

Radiation Safety & Regulatory Compliance Manual

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POLICY AND IMPLEMENTATION

The material included in this manual has the authorization of the President of Georgia State University. Safety, in the use of sources of ionizing radiation, is a serious matter and is governed by both federal and state rules and regulations.

The purpose of this manual is to prescribe the standards and procedures to be followed in establishing and administering the radiological safety program at Georgia State University. At this institution it is the responsibility of every person who utilizes radioactive materials or machines producing ionizing radiation, or who is involved in the radiological safety program, to be familiar with and to adhere to the information contained herein. All users, and all other personnel, are especially requested to extend their full cooperation to the Office of Radiological Safety, which will assist in carrying out these procedures.

Your help in making this radiological safety program a success is greatly appreciated. I know that we can depend upon all who are concerned with the use of sources of radiation to follow these procedures and to help protect the health and safety of the University community and the general public.

Dr. Mark Becker
President
Georgia State University

I. RADIATION PROTECTION PROGRAM

Georgia State University is licensed to possess certain radioactive materials by the state of Georgia. The University may, at some future date, be authorized to possess radioactive materials that are licensed by the United States Nuclear Regulatory Commission. The laws require that certain "Standards for Protection Against Radiation" as set forth in Nuclear Regulatory Commission (NRC) Title 10 Code of Federal Regulations, Part 20 (10 CFR Part 20) and Georgia Department of Natural Resources "Rules and Regulations for Radioactive Materials," Chapter 391-3-17, must be enforced by persons holding such licenses. It is also required that all individuals working or frequenting areas where radioactive materials are stored or used shall be informed of the Basic Right-To-Know information that is stated in Title 10, Code of Federal Regulations, Part 19 (10 CFR Part 19), "Notices, Instructions and Reports to Workers; Inspections" or "The State Notice To Employees Sign". Further, users of X-ray and radiation producing machines are required by state law to comply with the "Rules and Regulations for X-ray," Chapter 290-5-22. This Radiation Safety & Regulatory Compliance Manual is written for the purpose of administering these standards at Georgia State University. Definition of terms used in this manual may be found in these various Federal and State Rules and Regulations. In no case should any statement in this manual be construed to be in variance with any of these federal or state regulations.

II. RESPONSIBILITIES

A. Radiation Protection Committee

A Radiation Protection Committee (RPC) has been established by the President of the University to assure and to offer direction for the safe use of radioisotopes and other sources of ionizing radiation on the campus. Members of the Committee are selected from personnel of the various schools and departments on the basis of their experience in the safe handling of radioactive materials and radiation producing machines for research and instructional purposes. The purchasing agent of the University works closely with the RPC in order to provide guidance in business and financial matters.

The Chairman of the Committee shall call a meeting whenever he/she deems it necessary. At least two meetings will be held annually. When a member of the Committee can not be present they shall appoint a competent alternate to represent them at the meeting. Minutes of the meeting shall be recorded and distributed.

The RPC represents the President as the final authority in all matters pertaining to radiation safety. The Committee shall review all applications of radioactivity and for the use of ionizing radiation producing machines or substances on the campus. Any modifications or improvements it deems necessary in the interest of radiation safety shall be effected at the earliest possible time. The Committee may delegate authority to the Chairman and the Radiation Safety Officer (RSO) to act in its behalf on such occasions that arise between normal meeting dates that do not warrant a special meeting of the full Committee. In case of noncompliance with the rules set forth in this manual the Committee has the authority to terminate a Principal Investigators authorization.

The RPC is the authorizing agency for the Principal Investigator. A Principal Investigator is a person who by virtue of his or her experience, training and knowledge is approved by the Committee to possess and use radioactive material or radiation producing machines. The Principal Investigator is the responsible person charged with their proper use. Other persons may work under the Principal Investigator's supervision and under the terms of the authorization issued to him.

B. Radiation Safety Officer

The Radiation Safety Officer (RSO) is that person, appointed by the administration of the University, who by reason of education, training and experience, is qualified to advise others on safety matters pertaining to ionizing radiation and to supervise the Radiation Safety Program on the campus. The RSO shall be directly responsible to the President of the University. In the absence of the Radiation Safety Officer, a designated Deputy Radiation Safety Officer shall act on his behalf for routine matters. The Radiation Safety Officer must always

provide a means for communication in his/her absence, The Radiation Safety Officer, with the assistance of his staff, shall:

1. Implement the policies and procedures established by the Radiation Protection Committee.
2. Act in a supervisory capacity in all aspects of the University's radiation measurement and protection activities, including personnel monitoring, maintenance of exposure records, survey methods, waste disposal and radiological safety practices.
3. Approve all activities and procedures which involve actual or potential exposure of personnel to radiation or the release of radioactive materials to the environment.
4. Be available to consult with all users of ionizing radiation and give advice in radiological safety.
5. Suspend any operation causing excessive radiation hazard or, that in his/her professional opinion, constitutes an immediate danger to life, health, property, or the environment as rapidly as possible.
6. Maintain an inventory of all radioisotopes and ionizing radiation producing machines and be available to consult with their users on matters of radiological safety.
7. Have radiation surveys implemented as deemed necessary in the interest of radiation safety.
8. Maintain all records of radiation surveys and exposures of personnel to ionizing radiation as may be required by the Nuclear Regulatory Commission, the State of Georgia and other rules of good practice.
9. Obtain, issue, collect and record results of all personnel monitoring devices deemed necessary to determine significant personnel exposures to radiation.
10. Assist Principal Investigators in the training of users of radioisotopes and ionizing radiation producing machines.
11. Report promptly to the Chairman, Radiation Protection Committee, any radiation hazards, serious infractions of rules, etc.

C. Principle Investigator

Each Principle Investigator shall:

1. Develop written procedures for the use of radiation sources or radioactive material as appropriate for the intensity and scope of the activities covered in the Principle Investigator's laboratory and commensurate with good radiation protection practices.
2. Furnish all information requested by the Committee or Radiation Safety Officer concerning his/her qualifications, facilities, equipment and safety procedures (as required in C(i) above).
3. Maintain records as required by this Manual.

4. Designate an alternate Principle Investigator to provide oversight of his/her laboratory operations during absences exceeding thirty days, and to transmit this information to the Radiation Safety Officer at least 3 weeks prior to leaving, if possible.
5. Comply with the applicable portions of this Manual to the best of his/her ability.
6. Ensure that each individual using radioisotopes under his/her supervision has received radiation safety training appropriate to such use and to include special instructions for pregnant women or women of child-bearing potential.
7. Notify the Radiation Safety Officer of any changes in authorization status.
8. Notify the Radiation Safety Officer of intention to terminate the Authorization, no later than thirty days prior to the proposed termination.

D. Radiation Worker

Each individual working with unsealed radioactive material, sealed sources or radiation-producing machines shall:

1. Understand and implement the appropriate radiation safety precautions for the specific radioactive nuclide(s) being used.
2. Conduct operations so as to minimize exposure (internal and external) to all personnel in the laboratory.
3. Wear a personnel monitor as directed in this manual and make the monitor available for scheduled exchanges.
4. Periodically survey his/her hands, feet and clothing, and the work area for contamination.
5. Periodically survey around storage and waste areas.

III. ENFORCEMENT POLICY

A. Purpose

This section specifies the actions of the Radiation Safety Officer and the appropriate Radiation Protection Committee to correct specific items of non-compliance, ensuring that radiation users work with the Radiation Safety Officer and the Committee to maintain safety and compliance.

B. Enforcement Process

The Radiation Safety Officer is authorized to immediately suspend any operation causing excessive radiation hazard or order the termination or limitation of any procedure or other laboratory activity that in his/her professional opinion constitutes an immediate danger to life, health, property, or the environment.

