Tuskegee University

Division of Research and Sponsored Programs
Office of Grantsmanship and Compliance

Manual for Radiation Safety

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FIGURE

TABLE

I. Radiation Safety Program

Tuskegee University is licensed to possess and utilize radioactive materials and devices that produce ionizing radiation by the State of Alabama. Federal and state laws require that standards, policies and procedures that are set forth in the Rules of Radiation Control of the Alabama State Board of Health, Chapter 420-3-26, must be enforced by persons (institutions) holding such licenses. This Radiation Safety Manual is written for the purpose of administering radiation standards, policies and procedures among Tuskegee University faculty, staff, and students who use sources of ionizing radiation or radioactive materials that emit ionizing radiation. No statement in this manual should be construed to be at variance with state or federal regulations.

II. Radiation Safety Committee

A Radiation Safety Committee (RSC) was established by the President of Tuskegee University on March 8, 1966. The members of the Committee are appointed by the President; they are selected from various departments on campus, and they are chosen because of their experience with the safe use of radioisotopes and ionizing radiation-producing devices. The current and primary purpose of the RSC is to assure that

radioisotopes and devices producing ionizing radiation are used safely on campus and that they present no danger to either the campus community or to persons living in communities around the campus. Also, included in the RSC membership is the Radiation Safety Officer (RSO) who is also appointed by the President.

The chairman of the RSC reports to the President through the Provost (see Fig. 1, Organizational Chart for Radiation Safety). The chairman or any member of the RSC

shall call a meeting whenever he/she finds it necessary. However, there shall be at least one meeting of the RSC each quarter. An agenda shall be prepared; and, it shall be sent out by the chairman at least one week in advance of the meeting. Minutes of the meeting shall be recorded and filed in a permanent file by the RSO, who shall serve as the permanent Secretary to the RSC. The RSO shall also distribute a copy of these minutes to other RSC members and interested University official.

The RSC is the primary authority on campus for all matters pertaining to radiation safety. It shall review all policies pertaining to the authorization of use, purchase, utilization, licensing, monitoring and disposal of radioisotopes and devices that may produce ionizing radiation on campus. The RSC requires the RSO to enforce these policies and expects the RSO to report to the RSC during each meeting on matters related to these policies. The RSO, after consultation with the RSC chairman, shall terminate a principal investigator's (PI) authority to utilize ionizing radiation in case of non-compliance with standards of good practice. A PI will remain suspended for non-compliance for a minimum of two weeks after which the PI may be reinstated by the RSC upon written appeal by the PI.

A principal investigator (PI) is a person who, by virtue of his/her experience,

training, and knowledge, is approved by the RSC to possess and use radioisotopes and devices producing ionizing radiation. The PI is the person charged with the responsibility to properly use radiation and devices that produce ionizing radiation. Other persons may work under the PI's supervision and under the terms of the authorization issued to the PI.

III. Enforcement Policies

a. To ensure punctual inventory response:

When the Radiation Safety Office sends out the Radioisotope Inventory Form to the PIs as listed in the RSO records, a response must be made by the PIs to the RSO within two weeks. At the time the inventory is sent, a list of the names of PIs using radioisotopes will also be sent to the Provost with a copy to the Associate Director of the Office of Grantsmanship and Compliance (OGC). If the completed inventory is not returned to the Radiation Safety Office within two weeks, the OGC will be notified. The Associate Director of OGC will then call the delinquent PI and allow three additional days for compliance before the PI is suspended from performing any activity with radioisotopes and ionizing radiation. Thus, for this infraction, the PI loses his/her authorization to work with ionizing radiation; the PI is in noncompliance. This suspension will be for a minimum of two weeks. Authorization will not be issued, until the PI is in compliance and has indicated through written appeal to the RSC, how he/she will remedy his/her action to be in compliance with procedures written in the Radiation Safety

Manual in the future.

b. For violations with respect to other policies and procedures established in the Radiation Safety Manual and by the Radiation Safety Committee:

Each time a PI or his/her laboratory is found to be in violation of policies and procedures established in the Radiation Safety Manual and by the Radiation Safety Committee, the PI will be cited for that violation. If two citations have been received by a PI within a period of one year, that PI will be considered in noncompliance. All activities with radioisotopes and ionizing radiation will be suspended for a minimum period of two weeks. Reauthorization will be granted when the PI comes into compliance after writing an appeal to the RSC explaining how he/she has remedied the situation.

