health recommendation which states that the whole body Total Effective Dose Equivalent (T.E.D.E.) for a given month for a student radiographer under age 18 yrs. should not total or exceed 30 mR.

Procedure

If the minor student exposure totals or exceeds 30 mR/month, the RSO/designee must meet with the student, complete and maintain this record of notification.

Name of Student _____ Date _____

Social Security # _____

- The Radiologic Technology Program wishes to inform you that according to the ICN Radiation Report for the month of _____, 200__, the report reveals that you have received Deep dose _____ mR; Eye dose _____ mR; Shallow dose _____ mR.
- The RSO/designee will review with the student the Radiation Protection Safety Guidelines, Policy #11.

Analysis of Badge Report

- Hospital/affiliate: _____
- Radiographic Area(s) Assigned: _____
- Total Dose since beginning of the program: _____

Possible reasons for exposure received: (List specific exams, dates, room assignments, and other information that may have contributed to the exposure listed above, especially involvement with Fluoroscopic, portable, and special procedures.)

*****Note: On many occasions Radiologic Students have been noted to place or leave badges in nondesignated areas causing an inaccurate report. In such cases another report must be prepared for documentation as follows. ***Need to SCAN this document.**



Radiation Protection Safety Guidelines

LaGuardia Community College
Radiologic Technology Program
Dosimeter Gestation Log Record

Name _____ SS# _____ Badge# _____

- Written declaration of pregnancy on _____
- Gestation Period _____
- Expected date of delivery _____
- Dosimeter Numbers _____
- Previous exposure history from beginning of program _____
- Previous exposure history last 9 months _____
- Report prepared by _____

Month	Collar	Waist	Deep Dose (DDE)	Eye Dose (LDE)	Shallow Dose (SDE)	Signature

- All documentation reviewed monthly with student and R.S.O.
- cc: Radiation Safety File

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Pregnancy Policy

Part 4: Pregnancy Policy

According to New York State Sanitary Code, Chapter 1 Part 16.6(h), (4/18/2001) and the US NRC Regulatory Guide 8.13 – Instruction Concerning Pregnant Radiation Exposure (June 99) the **pregnant student/employee has the right to decide whether to declare her pregnancy or not.** This voluntary decision can be withdrawn at any time.

Upon written declaration of pregnancy by the student/employee the following procedures are required:

The student/employee will:

Submit a statement from her physician verifying pregnancy and expected due date. The statement must include the physician's recommendation as to which of the following options would be advisable (check one).

- a) Immediate withdrawal from the program for health reasons
- b) Continued full time status including appropriate Radiation Safety precautions.

The physician's statement shall be attached to this copy of the Policy. The student should sign this copy as proof that she has read and understands the procedure.

Options for continuance in the program.

1. A student may withdraw for pregnancy may apply for readmission. Re admission is dependent upon the availability of clinical space and academic standing and must be done within one year from the date of withdrawal.
2. A student may continue in the program. Required steps:
 - A. Consultation with the Radiation Safety Officer prior to continuation in clinical assignments.
 - B. The RSO and the declared pregnant worker will review the Program's Radiation Protection Safety Guidelines, Policy 11, and the potential risks involving ionizing radiation to the developing embryo/fetus.
 - C. The pregnant worker will be informed of the specific exposure limits as: the dose to the embryo/fetus during the entire pregnancy, due to occupational exposure should not exceed 0.5 rem (500 mrem). The R.S.O. will review the past exposure history and may adjust working conditions so as to avoid a monthly exposure rate of .05 rem (50 mrem) to the declared pregnant worker. NYS Chapter 1, part 16.6 (h). 9/9
 - D. Two dosimeters will be worn throughout gestation. Whole body dosimeter worn at the uniform collar, and the baby badge worn at the waist under the lead protective apron to monitor the embryo/fetus exposure. (N.Y.S. Sanitary Code, Chapter 1. – Part 16.11, b (2).-4/18/01)
 - E. A monthly radiation exposure log will be established throughout the entire gestation period. Analysis of the monthly exposure totals will be reviewed by both the pregnant worker and the R.S.O. This log will also document the entire past radiation exposure history (see page 9).



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- F. Specific radiation protection measures are required when participating in fluoroscopic, portable/operating room procedures. The pregnant worker is to wear a lead apron (preferably .5 mm pb.eq.) with one badge worn outside the apron at the collar, and the other under the lead apron at the waist level. These procedures do not need to be restricted (especially after the first 18 weeks of gestation) as long as their monthly radiation dose falls below the established limits. Time, distance, and shielding principles must be utilized by the pregnant worker.
- G. The completed radiation record is to remain on file however the recorded radiation exposure dose to the embryo/fetus will not be forwarded to a new employer unless the declared pregnant worker requests this in writing. N.Y.S. Chapter 1, Part 16.14F (4).