1. Radiation Safety Officer will provide the Principle Investigator with an initial, verbal notification of any items of non-compliance discovered in that Principle Investigator's area of responsibility.
2. If immediate action is not taken by the Principle Investigator, the Radiation Safety Officer will provide the Principle Investigator with written notification of any items of non-compliance discovered in that Principle Investigator's area of responsibility in which immediate action was not taken. If appropriate, the Radiation Safety Officer may also notify the Department Chair and the Chair of the Radiation Protection Committee. The Principle Investigator must provide a written response to the Radiation Safety Officer regarding corrective measures for any items of non-compliance referred to in the Radiation Safety Officers written notification. Any such written response shall be provided by the Principle Investigator to the Radiation Safety Officer on or before the date specified in the written notification.
3. If the Principle Investigator has not achieved compliance to the Radiation Safety Officer's satisfaction on or before the date specified in the written notification, the Radiation Safety Officer and the Principle Investigator will discuss the matter with the Principle Investigator's Departmental Chair and the Chairman of the RPC, or other representative of the Institutional Administration as appropriate.
4. If satisfactory resolution still cannot be obtained, the matter will be escalated to the Radiation Protection Committee and enforcement option listed below will be instituted until satisfactorily resolved.
5. If repeat violations or other patterns of multiple violations is discovered, the Principle Investigator must, within one week of notification, meet with the Radiation Safety Officer and the Chairman of the RPC with an explanation of:

- a. what caused the item(s) of non-compliance,
- b. steps taken to date by the Principle Investigator to correct the item(s),
- c. further steps to be taken by the Principle Investigator, and
- d. measures the Principle Investigator took or will take to prevent recurrence.

Minutes of this meeting will be maintained for review by the RPC and will be placed into the minutes of the RPC.

C. Enforcement options

1. General

Radiation Safety Intervention may include, but is not necessarily limited to, the suspension of radioactive materials orders, the withholding of pending deliveries of radioactive material and the confiscation of existing stocks of radioactive materials.

2. Withholding Material:

- a. The Radiation Safety Officer or his/her designee may withhold delivery of radioactive material from any Principle Investigator failing to meet their Radiation Safety Manual responsibilities. Radiation Safety staff will immediately notify the Principle Investigator, the Principle Investigator's Departmental Chair or Faculty Dean, and the appropriate Institutional Administrators of any material being held and of the reason the material is being held.
- b. The withheld material will be delivered immediately upon fulfillment of the outstanding obligations by the Principle Investigator.

3. Restriction and Revocation

The Chairman of the RPC may, upon the Radiation Safety Officer's recommendation, restrict the authority of a Principle Investigator as a result of repeated or serious violations of policy. The Radiation Safety Officer must immediately notify the Principle Investigator, the Principle Investigator's Departmental Chair, and the appropriate Institutional Administrators of any restriction and of the reason for that restriction. Such restriction remains in effect until review by the RPC either reinstates, modifies, or revokes the restricted privileges by a majority vote.

IV. Limits to and the Control of the Exposure to Ionizing Radiation

A. Limits to Exposure to Ionizing Radiation

1. In keeping with currently accepted practices and standards all unnecessary radiation exposures shall be considered undesirable. All radiation exposure shall be limited to As Low As Reasonably Achievable - (ALARA).
2. Occupationally exposed persons

No occupationally exposed person shall be permitted to receive a radiation dose in one calendar year in excess of those listed in this paragraph, except under the special conditions as specified in the State Rules and Regulations chapter 391-3-17. These exposure limits are (in Rems per calendar year):

- a. Whole body, total effective dose equivalent: 5 (0.05 Sv)*
 - b. Hands and forearms; feet and ankles (Up to the elbow and /or knee): 50 (0.50 Sv)
 - c. Skin of whole body (Shallow dose equivalent) : 50 (0.50 Sv)
 - d. Eye dose equivalent: 15 (0.15 Sv)
- * (1 Sv Sievert = 100 rem)

3. Non-occupationally exposed persons (general public in restricted areas),

No non-occupationally exposed person (general public in restricted areas), shall be permitted to receive a radiation dose in one calendar year in excess of those listed in the paragraph except under specific conditions as stated in the State Rule and Regulations chapter 391-3-17. These exposure limits are (in Rems per calendar year):

- a. Whole body, total effective dose equivalent: 0.1 (1.0 mSv)
- b. Furthermore the above dose (0.1) shall not be received at a rate of more than 2 mrem in any one hour.

4. Minors

Minors (individuals under the age of 18) are permitted to enter or have access to areas authorized for the use, storage or disposal of radioactive materials **only if** they are doing so as part of an established, supervised course of study or as an employee of Georgia State University. All other minors are not permitted in these areas.

Those minors permitted in these areas but who **will not** work with radioisotopes must attend a radiation safety awareness course provided by the Radiation Safety Officer prior to their entering or having access to these areas. In no case shall a minor be permitted to receive a radiation dose in excess of 10 percent of the limits set forth in Paragraph 2 of this section.

Also, the dose to an embryo/fetus (for purposes of regulations are considered a minor) due to the occupational exposure of a declared pregnant woman shall not exceed 0.5 rem (5 mSv) during the entire pregnancy.

5. Occupational Exposure to Pregnant Women

Obviously, not all radiation workers may become pregnant. However, any radiation worker may have the opportunity to work with a radiation worker who is, or has the potential to, become pregnant. Principle Investigators may be required to supervise the activities of occupationally exposed pregnant women. Therefore, all radiation workers should be instructed in regard to the hazards of radiation exposure to unborn children. Also, the following policies apply:

- a. A pregnant radiation worker must make her own decision regarding whether or not to declare her pregnancy in accordance with NRC Regulatory Guide 8.13.
- b. The declaration of pregnancy must be submitted in writing to the Radiation Safety Officer. An example declaration form is provided in the appendix.
- c. Once pregnancy is declared in writing, the declaration will remain in effect for a period of 10 months from the date of submission, unless it is revoked in writing.
- d. The radiation exposure to the embryo/fetus of a declared pregnant woman shall not exceed 500 mrem during the entire term of the pregnancy.
- e. The radiation exposure to the embryo/fetus of a declared pregnant woman should not exceed an ALARA action level of 50 mrem per month. Any monthly exposure in excess of this value will be evaluated by the Radiation Safety Officer and the responsible Principle Investigator. When appropriate, corrective actions will be taken to prevent future monthly exposures from exceeding this ALARA action level.

- f. If a pregnant woman has already received ≥ 450 mrem during the term of pregnancy by the time she declares, the limit for the remainder of the entire term of declared pregnancy shall be 50 mrem.
- g. If a declared pregnant woman has already received a radiation exposure of < 450 mrem by the time she declares, the monthly ALARA action level may be reduced by the RSO to a level that will ensure that the dose to the embryo/fetus will not exceed 500 mrem for the term of the pregnancy.

6. Occupational exposure to airborne radioactive materials

No occupationally exposed individual shall ingest or be exposed to airborne radioactive material in concentrations or amounts in excess of those specified in Appendix B, Table 1 of Title 10, CFR, Part 20. These concentration limits may not be altered by the use of respiratory protection or particle size determinations except as specifically authorized by these Federal and State Regulations.

7. Human research subjects (Not Knowingly Pregnant)

All exposure of humans to ionizing radiations for the purpose of research should be kept to an absolute minimum. All research involving Human Subjects must have the prior approval of the Radiation Safety Officer, The Radiation Protection committee and the Institutional Review Board (**IRB**).

All human subjects involved in research projects, protocols or studies that involve the application of ionizing radiations shall:

- a. Have a prescription for the radiation dose from a medical physician licensed in Georgia
- b. Be counseled by the physician, P.I or his/her designate about the effects of ionizing radiation related to their exposure and, if a female, the effects of the exposure on the developing fetus.
- c. Sign and date the standard consent form.

8. Human research subject (Pregnant)

It is the policy at Georgia State University that all research projects, protocols or studies that involve the application of ionizing radiations to a woman or any part of a woman who is knowingly pregnant as part of the research be presented to and unanimously approved by the Radiation Protection committee prior to approval by the IRB.

Research proposals submitted but not approved unanimously by the Radiation Protection committee will not be allowed at Georgia State University.

It is the opinion of the Radiation Protection committee that, due to the proven harmful effects of ionizing radiation on the human fetus, the proposing researcher must provide extraordinary justifications and detailed application procedures to the committee to seek approval for research involving the whole body or partial body application of any level of ionizing radiation to a woman who is knowingly pregnant.