IV. Radiation Safety Officer

The Radiation Safety Officer is the person appointed by the administration of Tuskegee University who because of education, training and experience is qualified to advise others on safety matters pertaining to ionizing radiation and to supervise the Radiation Safety Program at Tuskegee University. The RSO, with the assistance of staff, shall discharge the duties, which are summarized below:

A. The RSO shall be directly responsible for the overall administration of the Radiation Safety Program at Tuskegee University. The RSO shall be directly responsible to the RSC for carrying out these duties properly.

B. The RSO shall be responsible for all aspects of the University's radiation measurement and protection activities which include (a) personnel monitoring, calibration of instruments, (c) survey checks and smear swipes, (d) leak testing, (e)

ionizing radiation inventory, (f) waste disposal, and (g) radiation safety practices. Guidelines for this work will be found in this Tuskegee University Radiation Safety Manual as well as the rules for Radiation Control (Chapter 420-3-26) of the Alabama State Board of Health.

1. Personnel Monitoring - The RSO shall obtain appropriate personnel monitoring devices or establish monitoring procedures for any person likely to be exposed to ionizing radiation. If a film badge is required by an individual, it shall be issued to and collected from that user by the RSO each month. Exposure dose results from these badges and pocket dosimeters (if any) shall be recorded and maintained in the RSO's office. Each user shall be notified annually of his/her) total yearly exposure dose if that user receives an exposure in excess of any applicable limit set forth in these regulations. Corrective action will be taken in all cases of excessive readings by the RSC and the RSO. That action will consist of an investigation of the activities of the user who receives an exposure dose in excess of the University's ALARA level. If warranted, it may be followed by a protocol change, disciplinary action, or another appropriate response by the RSC.

2. Calibration of Instruments - Survey instruments utilized in the Tuskegee University Radiation Safety Program shall be calibrated at a minimum of twelve month intervals with records of verification. A listing of all survey instruments shall be maintained on file with the RSO at 526 Foster Hall, Tuskegee University and with state officials in accordance with licensing procedures.

3. Survey Checks and Smears Swipes - The RSO shall ensure that routine and special radiation surveys and contamination smears are performed when necessary, in the interest of radiation safety. The PI will be the person primarily responsible for such surveys and smears and will maintain a record of them for perusal by the RSO, the RSC, State of Alabama Board of Health Official, and other authorized officials. For

present activity, these records will be posted. Periodically, the RSO will check the PI's surveys and will also conduct surveys and contamination smears to verify the PI's records. When this occurs, the RSO will notify the PI when and if contamination is found. A level of twice background shall constitute contamination. If contamination is found, the PI is responsible for cleanup; but, the RSO will supervise the action.

4. Leak Tests - Leak tests will be performed by the RSO or an authorized outside vendor on all actively used "sealed sources" of ionizing radiation at least every six months, to verify that these sources are not leaking. The presence of 0.005 microcuries (μCi) or more of activity shall constitute leakage. Leak test records will be maintained in microcurie levels. Excessive radiation levels shall require immediate withdrawal of the source from use and cause it to be decontaminated followed by repair of the source or proper disposal. The RSO shall also survey, swipe, and/or, as appropriate, where applicable, leak test all sources of ionizing radiation arriving on campus. In each case, a record of the survey, swipe, or leak test will be maintained by the RSO.

5. Ionizing Radiation Inventory - The RSO shall maintain a list of all active PIs authorized to use ionizing radiation at Tuskegee University and all sources of ionizing radiation ordered by the PIs under their individual authorizations. Each PI shall be responsible for updating his/her inventory of radioisotopes every six months (every Spring and Fall semester). This shall be accomplished by the RSO sending an inventory list to the PI, indicating all known radioisotope acquisitions by the PI. The PI will verify this list for accuracy of holdings, add or delete items to make it complete, and return the updated list to the RSO within two weeks. These lists will be maintained as a record by the RSO.