NOTE: Undeclared pregnant student/employee refer to N.Y. S. Chapter 1, part 16.6 Occupational Dose Limits.

Student Signature

Date

cc: Clinical Instructor at Student's Assigned Affiliate
RSO/Designee

Approved by the Radiologic Technology Faculty on 6/01

Attach Physician's statement here, and give a copy of entire signed Policy to the RSO, and a copy to the student, and file original signed Policy in student's folder.

#2 (continued)

D. Two dosimeters will be worn throughout gestation. Whole body dosimeter worn at the uniform collar, and the baby badge worn at the waist under the lead protective apron to monitor the embryo/fetus exposure. (N.Y.S. Sanitary Code, Chapter 1. – Part 16.11, b (2).-4/18/01)

E. A monthly radiation exposure log will be established throughout the entire gestation period. Analysis of the monthly exposure totals will be reviewed by both the pregnant worker and the R.S.O. This log will also document the **entire past radiation exposure history** (see page 9).

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NOTE: Undeclared pregnant student/employee refer to N.Y. S. Chapter 1, part 16.6 Occupational Dose Limits.

Student Signature

Date

cc: Clinical Instructor at Student's Assigned Affiliate
RSO/Designee

Approved by the Radiologic Technology Faculty on 6/01

Attach Physician's statement here, and give a copy of entire signed Policy to the RSO, and a copy to the student, and file original signed Policy in student's folder.



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LaGuardia Community College ****May have a copy above**

Radiologic Technology Program

Dosimeter Gestation Log Record

Name _____ SS# _____ Badge# _____

- Written declaration of pregnancy on _____
- Gestation Period _____
- Expected date of delivery _____
- Dosimeter Numbers _____
- Previous exposure history from beginning of program _____
- Previous exposure history last 9 months _____
- Report prepared by _____

Month	Collar	Waist	Deep Dose (DDE)	Eye Dose (LDE)	Shallow Dose (SDE)	Signature

- All documentation reviewed monthly with student and R.S.O.
- cc: Radiation Safety File

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Section B

Student Radiation Monitoring Device Policy

It is the position of the LaGuardia Community College-Radiologic Technology Program that no student will be exposed to ionizing radiation before receiving basic instruction and demonstrating an understanding regarding risks, exposure limits, radiation monitoring practices and safety precautions. These objectives will be obtained during Intro to Radiation Protection. The before mentioned topics will be explored in greater depth throughout the two year period.

During the orientation, each student will be given the Radiation Protection Policies along with the program's Pregnancy Policy is in the Student Handbook. These policies will be thoroughly discussed throughout the Radiation Protection Unit.

Each student will be given (1) radiation badge to be worn during the clinical experience.

Film badges are to be purchased by the hospital. A copy of exposure received in these situations will be maintained in the School Office. The whole-body badge will be worn on the waist under the lead apron. The collar badge is worn on the collar outside the protective lead apron. All film badges are to be kept in the designated area in the Diagnostic Imaging Department.

The school will order the badges. The Radiation Safety Officer reviews the monthly radiation reports of each student. The Radiation Safety Officer who will discuss the findings with the student will investigate any excessive exposure readings. The findings and recommendations will be documented and placed in the student's individual file and Radiation Safety Officer's report. If found that the student is negligent in the care of the badge, the student would be subject to disciplinary action.

The ALARA concept will be emphasized and followed.

During fluoroscopy the student must abide by the following guidelines:

- a. A lead apron of .5mm lead equivalent shall be worn. You must keep the front of the body to the beam at all times.
- b. A lead Thyroid collar may be worn.
- c. Stand as far away as possible from the source of radiation without interfering with the procedure.
- d. Waist baby badge shall be properly positioned under the apron for a pregnant student. Collar badge shall be worn outside the protective apron.

Personnel Protection

The exposure of individuals can be greatly reduced by the correct application of radiation protection devices. The objective is to minimize the genetic effect for the population as a whole. The following guidelines shall be adhered to:

1. Increase the distance of the individual from the source.
2. Reduce the duration of the exposure.
3. Use protective barriers between the individual and the source:
 - a. Protective shielding incorporated into the equipment.
 - b. Mobile or temporary devices.
 - 1) moveable screens
 - 2) lead aprons
 - 3) lead gloves
 - 4) gonad shields
 - c. Permanent protective barriers.
 - 1) walls; lead, concrete
 - 2) primary
 - 3) secondary
 - 4) Control switch-activated only from protected area.