B. Personal Dose Monitoring

1. All persons who enter a Controlled Area under such conditions that they are likely to receive a radiation dose in excess of 10 percent of the radiation exposure limits specified in section IV(a)(2) (except in the case of persons under 18 years of age, where 5 percent of applicable limits for minors shall apply) shall be issued and will wear appropriate personnel monitoring devices. These monitoring devices shall be thermoluminescent dosimeters unless other devices are authorized by the Radiation Safety Officer.
2. The Radiation Safety Officer shall supervise the obtaining, distribution, collection and analysis of personnel monitoring devices.
3. No individual will be issued a dosimeter nor be allowed to work with ionizing radiation until they have completed the introductory Radiation Safety Course.
4. All persons issued personnel monitoring equipment by the Radiation Safety Officer shall wear such devices at all times when they work with or near sources of radiation.
5. Dosimeters may be used for up to the exchange period or 3 months (whichever is sooner) before analysis (provided the person is not likely to receive a dose in excess of 10 percent of the limits). If an exposure in excess of the limits specified is suspected, the Radiation Safety Officer shall be notified immediately so that the device may be processed for rapid analysis.
6. It is the responsibility of the Principal Investigator to inform the Radiation Safety Officer whenever personnel monitoring termination is needed. This should occur within 1 month of the termination of the individual or their work with ionizing radiation.
7. When not in use, personnel monitoring devices shall be stored on the designated dosimeter badge rack.
8. **AT NO TIME SHOULD A PERSONNEL MONITORING DEVICE BE EXPOSED TO RADIATION UNLESS IT IS WORN BY THE EXPERIMENTER.** Personnel monitoring devices shall not be worn during non-occupational exposure such as medical X-ray.

9. All personnel monitoring records shall be maintained by the Radiation Safety Officer.
10. Each badged worker will receive a written report of the worker's dose annually.
11. At the request of a worker who was formerly engaged in activities controlled by the University's license, the Radiation Safety Officer will furnish a written report of a worker's exposure to sources of radiation at the request of the worker. The report will include the dose record for each year the worker was required to be monitored. Such report shall be furnished within 30 days from the date of the request, or within 30 days after the dose of the individual has been determined, whichever is later. The report will cover the period of time that the worker's activities involved exposure to sources of radiation and shall include the dates and locations of work under the license in which the worker participated during this period.
12. When a University is required to report to the Georgia Department of Natural Resources any exposure of an individual to sources of radiation, the University will also provide the individual a report on the exposure data included therein.
13. At the request of a worker who is terminating employment with the University in work involving exposure to radiation or radioactive material, during the current year, the Radiation Safety Officer will provide, at termination, a written report regarding the radiation dose received by that worker from operations during the current year or fraction thereof. If the most recent monitoring results are not available at that time, a written estimate of the dose will be provided together with a clear indication that this is an estimate.

C. Internal dose monitoring

1. Radioactive Iodine Monitoring and Action Levels
 - a. Individuals shall receive a thyroid bioassay after completion of operations involving, at any one time, direct handling or use of unsealed radioiodine in individual quantities in excess of the quantities specified in Table below.
 - b. Persons routinely working with individual quantities of radioiodine in excess of these amounts should have monthly bioassays.
 - c. Scheduling of routine bioassays is the responsibility of the individual radiation worker.

Radioiodine Bioassay Requirements

Type of Operation or Procedure Conducted	Quantity Requiring a Bioassay	
	volatile form*	bound to non-volatile agent*
Operations performed in an open room or bench.	>0.1 mCi	>1 mCi
Operations performed in a fume hood.	>1 mCi	>10 mCi

*Volatile forms include, but are not limited to, unlabeled sodium iodide (NaI) or operations involving acids or chlorine. Non-volatile forms are those that are chemically bound and used in such a manner that the radioiodine will remain nonvolatile and are diluted to concentrations less than 0.1 mCi/mg of non-volatile agent. Radioimmunoassay (RIA) kits are considered non-volatile.

- d. If historical data indicates that exposures are consistently minimal and personnel/procedures are uniform in nature, the RSO may reduce the frequency of routine thyroid bioassays to a quarterly, bi-annual, or annual schedule.
 - e. The optimum schedule for a thyroid bioassay is within the time period of 8 to 72 hours of exposure. No more than a two week delay is considered acceptable.
 - f. Operations involving, at any one time, direct handling or use of unsealed radioiodine in individual quantities in excess of the quantities specified in Table above shall be performed in either a closed system or in a certified working fume hood. Operations in biosafety cabinets or on benchtops are prohibited.
 - g. Persons with internal radioiodine exposures in excess of 10% of the applicable limit will be counseled by a Radiation Safety staff member.
 - h. The Principle Investigator and Radiation Safety will evaluate the probable causes of the exposure and changes in procedures, work habits, or equipment will be recommended as appropriate.
 - i. A written summary of the investigation results, including potential corrective actions, should be provided to the Radiation Protection Committee.
2. Tritium Monitoring and Action Levels
 - a. Individuals involved in operations which utilize, at any one time, more than 100 millicuries of tritium in a non-contained form, other than metallic foil, shall have a bioassay performed within one week following a single operation, and at weekly intervals for continuing operations.

- i. Tritium shall not be used in such a manner as to cause any individual to receive a radiation exposure such that urinary excretion rates exceed 28 microcuries of tritium per liter when averaged over a calendar quarter.
 - ii. If the average concentration of tritium in urine for an individual during a calendar quarter is less than 10 microcuries per liter, urinalysis may be performed on that individual at monthly intervals for the following calendar quarter and may continue at monthly intervals so long as the average concentration in a calendar quarter remains below 10 microcuries per liter.
 - iii. The urine specimen should be collected on the same day of the week, whenever practical.
 - iv. Scheduling of routine bioassays is the responsibility of the individual radiation worker.
- b. Operations which utilize 100 millicuries or more of tritium in a non-contained form, other than metallic foil, shall be performed in either a closed system or in a certified working fume hood. Operations in biosafety cabinets or on benchtops are prohibited.
 - c. Persons with more than 10% of the applicable limit for internal exposure of tritium will be counseled by a Radiation Safety staff member.
 - d. The Principle Investigator and Radiation Safety will evaluate the probable causes of the exposure and changes in procedures, work habits, or equipment will be recommended as appropriate.
 - e. A written summary of the investigation results, including potential corrective actions, should be provided to the Radiation Protection Committee.

D. Airborne Radioactivity Exposure

Any intentional exposure of individuals to airborne radioactive materials or conduct of a project which will require the use of radiological respiratory protective equipment is highly restricted. Such actions will require the development of procedures, plans, and/or protocols for the proposed activity by the Principle Investigator and Radiation Safety. A complete review and approval of the proposed project and associated documentation by the Radiation Protection Committee will be required prior to the initiation of any such activity. Procedures that might produce airborne radioactivity shall be conducted in a hood, glove box, or other suitable closed system. Such airborne radioactivity hoods must undergo an annual certification of airflow.

The air concentrations of radioactive material due to potential discharges from fume hoods will be evaluated by the Radiation Safety Officer. Where indicated, appropriate control methods such as activated charcoal filters will be employed to ensure regulatory compliance.

E. Examination by a Physician

Persons who are expected to work near radiation sources for an extended period are require monitoring and may be required by the Radiation Protection Committee to undergo a medical examination by a qualified physician at the time they start work. A termination physical examination may be required for such persons at the conclusion of their work in a radioisotope program. Additional examinations may be required if the possibility of physical changes in an individual due to radioactive materials is suspected. It shall be the responsibility of the Principal Investigator to inform the Radiological Safety Officer in advance when persons will require examinations. Doctor fees shall be paid for by the appropriate department. The maximum possible advance notification should be given to the Radiation Safety Officer concerning persons terminating their work so that a physical examination may be scheduled while they are in Atlanta.

F. ALARA Policy

1. **Time/Distance/Shielding:** The principal objective of radiation protection is to ensure that the dose received by any individual is as low as reasonably achievable (ALARA), while not exceeding the maximum permissible limit. Any one, or a combination, of the following methods may achieve this objective:

Time. Limit the time of exposure. For illustrative purposes, a person entering a relatively high radiation field of 1000 millirem/hr, but for only 30 seconds, would receive a relatively low dose of 8 millirem. The maximum permissible whole body dose is 5000 millirem per calendar year for occupational workers.