6. Radioactive Waste Disposal - The RSO shall be responsible for disposal of sources of ionizing radiation at Tuskegee University and maintaining proper records of such

disposals. The method of disposal, will be documented, whether in the normal trash stream because of decay, in the sanitary sewage system, or by special provision. Although Tuskegee University maintains a Radioisotope Burial Ground (a map and markers indicate burial sites), it has not been utilized for years and there are no plans to reactivate it. Nevertheless, it will be maintained until it can be decommissioned.

7. Radiation Safety Practices - The RSO shall conduct a Radiation Safety Short Course on an as needed basis but no less frequently than three months after being requested by individuals needing the course. The course is offered in two parts; each is two and one-half hours in duration. Handout material is prepared for each user on each of the topics covered. To be certified as a new user who may work with ionizing radiation, a prospective user must attend both parts of the short course and pass the examination administered at its completion. A student or staff member who joins the University after the short course is administered may be given special training by the PI involved, to enable that person to work with radiation. However, the training must be commensurate with the level of involvement with radiation, and the person must take the next available short course. The outline of the Radiation Safety Short Course is provided in Table 1.

   A Tuskegee University Radiation Safety Manual, indicating basic rules and policies concerning the use of ionizing radiation, shall be prepared by the RSO and revised periodically. Prior to promulgation, the manual will be reviewed and approved by the RSC and by the Provost of Tuskegee University as well as the Alabama Board of Health. It will then be distributed to the Tuskegee University users of ionizing radiation.

C. The RSO shall be a member and permanent secretary of the Radiation Safety Committee. The responsibility of the RSO encompasses cooperating with the chairman, preparing the agenda, and writing up and distributing the minutes of

meetings to each member of the RSC and to other University officials.

Table 1. Radiation Safety Short Course Outline

Part I

A. Basic Theory, Terminology, Units

B. Biological Effects of Radiation

1. Chronic Effects
2. Genetic Effects
3. Acute Somatic Effects
4. External Radiation Hazards
5. Internal Radiation Hazards
6. Normal Body Burden
7. Maximum Permissible Exposure
8. Maximum Accumulated Dose

C. Detection Fundamentals

1. Excitation and Ionization
2. Detection Factors and Efficiency

D. Basic Laboratory Safety

1. General Procedures
2. Contamination Smear Tests
3. Laboratory Surveys

E. Basic Laboratory Calculations

1. Activity
2. True Count Rate - Efficiency
3. Contamination

Part II

F. Tuskegee University Facilities

1. RIA Laboratory-LSC, Auto Gamma Counter (Williams-Bowie Hall)
2. Veterinary Medicine
3. Carver Research Foundation-Radiation Safety Office and Laboratory
4. Carver Research Lab
5. Disposal-Carver Research Foundation Vault

G. Regulations for Control of Ionizing Radiation

1. Code of Federal Regulations 10 CFR 90
2. Alabama Regulations-Licenses
3. Tuskegee University Regulations-Radiation Safety Guide
   a). Radiation Safety RSC and Officer (RSO)
   b). Personnel Monitoring-Training-RS-100
   c). Authorization for Use-RS-l0l
   d). Procurement of Radioisotopes-RS-l09
   e). Receiving-RS-110
   f). Past Radiation History, RS-104, RS-104A
   g). Marking and Labeling
   h). Contamination Checks and Lab Surveys
   i). Inventory Control
   j). Radioactive Waste Disposal
   k). Records
   1). Emergency Procedures

H. Radiation Detection Instrumentation

1. Film Badges
2. Pocket Dosimeters
3. Portable Survey Meters
4. G. M. and Proportional Detection Systems
5. Liquid Scintillation Systems
6. Gamma Ray Spectrometry and Autogamma Systems

I. Accident Scenarios - The Four C's

1. Scintillation Vial
2. Stock Solution
3. Fire
4. Accidental Cut

J. Quiz and Certification (Take Home Examination)

D. The RSO shall be available to consult with all users of radioisotopes or of ionizing radiation-producing devices and to make recommendations to them on radiation safety. A designated procedure for each usage including the estimated radioactivity level required for the procedure must be submitted to the RSO in order for it to be considered a part of a PI's authorization.. Upon receiving such information, the RSO shall prepare a recommendation to the RSC, including suggesting an upper limit of activity for specific radioisotope utilization for the PI. In the interim between meetings of the RSC, the RSO may give tentative authorization for any activities and procedures, involving ionizing radiation or the release of radiation or radioactive materials to the environment, if the procedures have been properly submitted. The RSO shall also help PIs with procedures for radioactive waste disposal, if they are required, and present these procedures to the RSC for approval. Finally, the RSO shall also help PI's prepare license applications for ionizing radiation sources or uses that require a special license.