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- 5) Doors closed at all times.
 - 6) Primary beams shall not be directed towards doors.
4. Personnel Monitoring
 - a. Radiation badge – replaced quarterly.
 - b. Report filed.
 5. All lead aprons in the department will be inspected annually both visually and radiographically for defects and will not be folded for storage to avoid cracks in the protective material.

*All lead aprons should be cleansed with disinfectant bi-annually for defects.
 6. All lead gloves will be inspected annually for defects.
 7. All radiation workers will wear lead aprons for portable radiography.
 8. No radiation worker or person other than the patient will stand in the primary beam and the exposure switch will be located at least six feet from the beam.
 9. All cords leading to hand control switches of diagnostic units in the department will be fixed into position to discourage unnecessary exposure.
 10. The quarterly radiation monitoring report is available to students showing their current exposure dosage.
 11. The Radiation Safety Officer will review the quarterly radiation monitoring report and counsel those with unusual dosage readings.
 12. The Radiation Safety Officer shall be available for consultation on all aspects of radiation safety and he/she or a designated substitute shall be available to handle emergencies at all hours of the day or night.
 13. All doors of radiographic rooms shall be shut during exposure.
 14. No fluoroscopy shall be done on known pregnant women without direct, specific instructions from the referring physician and/or radiologist.
 15. A copy of this policy will be given to all present radiation worker employees, all new employees, and all students and will be included in the Department Handbook of policies and procedures.

The before mentioned regulations are in compliance with the National Council on Radiation Protection and Measurements Report No. 91.



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ANALYSIS OF BADGE READING Copy of Report and expand on

- Ways to Prevent (Include specific guidelines and regulations on Radiation Safety.)

I have discussed the above material with the RSO/designee and I will take every precaution necessary to keep my radiation exposure dosage to the lowest possible level.

Signature of Student

Signature of RSO/Designee

Date

Date

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Section D

Radiation Protection Precautions for Personnel

Part 1: Diagnostic Areas

- Holding Patient Restrictions: No person shall be regularly employed to hold patients or image plates during exposures nor shall such duty be performed by any individual occupationally exposed to radiation during the course of his/her other duties. When it is necessary to restrain the patient, mechanical supporting or restraining devices shall be used. If patient or image plates must be held by an individual, that individual shall be protected with appropriate shielding devices such as protective gloves and a protective apron of at least 0.25 mm lead equivalent. No part of the attendant's body shall be in the useful beam. The exposure of any individual used for holding patients shall be monitored. Pregnant women and persons under 18 years of age shall not hold patients under any conditions. N.Y.S. sanitary Code, Chapter 1, Part 16.57, C 1.
- **Mechanical devices** (instead of persons) must be used whenever possible to restrain patients. Examples include adjustable restraints, sponges, sheets, tape, pigostat, bat-mobile, chest unit, velcro straps, etc. **See illustration #2.**
- Always have proper monitor* Protective Barrier Shielding utilization of Primary and Secondary Barriers, lead glass window, lead equivalent lined walls, doors, floor and ceiling. Always, close doors, stay behind lead barriers and use door interlocks
- Protective Tube Housing protects both radiographer and patient from off focus radiation (x rays emitted through the x ray tube window see Figure 1) and leakage through sides of the collimator.
- Shielding lead wrap around apron no less than 0.25mm lead in thickness (0.5mm is commonly used). NCRP report #102 recommends a lead apron of no less than 0.5 mm. pb. eq. for fluoroscopic examinations. Lead protective gloves no less than 0.25mm lead in thickness. **See illustration #3.**
- Never leave protective barrier while making x ray exposures.

Part 2: Fluoroscopic and Portable/Operating Room Areas (see illustrations #4a, 4b, 4c)

Since Fluoroscopic and Portable/Operating Room procedures may cause the greatest potential for personal exposure from secondary and scattered radiation, precautions in these areas are essential. When on clinical rotation, be reminded of 3 Cardinal Principles:

- **Maximize DISTANCE** – Inverse Square Law stand as far back as possible while securing patient safety.
- **Utilize SHIELDING** – Apron, gloves, fluoro tower protective lead curtain, thyroid and eye shields, bucky slot cover and portable lead eq. barriers.