Distance. The inverse square law states that radiation intensity from a point source varies inversely as the square of the distance from the source. The formula is:

$$\frac{I_1}{I_2} = \frac{(D_2)^2}{(D_1)^2}$$

where $I_1, I_2 =$ intensities
and $D_1, D_2 =$ distances

By increasing the distance between the source of exposure and an individual, the dose received can be significantly reduced. When an individual doubles his/her distance from a source, the dose will usually be reduced by approximately three-fourths.

Shielding. Absorbing material, or shields, can be incorporated to reduce exposure levels. The specific shielding material and thickness is dependent on the amount and type of radiation involved. Lead shielding is generally used for x-rays & Gamma Rays, while plastic is used for high energy beta sources. The Radiation Safety Office will assist in designing and specifying appropriate shielding.

2. Each radiation worker at the Georgia State University whose exposure is likely to exceed 10% of any annual exposure limit due to external radiation detectable by industry standard dosimetry will have that exposure monitored by the use of personnel dosimetry.
3. The radiation exposure ALARA Action Levels in the table below will apply to all GSU radiation workers.

Radiation Exposure ALARA Action Levels

Exposure Measurement	ALARA Action mrem/monitoring period
Total Effective Dose Equivalent (TEDE)	125
The sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye	1875
Shallow Dose Equivalent (SDE) to the skin or any Monitored Extremity (SDEME)	1875
Lens of the eye Dose Equivalent (LDE)	750

4. If any individual exceeds an ALARA action level, Radiation Safety will report the exposure to the appropriate Principle Investigator and the Radiation Protection Committee.
 - a. The Principle Investigator, with assistance of the Radiation Safety Officer, will be responsible for performing an investigation of the radiation exposure.
 - b. A written summary of the investigation results, including potential corrective actions, will be provided to the Radiation Protection Committee.
 - c. Persons who turn in two consecutive monitoring badges that are over the ALARA action level will be individually counseled by a member of the Radiation Safety Officer.
 - i. The person will be informed of the risk from radiation exposure.
 - ii. The reason for the exposure will be determined, if possible.
 - iii. Changes in work habits, procedures, and equipment will be recommended as appropriate.

V. PHYSICAL SECURITY OF RADIOACTIVE MATERIALS

ALL RADIOACTIVE MATERIALS MUST BE SECURED OR UNDER CONSTANT SURVEILLANCE AT ALL TIMES. *GSU police shall be immediately notified of unauthorized, unknown persons in an area where radioactive materials are used or stored.*

A. Shipments

1. All Radioactive Materials shipments (regardless of isotope or activity) must be addressed and sent to the Radiation Safety Officer. **Direct delivery to the user is prohibited.**
2. All shipments of radioactive materials received must be secured by or be under constant surveillance at all times by a designate of the Radiation Safety Office.
3. The Radiation Safety Officer or designated delivery person is prohibited from delivering a processed package containing radioactive materials unless there is an authorized person (Principle Investigator, Alternate Principle Investigator, or Radiation Worker) at the location who will accept it, sign for its receipt, and secure the radioactive materials.
4. If the delivery person cannot find an authorized person to receive the shipment, the package will stored in the Radiation Safety Office or with a principle investigator who is both authorized to have the activity of material and has the appropriate storage facilities (ie. Ultra-cold freezer, lead cave, etc.). Radioactive materials are not to be left unsecured at any time.

B. Radioactive materials in use, storage and as wastes

1. **GSU police should be immediately notified of unauthorized, unknown persons in an area where radioactive materials are used or stored.**
2. Any radioactive material in use in a laboratory must be attended at ALL TIMES, or secured by locking the laboratory when not attended. **Radioactive materials may not be left unsecured even momentarily.**
3. Radioactive materials in storage, i.e. not being used, must be secured when the room in which it is stored is unoccupied. The required security may be accomplished by locking the room/area while unoccupied, or alternatively, by locking the radioactive materials within refrigerators, freezers, cabinets, or lock boxes. Wherever possible, lock boxes are recommended for storage of radioactive materials.
4. Only authorized persons may have access to radioactive materials. Radioactive materials that are stored or used in areas common to both authorized and unauthorized personnel must be secured at all times from unauthorized personnel. **All storage refrigerators/freezers have locks.**
5. Corridors (hallways, elevator lobbies, and utility chases, etc.) are not secured areas. Therefore, the use and storage of radioactive materials in these areas are prohibited.

6. All radioactive wastes are considered as radioactive materials. Radioactive wastes, including dry waste, liquid waste, medical pathological waste, and mixed waste, must be secured at all times. These materials must also be secured at all times.
7. Unescorted unauthorized personnel may not enter into a laboratory or radioactive materials area if an authorized person is not present. Any persons admitted into the laboratory or work area must be accompanied at all times by an authorized person who works in the area.
8. Persons performing work in the area, such as engineering or maintenance personnel, contractors or commercial service representatives must also be accompanied by an authorized person at all times.

VI. SEALED SOURCES

- A. Committee approval is required prior to the purchase of any sealed source (excluding Gas chromatograph ECD detectors, Polonium static elimination devices or exempt instrument check/calibration sources). Sealed sources are not to be received until the University's license is amended for that source and the Radiation Safety Officer has received a copy of the amended license.
- B. The Principle investigator (or his/her Department) purchasing the sealed source or device containing the sealed source (excluding Gas chromatograph ECD detectors, polonium static elimination devices or exempt instrument check/calibration sources) must provide \$500.00 to the Georgia Department of Natural Resources for amending the University's license to obtain the source.
- C. Each sealed source, other than hydrogen-3, with a half-life greater than 30 days and in any form other than gas, shall be tested for leakage or contamination as follows:
 1. Prior to initial use;
 2. At intervals not to exceed six months, except that each source designed for the purpose of emitting alpha particles shall be tested at intervals not to exceed three months;
 3. At any other time there is reason to suspect that a sealed source might have been damaged or might be leaking, it shall be tested for leakage before further use; and
 4. In the absence of a certificate from a transferor indicating that a test for leakage has been made within six months prior to the transfer, the sealed source shall not be put into use until tested and the results received.
- D. A sealed source is considered leaking if there is the presence of 0.005 μCi (185 Bq) or more of removable contamination on any test sample. If the test of a sealed source is leaking, the RSO will
 1. Immediately withdraw the source from use,
 2. take action to prevent the spread of contamination, and
 3. cause the sealed source to be decontaminated and repaired or to be disposed of .
- E. General Rules for Sealed Sources
 1. Sealed sources are to remain secure at all times
 2. The Radiation Safety Officer must be notified prior to relocating a sealed source.
 3. Sealed sources emitting penetrating radiations should be handled with remote manipulators, not by hand.
 4. Corrosives or chemical capable of reacting with the source or the source encapsulant shall not be applied to the source.
 5. Exhaust ports to gas chromatographs with ECD detectors must be vented to a fume hood.
 6. Gas Chromatograph sources must be cleaned and serviced by the manufacturer ONLY.
 7. Never open or disassemble a sealed source.

VII. GENERAL PROCEDURES FOR THE SAFE USE OF RADIOISOTOPES

A. Obtaining authorization to order, possess and use radioactive materials

Before a potential Principal Investigator can possess radiation sources for the first time, he shall:

1. Fill out and submit two copies of Georgia State University's "Form A - Principal Investigator/Radiation Use Authorization.
2. Attend the 2-hour "Introduction to Radiation Safety" training class.

The project will be reviewed for the Radiation Protection Committee by the Radiation Safety Officer who shall make an initial radiation survey (if he deems necessary) of any new areas where sources of radiation are to be used or stored. The Chairman of the Radiation Protection Committee shall tentatively approve each request for the committee pending a full committee vote at the next regularly schedule committee meeting. The Principal Investigator will be notified of his authorization to use radioactive materials or equipment by receipt of a copy of the approved Form A.

B. Procurement of Radioactive Materials

The following procedure shall be followed by all persons desiring to procure radioactive materials or radiation producing equipment.