E. The RSO, in consultation with the chairman of the RSC, shall suspend, as rapidly as possible, any operation causing a radiation hazard. The RSO shall report such action to the RSC for review as soon as possible after this action is taken.

F. The RSO shall have the responsibility of keeping all radiation licenses current for the University. The RSO must file and maintain in the Radiation Safety Office, all

records pertinent to these licenses and to the radiation safety at Tuskegee University.

V. General Radiation Safety Procedures

The following procedures shall apply to all persons using sources or devices that produce ionizing radiation:

A. General Rules:

1. No smoking, eating or drinking is allowed in any laboratory where radioactive materials are used or stored.
2. All persons who are designated to wear personnel monitoring devices by the RSO and the PI shall wear such devices at all times when they work with or near sources of radiation.
3. All persons who are permitted to work with sources of radiation shall be fully aware of the rules and regulations specified in this Radiation Safety Manual and they shall be trained by the PI in radiation safety.
4. Sources of radiation shall be used and stored to prevent unauthorized persons from using or removing such material or radiation producing devices.
5. All sources of radiation shall be properly labeled in conformance with the standards

required in State Regulations (chapter 420-3-26).

6. If there is ever an accident involving radiation or radioactive material, the principal investigator and the RSO shall be notified immediately in conformance with emergency procedures outlined in this Manual.

B. Authorization to Work With Ionizing Radiation:

A faculty or staff member who wishes to be designated as a PI (See Section II for definition) by the RSC shall first establish his/her experience, training and knowledge about ionizing radiation with the RSC. At the same time the specific procedures about how and what radiation, radioisotopes, and radioactivity will be used must be identified. This is done by submitting these procedures with Form RS-101 (Authorization for Use of Radioisotopes or Equipment Which Produces Ionizing Radiation) to the RSO. These procedures and this form will be reviewed by the RSO who will make a recommendation to the RSC with the understanding that if the recommendation is positive, the RSO may tentatively approve them in the interim between RSC meetings. The PI will be notified of his/her authorization as a PI by receipt of a copy of Form-101, which has been approved by the chairman of the RSC. This designation as a PI allows a researcher to possess, use and purchase radioisotopes and devices producing ionizing radiation within the restrictions indicated on the form and in this Manual.

The place of use of ionizing radiation is authorized only upon request for review of the location by the RSO (Form RS-50-2-Review of Principal Investigator's Proposed Project Location) followed by approval by the RSC. The RSO may tentatively approve a location in the interim, between RSC meetings.

C. Training:

The PI shall be responsible for training in procedures for the safe handling of

radioactive materials by all persons who work on approved radioisotope projects. Such training shall include, but not be limited to, the Radiation Safety Short Course. A record of preliminary training by the PI shall be acknowledged on Form RS-100 (Personnel Monitoring Status and Training Record) which is submitted to the RSO at the time the person is designated to use radioisotopes or ionizing radiation or when a film badge is requested. This training shall include:

1. Knowledge of this Radiation Safety Manual, including the state regulations, under which his/her work must be performed, particularly Chapter 420-3-26 of the State Board of Health Regulations. These documents are available for reference in the Radiation Safety Office.
2. Familiarity with the specific procedures established by the PI for using the radioisotopes or ionizing radiation. These should include the procedures submitted by the PI in seeking authorization for this project.
3. Action to be taken in case of a radioactive spill or other accident (emergency procedures).
4. Purpose and availability of the RSO and the members of the RSC.
5. Use of radiation detection instruments provided for the project.
6. The procedures and techniques used in making contamination checks and laboratory surveys.