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- **Minimize TIME** – rotate staffing patterns to distribute dose among many staff.
 - a. **DISTANCE** – **Maximize** distance. Intensity of radiation changes with the square of the distance from the source of radiation.

$$I_1 = (D_2)^2$$

$$I_2 = (D_1)^2$$

Example: 2 x distance = 1/4 intensity

3 x distance = 1/9 intensity

4 x distance = 1/16 intensity

(see Illustration 4a, 4b).

- b. **SHIELDING** Placing shielding material between the radiation source and technologist reduces personnel exposure.
 - Protective apron*, gloves, thyroid shield, eye glasses, (minimum of .25 mm lead eq.) N.Y.S. Sanitary Code, Chapter 1, Part 16.56 (c) 1 & 2.
 - Sliding drape (minimal of 0.25mm lead)
 - Bucky slot cover (on the x ray table)
 - Mobile Radiation Barriers
 - Standing behind the PA /fluoroscopist (They become a barrier)
 - NOTE: NCRP National Council on Radiation Protection and Measurements recommends that protective aprons of at least 0.5 mm. Pb. eq. shall be worn in fluoroscopy. A wrap around protective apron should be used by individuals who are moving around during the procedure NCRP Report #102, Page 18, 6/89.
- c. **TIME** Duration of exposure should always be minimized whenever possible. The dose to the individual is directly related to the length of exposure. Example:

Exposure = exposure rate x time

10 mR/min x 5 min = total dose of 50 mR

It is noted that image intensification, the 5 minute reset timer, and the dead man switch that requires continuous pressure all aid in reducing the length of exposure for the patient and operator.

- d. **OTHER CONSIDERATIONS** – Many of the methods and devices which reduce the patients and operators exposure when operating fixed radiographic equipment will also reduce the dose received by the radiographer during a fluoroscopic procedure. These include:
 - Patient restraints Radiographers should never stand in the primary beam to restrain a patient during a radiographic exposure. Mechanical devices should be used to immobilize the patient. Also utilize:
 - a cumulative timing device (maximum 5 min limit)
 - source to table distance (no less than 15"/38 cm for fluoroscopy)
 - the safest place to stand during fluoroscopy may be directly behind the fluoroscopist t (see Illustration 4a, 4b).
 - mobile (bedside radiography) a long 6 foot exposure cord is beneficial in reducing dosage to the operator.

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Section E

Radiation Protection Guidelines for the Patient

Radiation Protection Guidelines for the Patient

- Possibility of Pregnancy

Always inquire about chance of pregnancy **before** any x-ray exposures are taken. Follow appropriate hospital procedures and guidelines on patient pregnancy.

- Collimation – Collimating devices capable of restricting the useful beam to the area of clinical interest shall be used. The x ray images used as the recording medium during the x ray examination shall show substantial evidence of cut off (beam delineation) N.Y.S. Sanitary code, Chapter 1, Part 16.56, (a) 2,3.
- Radiographic filtration – The aluminum equivalent of the total filtration in the useful beam shall not be less than 0.5 mm when operating below 50 kVp, 1.5 mm between 50 70 kVp, and 2.5 mm above 70 kVp. Minimum filtration equals inherent plus added. N.Y.S. Sanitary code, Chapter 1, Part 16.56 (a) 4.
- Gonadal Shielding – Gonadal shielding of not less than 0.5 mm lead equivalent shall be used for patients who have not passed the reproductive age during radiographic procedures in which the gonads are in the useful beam, except for cases in which this would interfere with the diagnostic procedure. N.Y.S. Sanitary Code, Chapter 1, Part 16.57, C 2.
- Entrance Skin Exposure (ESE) Measurements

It is essential that ESE measurements be available for common x ray examinations performed with each x ray unit. N.Y.S. Chapter 1, Part 16.23 (v).

Procedural Steps (not necessarily in the following order)

- Read and evaluate the clinical requisition carefully.
- Give clear, concise instructions. Communicate effectively to reduce the possibility of error.
- Collimate the primary beam only to area of interest(show visible evidence of beam restriction).
- Check for positioning accuracy
- Use appropriate source to image distance.
- Use proper lead gonadal shielding when appropriate, examples include: shaped contact shield, flat contact shield, shadow shield (0.5mm lead).
- Use established immobilization devices when necessary
- Check for adequate beam filtration for quality assurance
- Use proper exposure factors (within ESE recommendations)
- Use proper radiographic processing controls.

*Avoid repeats (they double patient exposure dose)

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Section F

Sources

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5. National Council on Radiation Protection and Measurements (NCRP) Report #102, Medical X ray, Electron Beam and Gamma Ray Protection for Energies up to 50 MEV. 1989, (Supersedes report #33)., Bethesda MD 20814.
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