1. When an approved Principal Investigator plans to order a source of radiation he/she shall compare his/her authorized isotope(s) and activity(s) with the current inventory on hand. If the addition of the source material with the material on hand will not exceed the authorized amount on his her most current Form A, an order for the material may be placed. Other methods of ordering may be approved by the Radiation Safety Officer.
2. When ordering, delivery instructions must specify that it be shipped to:

RADIATION SAFETY OFFICER/Stockroom
Natural Sciences Center - GSU
50 Decatur Street
Rm 262
Atlanta Ga 30303
ATTN: (PI last name)

3. The Office of Radiological Safety will receive the shipment, perform a contamination survey, inventory and deliver the isotope to the Principal Investigator unless other arrangements have been made. The Radiation Safety Officer or designated delivery person is prohibited from delivering a package with radioactive materials unless there is an authorized person

(Principle Investigator, Alternate Principle Investigator, or Radiation Worker) at the location who will accept it, sign for its receipt, and secure the radioactive materials.

4. If the delivery person cannot find an authorized person to receive the shipment, the package will be stored in the Radiation Safety Office or with a principle investigator who is both authorized to have the activity of material and has the appropriate storage facilities (ie. Ultra-cold freezer, lead cave, etc.). Radioactive materials are not to be left unsecured at any time.

C. Transfer of radioactive materials

Transfer of radioactive material between Principle Investigators, or between a User and an outside facility, are permitted as long as such transfers are in compliance with Georgia State University's license conditions and any other applicable regulatory requirements. Transfer of radioactive material to another institution requires an NRC or Agreement State license to possess that material by the receiving institution, and oversight by the Radiation Safety Officer of the receiving institution. The Radiation Safety Officer must be notified before any transfers take place, either between Principle Investigators or with outside facilities. The Radiation Safety Officer will facilitate the proper transfer of radioactive materials.

D. Transportation of radioactive materials

The transportation or shipment of radioactive material on campus and to other institutions, including the Animal Research Center, must comply with both State of Georgia DNR and United States Department of Transportation (USDOT) regulations. All radioactive shipments and transport within or from Georgia State University must receive prior approval from Radiation Safety. In addition:

1. Transport of radioactive material off-campus as checked baggage on public conveyances is prohibited.
2. Transportation of radioactive materials shall be performed in a State owned vehicle.
3. All vehicles transporting radioactive materials must have a dated letter of intent in the vehicle. This can be obtained from the Radiation Safety Officer.

E. Transfer, donation, surplus, disposal or selling of devices either containing, contaminated by or that were used with radioisotopes or that produce ionizing radiation. The following **SHALL NOT** be transferred, donated or disposed of without prior approval from the Radiation Safety Officer:

1. Radiation sources (such as x-ray machines, x-ray diffraction systems, analytical units, etc.)
2. Equipment containing sealed sources of radioactive material (such as liquid scintillation/gamma counters, gas chromatograph electron capture detectors, isotope storage refrigerators, isotope storage freezers, etc.)
3. Laboratory equipment used with radioisotopes (refrigerators, freezers, centrifuges, pumps, etc.)

F. Termination of laboratory operations (CLOSE-OUT)

When the Principle Investigator ends his/her affiliation with Georgia State University or desires to terminate his/her radiation license, any laboratory space controlled by that user must be decommissioned (cleaned out by the Principle Investigator and checked by the Radiation Safety Officer) before the area can be returned to non-radiation use or occupied by another Principle Investigator. Any Principle Investigator who anticipates terminating his or her Authorization shall notify the Radiation Safety Officer of the termination in writing or via electronic mail no less than thirty (30) days prior to the anticipated date of termination.

G. General rules and procedures

1. Eating, drinking and smoking are not permitted in any laboratories or rooms where radioactive materials are used or stored unless specifically authorized by the Radiation Safety Officer.
2. If radioactive materials are in use, all injuries, no matter how slight shall be monitored to determine if the wound is contaminated.
3. Protective clothing appropriate to the conditions shall be worn at all times when working with loose radioactive materials. This means

a. DURING ALL PROCESSES, WEAR APPROPRIATE:

- i. GLOVES,
- ii. INDUSTRIAL GRADE EYE PROTECTION, AND
- iii. LABORATORY COATS

THIS IS THE MINIMUM PROTECTION REQUIRED.

b. Sandals, shorts, flip-flops and skirts are not to be worn.

4. Special protection is required so as to prevent the entry of radioactive materials into the body through wounds.

5. All equipment which might come in contact with loose radioactive material shall be considered potentially contaminated and shall be monitored for contamination before being removed from the laboratory.
6. All persons shall monitor themselves for contamination before leaving a laboratory where loose radioactive material is used or stored or suspected to be present.
7. All persons who are permitted to work with sources of radiation shall be fully aware of the procedures specified in this manual and be trained by the Principal Investigator in matters of radiological safety. The Officer of Radiological Safety will conduct short courses to assist in training personnel.
8. Sources of radiation shall be used and stored in such a manner as to prevent unauthorized persons from using or removing such material or machines.
9. All sources of radiation shall be properly labeled in conformance with the standards required in 10 CFR Part 20 and / or State Regulations, Chapter 290-5-22 and 391-3-17.
10. Principal Investigators shall have appropriate radiation detection instrumentation accessible to their working area for the control of contamination.
11. Solutions shall not be pipetted by mouth.
12. Persons working with radioactive materials shall monitor themselves their clothing and work area before leaving the laboratory.
13. Radioisotopes shall be used in such a manner that radiation exposure rates to personnel are not increased unnecessarily. The use of lead brick and other shielding will serve to minimize exposure.
14. Remote equipment (long-handled tongs, remote pipettes, etc.) shall be used routinely when handling highly radioactive materials.
15. The minimum velocity into a ventilation hood at its opening, where unsealed radioactive materials are actively in use, shall be at least 100 linear feet per minute at all points. Storage of some radioactive materials in a hood may also be required. Care shall be taken to avoid excessive velocities due to potential "blow back" into the room.
16. Appropriate safety glasses, face shields, or personal eyeglasses should be worn when exposure is from beta particles.
17. Warning devices, fail safe interlocks and other required safety features shall be utilized in and around shielded irradiation facilities or hot cells where high level radiation sources are used.

H. Rules for Specific Isotopes

1. S-35

Because of low temperature storage of ^{35}S compounds, pressure may develop in the vial during the thawing process. Also, ^{35}S compounds decompose at a rate of about 0.1% per week. All vials should be opened in a working fume hood using the following procedures:

- a. Slide aside the dust cover on the cap (if there is one) to expose the septum.
- b. Pierce the septum with a cotton-plugged syringe needle or charcoal trap (be careful not to touch the frozen product with the syringe tip).
- c. Quick-thaw the product at room temperature or in a water bath. (Any pressure will vent through the syringe).
- d. Remove the needle, place it in a puncture resistant box and place it in the DRY RADIOACTIVE WASTE container.

For In-Vivo labeling (in the incubator or water bath), use a shallow tray of activated charcoal, charcoal sticks or charcoal filter unit to trap ^{35}S volatiles and reduce contamination

2. P-32

- a. Use plastic or plexiglass shielding when working with P-32
- b. Wear safety glasses or splash goggles
- c. If 1.0 mCi or more is to be handled:
 - i. Use remote manipulators (ie. Tongs, clamps, etc.)
 - ii. Never handle the stock vial or any container with > 1 mCi with your hands.
 - iii. Obtain and wear a ring dosimeter badge.
 - iv. Obtain and use a pipette shield
- d. Survey the area, yourself and all devices used with the procedure every 10 minutes with a working Geiger counter.

3. H-3

- a. Smear all work areas and laboratory equipment for contamination after each procedure.
- b. Count smears in the liquid scintillation counter
- c. To obtain dpm, after subtracting background, multiply cpm number by 2 to obtain dpm.