D. Procurement of Radioactive Materials or Ionizing Radiation Producing Devices:

1. When the PI has selected the radiation source(s) or device which he/she plans to order, he/she shall transmit that information first to the RSO on Form RS-102 (Radioisotope Request Form) together with a purchase requisition. The RSO will review the purchase requisition and determine if Tuskegee University is licensed by the State Board of Health to obtain the radioactive material or device and if the PI is authorized by the RSC to purchase it. If the purchase is permissible, the purchase

requisition will be signed by the RSO and forwarded to the purchasing department for processing. The purchasing department has been provided with a Protocol for Processing of Purchase Orders for Radioactive Substances that govern such purchases. A copy of the Protocol is included in the Appendices.

All purchases must indicate delivery to:

Radiation Safety Officer
c/o. Campus Security Office
Tuskegee University
Tuskegee, AL 36088

2. After the RSO has received the radioisotope request from the PI, Form RS-103 (Radioisotope Authorization) is filled out in order to ensure that the purchase will not exceed the limits established with the PI by the RSC. This form is then filed in the PI's folder for future reference by the RSO.

3. The RSO will receive the shipment from the security office, perform a radiation survey on it utilizing Form RS-110 (Radioactive Shipment Receipt Report), and deliver the item to the principal investigator with a copy of RS-110. It is the responsibility of the PI to send the packing slip to the proper authorities.
4. If radioactive materials or devices are needed and not covered by the present Tuskegee University licenses, the RSO will assist the Principal Investigator in the preparation of an application to the proper governmental agency for such a license.

E. Loose-Form Radioisotope Procedures:

1. All work with radioisotopes should be confined to the designated work areas

identified by radiation signs. The access to the work area will be restricted to the PI and his associates who need access to this area. Normally, all work should be performed within a large flat metal tray lined with absorbent paper or at least a table area lined with it. The absorbent paper safeguards table tops against contamination from accidental spills and also facilitates the disposal of the spilled material.

2. Protective clothing (e.g., lab jackets, rubber gloves) appropriate to the conditions shall be worn at all times when working with loose-form radioactive materials. IN ALL USES, GLOVES SHALL BE THE MINIMUM PROTECTION REQUIRED.
3. Solutions should never be pipetted by mouth. Instead a propipetter, syringe, screw type control, or other type suction device should be utilized with pipettes or micropipettes.
4. Radioisotopes shall be used to ensure that radiation exposure rates to personnel are not increased unnecessarily. The frequent use of lead bricks and other shielding will serve to minimize exposure.
5. Remote equipment (long-handled tongs, remote pipettes, etc.) shall be used routinely when handling radioactive materials of higher activity (of the order of one curie).
6. All equipment, which might come in contact with loose-form radioactive material shall be considered potentially contaminated and shall be monitored for contamination before being removed from the laboratory.
7. Contaminated waste should be disposed of in the appropriate "radioactive" solid waste can or liquid waste container. Each time radioactive waste is disposed of, it must be documented on Form RS-105 (Radioactive Waste Disposal) and totals along with identity and date must be indicated on the package when it is prepared for pick-up by the RSO. In special cases, the RSO shall work out a special liquid disposal procedure with the PI when waste can be disposed of directly into a sink connected to the sanitary sewage system. The sink should be labeled for radioactive work; and, it should also be used for cleaning contaminated laboratory apparatus.
8. If there is ever an accident involving radioactive material (e.g., a spill, a cut with a

pipette holding radioactive material), the principal investigator and the RSO should be notified immediately.

9. In the event that a spread of radioactive contamination is suspected, all work in that area shall be halted immediately. The PI and the RSO shall be summoned so that they may evaluate the situation and give advice. Personnel should remain in the general area to prevent further spread of contamination. A plan of decontamination shall be determined by the RSO and the principal investigator. All decontamination shall be performed by personnel of the laboratory concerned and/or the RSO; janitorial employees shall not be used in decontamination work except with the specific approval of the RSO.
10. Radioisotopes and rooms containing radioisotopes shall be appropriately labeled, e.g., "CAUTION-RADIOACTIVE MATERIALS." All labeling shall be in conformance with Sections 420-3-26-.03 (11) and (12) of the Rules of the State Board of Health.
11. All personnel working with ionizing radiation must have 24-hour access to a telephone.
12. Liquid scintillation cocktails utilized with loose-form radioisotopes must be of biodegradable, solvent-free type.