- d. All operations which utilize, at any one time, more than 100 millicuries of tritium in a non-contained form, other than metallic foil, shall have a bioassay performed within one week following a single operation, and at weekly intervals for continuing operations.
 - i. Tritium shall not be used in such a manner as to cause any individual to receive a radiation exposure such that urinary excretion rates exceed 28 microcuries of tritium per liter when averaged over a calendar quarter.
 - ii. If the average concentration of tritium in urine for an individual during a calendar quarter is less than 10 microcuries per liter, urinalysis may be performed on that individual at monthly intervals for the following calendar quarter and may continue at monthly intervals so long as the average concentration in a calendar quarter remains below 10 microcuries per liter.
 - iii. The urine specimen should be collected on the same day of the week, whenever practical.
 - iv. Scheduling of routine bioassays is the responsibility of the individual radiation worker.
- e. Operations which utilize 100 millicuries or more of tritium in a non-contained form, other than metallic foil, or in volatile forms, shall be performed in either a closed system or in a certified working fume hood. Operations in biosafety cabinets or on benchtops are prohibited.

I. Marking and Labeling

Rooms, areas and equipment where sources of radiation are used or stored, shall be clearly marked with appropriately worded and designated standard Health Physics signs whenever required under the conditions set forth in this section and which will comply with OSHA standards.

- 1. Each area or room where radioactive materials are used or stored (excepting natural uranium or thorium) in quantities in excess of 10 times the quantities listed in Appendix C of 10 CFR Part 20, NRC Regulations or 100 times the quantities listed in the case of natural uranium and thorium, shall be posted with the standard sign and words CAUTION: RADIOACTIVE MATERIALS. Exceptions to this rule are in cases where:
 - a. The radioactive materials are in the form of a sealed source such that the radiation level at 12 inches from the surface of the source container does not exceed 5 millirem per hour.

- b. The radioactive material is used in a controlled area and is in use for less than eight hours and is constantly attended during the period by a person trained in radiation safety. (Controlled Area means any area access to which is controlled by Georgia State University for purposes of protection of individuals from exposure to radiation and radioactive materials; however, residential quarters cannot be included in a Controlled Area.) The term Restricted Area is used in 10 CFR Part 20 and has the same meaning.
 - c. The area is thoroughly surveyed (using both portable instrumentation and smears) and decontaminated.
 - d. The Radiation Safety Officer must be notified prior to use in the area or room.
2. Each container in which radioactive material is used, stored or transported shall be labeled with the radiation symbol, the words CAUTION: RADIOACTIVE MATERIALS, and the isotope, quantity and date of measurement if the quantity involved exceeds those listed in Appendix C of 10 CFR Part 20, NRC Regulations. Exceptions to this rule are in cases where:
 - a. The concentration of the material in the container does not exceed the limits specified in Appendix B, Table 1, Column 2 of NRC Regulations 10 CFR Part 20.
 - b. The containers are used transiently in lab work with the user present.
3. All areas and machines in which radiation hazards from non-medical X-ray sources may arise shall be identified by an appropriate and easily recognizable warning sign as described in State Regulations, Chapter 290-5-22.
4. Any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 millirem is defined as a Radiation Area. Each such area shall be clearly marked with a standard radiation sign bearing the words: CAUTION: RADIATION AREA.
5. Any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirem is defined as a High Radiation Area. Each such area shall be clearly marked with a standard radiation sign bearing the words: CAUTION: HIGH RADIATION AREA.

6. Any room, enclosure or operating area in which a radiation exposure of 500 rads (5 Gy) or more in one hour at a meter from a source of radiation could be encountered will be defined as a Very High Radiation Area. Each such area shall be clearly marked with a standard radiation sign bearing the words: CAUTION: VERY HIGH RADIATION AREA.
7. An Airborne Radioactivity Area is defined as:
 - a. Any room, enclosure or operating area in which airborne radioactive materials exist in concentrations in excess of the amounts specified in Appendix B, Table 1, Column 1 of NRC Regulations 10 CFR Part 20.
 - b. Any room, enclosure or operating area in which airborne radioactive materials exists in concentrations which, averaged over the number of hours in any week during which individuals are in the area, exceed 10 percent of the amounts specified in Appendix B, Table 1, Column 1 of NRC Regulations 10 CFR Part 20. Any area which falls within the scope of this definition shall be clearly labeled with a standard radiation sign bearing the words: CAUTION: AIRBORNE RADIOACTIVITY AREA.

J. Radiation Surveys and Control

1. All laboratories and facilities where radioactive materials are used or stored shall be surveyed periodically in order to detect contamination. It shall be the responsibility of the Principal Investigator to inform the Radiation Safety Officer whenever there is a change in working conditions which might necessitate a change in the survey schedule.
2. Radiation surveys shall be conducted at least monthly in all areas or rooms where greater than exempt quantities of radioactive materials are stored or used.

3. Radioactive contamination control action levels shall be as follows:

BETA-GAMMA

<u>Smear Results</u>	<u>Action</u>
<500 d/m/100 cm ²	No action required. Left to the discretion of the Principal Investigator.
500-2500 d/m/100 cm ²	Area or surfaces shall be cleaned as soon as possible by the Principal Investigator or his authorized assistants.
2500-5000 d/m/100 cm ²	If contamination is on the floor (unless localized), shoe covers and step-off pad shall be used for all entries into the area. Areas or surfaces shall be cleaned as soon as possible by the Principal Investigator or his authorized assistants.
5000-20,000 d/m/100 cm ²	Immediate action shall be taken by the Principal Investigator to decontaminate surfaces. Shoe covers and step-off pad are required.
>20,000 d/m/100 cm ²	If the spill is widespread shut off air flow to other parts of the building and prevent entry into the room or area until personnel from the Office of Radiological Safety evaluate the condition. Clean up shall be the responsibility of the Principal Investigator.

ALPHA

<u>Smear Results</u>	<u>Action</u>
< 20 d/m/100 cm ²	No action required. Left to the discretion of the Principal Investigator.
20-200 d/m/100 cm ²	If contamination is on the floor (unless localized), shoe covers and a step-off pad shall be used for all entries into the area. Areas or surfaces shall be cleaned as soon as possible by the Principal Investigator or his authorized assistants.
>200 d/m/100 cm ²	If the spill is widespread, shut off air flow to other parts of the building and prevent entry into the room or area until personnel from the Office of Radiological Safety evaluate the condition. Clean up shall be the responsibility of the Principal Investigator.

Specific exceptions to these action levels may be instituted at the discretion of the Office of Radiological Safety. Every effort shall be made to assure that items released to the general public are free of any detectable removable activity.

4. Suitable radiation detecting instruments shall be available to laboratories where radioactive materials are used or stored. Calibration of survey instruments shall be on a three month basis. The calibration intervals may be adjusted plus or minus 25%. In cases where elapsed intervals have exceeded 100% of the specific interval the next interval shall commence at the end of the original specific period. Laboratory personnel shall use these instruments frequently so as to detect any radiation hazards. Wherever survey readings are masked by greater than ambient background radiation levels, smear samples shall be taken and checked in a low background area.

5. In the event that a spill or spread of radioactive contamination is known or suspected, all work in that area shall be halted immediately. Personnel should step away from the affected immediate area and control the zone so others are not exposed. The Radiation Safety Officer shall be summoned so that he may evaluate the condition and give advice. During other than normal working hours or if the RSO cannot be reached call the Georgia State University Emergency Extension (413-3333). Personnel should not expose themselves to a hazard unnecessarily, but should remain in the general area to prevent further spread of contamination. A plan of decontamination shall be determined by the Radiation Safety Officer and the Principle Investigator. All decontamination shall be performed by personnel of the laboratory concerned.

K. Radioactive Waste

1. Radioactive waste shall normally be retained in the laboratory in which it is generated.
2. Liquids shall be stored in capped and labeled plastic or other appropriate containers.
3. Mixed wastes are radioactive wastes that are:
 - a. Liquids containing RCRA listed hazardous chemicals must be separated from liquids not containing these chemicals. A list of these chemicals is available through the Department of Safety and Risk Management,
 - b. Flammable solvent based Liquid Scintillation fluids and vials, or
 - c. a Biohazard

These wastes must be handled separately. Please contact the Radiation Safety Officer prior to or immediately upon generating mixed waste.