F. Limits of Exposure to Ionizing Radiation - ALARA (As Low As Reasonably Achievable) Program:

1. In keeping with currently accepted practices and standards, all unnecessary radiation exposure shall be considered undesirable and excessive. Occupational radiation exposure shall be limited to the lowest practical level.
2. For specific limits, Tuskegee University has set levels of 40 millirem in any month (ten times lower than state regulations) and will investigate any occurrence in which

this level is exceeded. More stringent rules apply to individuals under 18 years of age and to personnel who are known or suspected to be pregnant.

3. An External Radiation Exposure Report (Form RS-210) is sent to each Tuskegee University faculty, student or staff user annually to indicate yearly exposure if the exposure is in excess of any applicable limit as set forth in these regulations or the Tuskegee University licenses. Even if exposure is within applicable limits, personnel monitoring is required. An individual may request information on radiation exposure and annual exposure data (Form RS-210) will be sent to the person requesting the data.

G. Personnel 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 Part F of this section (except in the case of persons under 18 years of age, where five percent of applicable limits shall apply) shall wear appropriate personnel monitoring devices. These monitoring devices shall be pocket dosimeters or film badges unless other devices are authorized by the RSO.
2. The RSO shall supervise the procurement, distribution, collection, and analysis of personnel monitoring devices. An independent distributor of such devices shall be utilized.
3. Personnel monitoring devices shall be changed and analyzed on a monthly basis. If an exposure in excess of the limits specified is likely, the RSO shall be notified immediately so that the device may be processed for rapid analysis.
4. It is the responsibility of the principal investigator to notify the RSO on Form RS-100 (Personnel Monitoring Status and Training Record) whenever an individual will require personnel monitoring and whenever the need for personnel monitoring is terminated.
5. When not in use, personnel monitoring devices shall be stored in areas where they

will not be exposed to ionizing radiation.

6. AT NO TIME MAY A PERSONNEL MONITORING DEVICE BE EXPOSED to RADIATION UNLESS IT IS WORN BY THE EXPIREMENTER. Personnel monitoring devices shall not be worn during non-occupational exposure such as during a medical X-ray.
7. Visitors to controlled radiation areas shall also be monitored.

a. Individual visitors shall be escorted by trained personnel who shall issue a pocket dosimeter or film badge to the visitor during his/her visit.
b. Groups of visitors shall be escorted by trained personnel who shall issue pocket dosimeters or film badges to several group members as indicators for the group.

H. 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.

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 B of Chapter 420-3-26 of State Board of Health Regulations or 100 times the quantities listed in the case of natural uranium and thorium, shall be posted with the standard sign and the words CAUTION-RADIOACTIVE MATERIALS. Exceptions to these rules can be noted in Chapter 420-3-26 of the state regulations.
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 other information as listed in Section 420-3-26-.03(11) of the state regulations.
3. 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 or in any five consecutive days a dose in excess of 100 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.

4. Any area, accessible to personnel, in which there exists radiation at such levels that 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.

I. Contamination Checks and Laboratory Surveys:

If loose-form radioisotopes are utilized in a laboratory, a contamination survey check must be carried out by the PI, according to rules provided in this manual, in Section K.

If ionizing radiation other than in loose-form is utilized, routine surveys must be carried out by the principal investigator to determine radiation levels. This should be done according to the rules listed in Section L. New radiation surveys must be conducted every time configurations with the radioisotopes or devices producing ionizing radiation are altered.

J. Frequency of Contamination Survey:

The frequency of contamination survey shall be not less than once a month during active operation by the PI. If work with radioisotopes is stopped, a contamination check must be carried out by the PI after the last usage. The RSO will also survey laboratories annually and, if found to be contaminated, the results of the survey will be reported to the PI on the Form RS-111 (Smear Test Report).