4. Biohazard waste that is radioactive **must not be autoclaved under any circumstance!** Separate waste handling procedures are to be developed by the Radiation Safety Officer, the Biosafety Officer and the Principle Investigator prior to waste generation.
5. Solid wastes shall be stored in plastic lined containers according to isotope half life (< 90 days or > 90 Days).
6. Carcasses are to be kept frozen.
7. Liquid Scintillation vials containing non-flammable, non-RCRA fluids are to be collected in plastic lined containers (5 gallon pails) according to isotope half life and isotope ($t_{1/2} < 90$ days, H-3 and C-14 **or** $t_{1/2} > 90$ days). H-3 and C-14 vials can be collected with short or long half life vials.

8. The Radiation Safety Officer shall be responsible for picking up all waste materials when notified by the Principal Investigator and preparing it properly for final disposal. The Principal Investigator is responsible for informing the Radiation Safety Officer as to the types, quantities, and date of isotopes in the waste.
9. In cases where the above specified system of waste disposal is not satisfactory, the Radiation Safety Officer and Principal Investigator may agree upon an alternate method of waste disposal which satisfies Federal and State Regulations and all license conditions.
10. All radioactive waste shall be clearly marked and labeled.
11. Records shall be maintained by the Radiation Safety Officer of the disposal of all radioactive materials including information as to isotope, quantity, and ultimate disposal.

VIII. TRAINING

A. Initial training

All persons (faculty, staff and students) shall attend the 2-hour "Introduction to Radiation Safety" training class, prior to beginning any work with radioactive materials or radiation producing machines. A record of completion of this training shall be maintained by the Radiation Safety Officer. Additionally, the Principal Investigator shall be responsible for the training in the safe handling of sources of radiation of all persons who work on their specific projects.

Unless otherwise specified, initial training classes will be provided on the first Wednesday of each month at 10:00 a.m. This training shall include:

1. Knowledge of the Federal and State Regulations under which work must be performed, particularly 10 CFR Part 20; State Regulations, Chapter 391-3-17; and State Regulations, Chapter 290-5-22.
2. Familiarity with the procedures contained in this manual.
3. Action to be taken in case of a radioactive spill or other accident.
4. The purpose, name and availability of the Radiation Safety Officer and his staff.
5. Use of radiation detection instruments provided for the project.
6. Notice to employees that a copy of Georgia State University's license; 10 CFR Part 19; 10 CFR Part 20; State Regulations, Chapter 391-3-17; State Regulations, Chapter 290-5-22; Operating Procedures and other pertinent information may be examined at the Office of Radiological Safety.

B. Annual retraining

1. All persons must perform and document update training annually. This can be accomplished by either attending the 2 hour introduction course or completing a multimedia course provided by the Radiation Safety Office.
2. Persons or laboratories not completing retraining will not be allowed to use or be occupationally exposed to ionizing radiations until said training is performed and documented.

IX. IONIZING RADIATION PRODUCING DEVICES

- A. Prior to obtaining a radiation-producing device the Principle Investigator must:
1. Submit an application (Form A) to use the device to the Radiation Safety Officer
 2. Provide the Radiation Safety Officer with the following information for device registration:
 - a. Name and address of the person having administrative control and responsibility for the proposed facility.
 - b. Location where the device(s) is to be stored or used
 - c. Documentation of the type, make, model, location, and maximum radiation output (kW, mAs and workload in hours per week) of the device before installation.
 - d. A copy of the radiation survey performed at the installation and acceptance testing shall be maintained for inspection, including exposure rates in all adjacent rooms. Radiation surveys shall be repeated after major maintenance, modification or relocation of the device.
 - e. A designation of the general category of proposed use (analytical, dental, medical, industrial, veterinary, or other).
 - f. A radiation shielding plan and specifications for the proposed facility,
 - g. an evaluation by a qualified expert such as to expected radiation levels, and
 - h. the name of the prescribing physician(s) (In the event of human subject experimentation).
 3. Obtain approval from the Radiation Protection Committee at their next scheduled meeting.
- B. Prior to using radiation producing devices, all individuals must receive radiation safety training offered by the Radiation Safety Office. Training must be completed prior to using a radiation-producing device. In addition individuals will be trained on the operation of the particular radiation producing device he/she will be using and actions to take in the event of an emergency by the principle investigator.
- C. Persons working around X-ray generators should treat the potential radiation hazard with respect.

- D. Persons should be especially careful about keeping their fingers out of the main beam, especially when making adjustments on goniometer heads. It is often best to keep one's hands on the X-ray tube side of the goniometer to prevent some part of the hand from drifting, unnoticed into the beam.
- E. Safety glasses, personal eyeglasses, or other appropriate eye protection devices shall be worn at all times when working with low-energy output X-ray apparatus.
- F. A current knowledge of the various radiation levels at all places around the X-ray apparatus should be maintained.
- G. Port closures should be double checked before moving the beam stop, collimator, on the main body of an instrument or before changing a specimen.
- H. When changing the equipment configuration or equipment alignment relative to an energized X-ray tube, one shall monitor or request personnel from the Office of Radiological Safety to monitor the radiation field continuously with a survey meter.
- I. Persons are required to wear film badges or other approved personal monitoring devices at all times while working around X-ray machines.
- J. In case there are any questions pertaining to the radiation safety of an X-ray generator, request assistance from the Office of Radiological Safety before using the equipment.
- K. Persons using X-ray generators shall make themselves aware of and follow other specific rules required by the State of Georgia Rules and Regulations for X-ray, Chapter 290-5-22.

X. RECORDS

The following records are established and maintained by the Radiation Safety Office.

A. Personnel Exposure

The radiation exposure record of every person subject to personnel monitoring as specified in this manual shall be maintained in accordance with 10 CFR Part 20.

B. Radioactive Materials Inventory

The receipt, assignment and final disposition of all radioactive materials shall be recorded and maintained.

C. Other Sources of Radiation Inventory

An inventory of all ionizing producing machines shall be maintained.

D. Monthly Radiation Survey Log

A complete description of all radiation and contamination surveys performed by the Office of Radiological Safety shall be entered in the Radiation Survey Log.

E. Air and Water Sample Log

The calculation and results of all air and water samples shall be maintained in an air and water sample log as needed.

F. Instrument Calibration Log

The date of calibration of radiation survey instruments shall be recorded in the Instrument Calibration Log and on the instrument itself.

G. Biannual Sealed Source Leak Test Log

The dates and results of all sealed source leak tests shall be maintained.

H. Authorized User Records

The allowed isotopes, limits, protocols and usage areas as well as specific limitations shall be maintained (in the form of an up-to-date form A).

I. Training Records

Records of initial and annual training as well as copies of any certificates are maintained.

XI. BIBLIOGRAPHY

1. United States Nuclear Regulatory Commission Rules and Regulations, Title 10, Chapter 1, Part 20, Code of Federal Regulations - Energy; Entitled, Standards For Protection Against Radiation.
2. United States Nuclear regulatory Commission Rules and Regulations, Title 10, Chapter 1, Part 19, Code of Federal Regulations - Energy; Entitled, Notices Instructions, and Reports to Workers; Inspections.
3. Georgia Department of Natural Resources Rules and Regulations for Radioactive Materials, Chapter 391-3-17.
4. Georgia Department of Human Resources Rules and Regulations for X-ray, Chapter 290-5-22.
5. Los Alamos Handbook of Radiation Monitoring (LA 4400), by John W. Healy, 1970, Superintendent of Documents, U.S. Government Printing Office.
6. Grady Disaster Plan, Medical Plan for Care of Multiple Casualties Resulting from Local Disasters, Grady Memorial Hospital, Atlanta, Georgia.

APPENDICES

[Appendix A](#)-----Emergency Procedures - Radiation Mishaps

[Appendix B](#)-----Form A - Principal Investigator/Radiation Use
Authorization

[Appendix C](#)-----Form B - Radioisotope Procurement
Authorization/Certification

[Appendix D](#)-----Inventory of Isotope Form

[Appendix E](#)-----Emergency Procedures Posting

[Appendix F](#)-----Personnel Monitoring Form

[Appendix G](#)-----Annual Retraining Record

Appendix A

Emergency Procedures - Radiation Mishaps

I. Purpose:

To establish a standard University-wide procedure to minimize any injury and /or property damage resulting from a radiological mishap.

No set of rules can be formulated which will apply to all emergencies which might arise involving sources of radiation. The most practical plan for handling radiation emergencies requires the training of persons who might become involved.

The primary consideration in an emergency is the prevention of injury and prompt medical assistance to anyone who requires it; the secondary consideration is the prevention of damage or salvage of facilities and equipment. The Georgia State University Police personnel have been trained to respond to such emergencies.

The Grady Hospital Disaster Plan includes provisions for handling emergencies involving radiation and radioactive contamination. It is the responsibility of the Georgia State University Safety and Risk Management Department to keep the campus radiation emergency response program current and all affected persons properly informed.

II. Procedures:

A. Initial Notification and Response

1. Individuals in need of emergency assistance or discovering a radiation emergency shall:

- As soon as possible notify the Georgia State University Police department at the University emergency extension 3-3333 (or 413-3333 from an outside phone).
- Stay in communication with the police officer and provide him with all necessary information requested.

2. The University Police Supervisor shall:

- Dispatch personnel to the scene of the mishap.

- Notify one of the following in the listed priority:
 - 1) Radiation Safety Officer or a member of their staff.
 - 2) The Principal Investigator of the affected project.
 - 3) The Chairman or member of the Radiation Protection Committee.
- Maintain simultaneous communications with the Radiation Safety Officer and the police officer dispatched to the emergency so that he can be advised of pertinent information and potential hazards to be encountered at the mishap site.

B. Emergency Medical Treatment

1. The Police Officer at the scene shall:

- Administer or have others (as appropriate) render first aid.
- Prepare the injured individuals to be transported to Grady Hospital if it is determined that a person has been exposed to high radiation levels and/or is contaminated with radioactive materials and is in emergency need of prompt professional medical assistance.

2. The Police Operations Officer shall:

- Notify the Grady Hospital resident-in-charge of the Surgical Emergency Clinic (616-6200) of the extent of the emergency if professional medical assistance is required.
- Make appropriate transportation arrangements to take the patient to Grady Hospital.
- Follow instructions from Grady's Emergency Clinic Team.
- Provide assistance to the hospital staff as appropriate for the specific emergency.
- Stay in radio or telephone communication with the Radiation Safety Officer or his staff if he is not already on the scene.

C. Mishap Investigation and Follow-Up

1. Each affected University personnel shall:

Conduct the necessary mishap investigation, Worker's Compensation form and other evaluation to determine corrective actions necessary to minimize future occurrences.

Appendix B

FORM A

**GEORGIA STATE UNIVERSITY
Principal Investigator/Radiation Use Authorization**

Instructions

This form shall be completed in duplicate and forwarded to the Radiological Safety Officer whenever a Principal Investigator plans to utilize radioisotopes or radiation producing equipment for the first time. The approval of the Chairman of the Radiation Protection committee is required before work involving ionizing radiation commences. Use this form also for authorization to use Radiation Producing Machines (X-ray devices).

For new applicants, the pre-licensing checklist on the back of this form must also be filled out completely.

Principal Investigator: _____ Date: _____

Office : Bldg: _____ Room # _____ Office Phone: _____ Lab Phone: _____

Indicate all locations where radioactive materials are to be stored, used, counted and disposed of:

Building: _____ Room #(s): _____, _____, _____, _____

Building: _____ Room #(s): _____, _____, _____, _____

List all isotopes requested and requested activities. **PROCEDURES FOR THE USE OF EACH ISOTOPE REQUESTED MUST BE SUBMITTED WITH THIS FORM BEFORE ISOTOPE USE CAN BE AUTHORIZED.**

ISOTOPE: _____ AMOUNT REQUESTED _____ PROCEDURE SUBMITTED (Y / N)

ISOTOPE: _____ AMOUNT REQUESTED _____ PROCEDURE SUBMITTED (Y / N)

ISOTOPE: _____ AMOUNT REQUESTED _____ PROCEDURE SUBMITTED (Y / N)

ISOTOPE: _____ AMOUNT REQUESTED _____ PROCEDURE SUBMITTED (Y / N)

Date you attended the GSU Radiation Safety Course: _____

Please submit a statement indicating your previous experience and training using radioisotopes.

Requested:

Principle Investigator Date

Reviewed:

Radiation Safety Officer Date

Approved:

Chairman, Radiation Protection committee Date

Pre-Licensing Checklist

- ❑ Procedures for routine in lab contamination monitoring, contamination swipe testing and clean up of spills are in place and available to all laboratory isotope users.
- ❑ End window or pancake geiger counter purchased and in laboratory. (not necessary for exclusively tritium and/or ^{63}Ni users)
- ❑ Appropriate waste containers are present in the laboratory (contact Radiation Safety Office to get containers).
- ❑ Plastic backed bench cover and radioactive materials tape/decals purchased and in the laboratory.
- ❑ Plastic beta shields purchased and in the laboratory (^{32}P , ^{36}Cl and/or ^{90}Sr users only).
- ❑ Thin lead sheets or leaded acrylic shielding purchased and in the laboratory (^{125}I users only).
- ❑ All areas where isotopes are to be used and stored are delineated with radioactive materials tape or decals with the radiation symbol.
- ❑ All personnel to use radioactive materials (**including the license applicant/principal investigator**) have gone through Georgia State University's Radiation Safety Course.
- ❑ All personnel to use radioactive materials have received a dosimeter badge (not necessary for laboratories using exclusively tritium, ^{14}C , ^{35}S , ^{33}P and/or ^{63}Ni users).
- ❑ All entrances are labeled with "Radioactive Materials" signs, and the "No eating drinking, smoking decal".
- ❑ The DNR "Notice to employees" posting and Emergency Procedures are posted in the laboratory.

Appendix D

Isotope# _____

GEORGIA STATE UNIVERSITY

Inventory of Radioisotopes

Principle Investigator: _____ Radioisotope: _____

Activity _____ Chemical Form _____

Date Received: _____ Date Assayed _____

Supplier _____ Catalog # _____ Lot# _____

Dose Rate(1 m /Surface) _____ / _____ mR/Hr Smear Test (In/Out) _____ / _____ dpm /100cm²

	Activity	Date	Location & Remarks
ORIGINAL BALANCE			
TRANSFERRED			
ORIGINAL BALANCE			
TRANSFERRED			
ORIGINAL BALANCE			
TRANSFERRED			
ORIGINAL BALANCE			
TRANSFERRED			
ORIGINAL BALANCE			
TRANSFERRED			
ORIGINAL BALANCE			
TRANSFERRED			
ORIGINAL BALANCE			
TRANSFERRED			

Date Used Up _____ By _____



EMERGENCY PROCEDURES



IN THE EVENT OF A RADIATION INCIDENT

1. Withdraw a safe distance from the affected area and restrict access to the area as much as possible.
2. Turn off the air conditioning; fume hoods and fans servicing the laboratory. Close windows and lock doors.
3. Notify the Office of Radiation Safety of the incident location and condition. Campus extension: 3-3568. Also Notify your Principle Investigator or Supervisor.
4. After normal working hours, notify the following persons immediately:

GEORGIA STATE UNIVERSITY POLICE: (404) 413-3333

S. Jenny Matte, Radiation Safety Officer

Home (770) 552-7961

24-hour pager (404) 379-2455

5. Use the laboratory Geiger Counter to monitor for personal contamination. In any case do not leave the immediate area until it has been determined that no contamination is present or could be readily spread outside of the laboratory.

*****REMEMBER ALARA*****

(As Low As Reasonably Achievable)

Time: The less time spent near a radiation source means the less dose received.

Distance: The greater the distance from a radiation source means the less dose received.

Shielding: Behind the appropriate shielding from a radiation source means the less dose received.

Appendix G

Mandatory Annual Update Training Radiation Safety

Principle Investigator:

Georgia regulations require all radiation workers be retrained on an annual basis. This form is associated with the Powerpoint training module Update 200*.ppt. Please have all workers listed below review the presentation, take the computerized quiz, sign, date and code this training form. Codes are obtained by passing the quiz at the end of the presentation. All forms are due no later than _____. After this date, workers who have not documented their retraining will not be allowed to use isotopes.

I can pick up completed forms (3-3568) or they can be campus mailed to me at ORI at PO Box 3999.

Please note if any personnel no longer work with radiation.

The following persons require annual retraining:

Name	Signature	Date	Code