K. Contamination Survey Smear (Swipe) Test Procedure:

1. Take a small piece of filter paper (3 to 5 cm in diameter) and rub it across the area to be checked for contamination (normally 100 to 150 square cm).
2. Place the filter paper in a scintillation vial. Label the vial with the smear location, incorporate some scintillation cocktail and count it along with the research vials in the liquid scintillation counter.
3. Record the count(s) in the log book provided along with information on the type of equipment used, the radioisotope mode used, the background count, and the standard count.
4. Correct the count for background.
5. If the count is less than twice the background level, then everything is considered normal and caution has been exercised. If the count is greater than twice the background, contamination has likely occurred and cleanup must be initiated. Notify your principal investigator (PI) and the Radiation Safety Officer (RSO). They will indicate when and how to proceed with the clean up. When the area is thoroughly cleaned, it must be smeared and checked again. If it is all right, the RSO will also come to check the area. Be sure to record the results of all smears.
6. If the smear is of a sealed source (a leak test), also correct for background and convert the corrected count to microcuries.
7. If the smear (leak test) activity is found to be less than 0.005 μCi, then everything is considered normal and the source is not leaking. If the activity is greater than 0.005 μCi, a leak has most likely occurred; so , notify your PI and the RSO to investigate the situation.

L. Radiation Level Surveys:

Monitor area with a radiation survey meter sufficiently sensitive to detect 0.1 mR/h. The results of this survey should be recorded on a standard form which should show:

a. Location, date, and type of equipment used.

b. Identification of person conducting the survey.
c. Drawing of area surveyed, identifying relevant features such as active storage areas, active waste areas, etc.
d. Measured exposure rates, keyed to location on drawing (point out rates that require corrective action).
e. Corrective action taken in the case of excessive exposure rates, reduced exposure rates after corrective action, and appropriate remarks.

M. Inventory Control:

1. Each PI is responsible for radioisotopes or devices that produce ionizing radiation in his/her charge.
2. Every six months an inventory list, updated by recent purchases, shall be sent by the RSO to each PI to compare with his/her actual holdings and indicate and account for any discrepancies with the RSO's listing. The list shall be returned to the RSO for record updating and a copy shall be kept by the PI in his or her log.
3. When the PI decides to leave the University, he/she must transfer all radioactive materials that remain in his/her possession to the RSO and complete the Form RS-301.

N. Location of Radioactive Wastes:

Tuskegee University has set the specific limit of exposure to ionizing radiation at the level of 2 mR/hr for waste material or radioactive sources kept in public access areas. If the dose rate at the surface is higher than 2 mR/hr, then the radioactive material will be placed in a controlled access area. Only authorized users will be allowed to handle radioactive sources that exceed a dose rate of 2 mR/hr at the surface.

O. Radioactive Waste Disposal:

Tuskegee University's Waste Disposal Program is designed to be in compliance with federal regulations and with Sections 420-3-26-.03(16-20), -.03(7) and -.03(1)(b) Rules of the State Board of Health. The most common method will be disposal by the RSO, following storage for as long as possible in the storage vault located at the Carver Research Building.

1. Radioactive waste shall normally be retained in the laboratory in which it is generated. Liquids shall be stored in capped and labeled plastic bottles. Solid wastes shall be stored in covered plastic or plastic-lined containers. The RSO shall be responsible for picking up all waste material when notified by the principal investigator. The principal investigator is responsible for informing the RSO about type and quantities of isotopes in the waste. A record of all waste must be kept by the PI on Form RS-105 (Radioactive Waste Disposal).
2. In cases when the above specified system of waste disposal is not satisfactory, the RSO and the PI may agree upon an alternate method of waste disposal which satisfies federal and state regulations. Two such methods which have been established on Tuskegee University's license with the State Office but which must be approved by the RSC are disposal by release into the sanitary sewage system and disposal by incineration. However, both of these methods are exceptions to the rule and cannot be used without the express written permission of the RSO and specific documentation of radioisotope and amount of activity disposed of by the PI.
3. All radioactive waste shall be clearly marked and labeled and accompanied by Form RS-105 (Radioactive Waste Disposal).
4. Records shall be maintained by the Radiation Safety Officer of the disposal of all radioactive materials, including information about isotope, quantity, and ultimate disposal.

P. Regulations for Use of Radioisotopes with Animals:

The principal investigator proposing to incorporate radioisotopes in animals must first bring the proposal to the RSO so that it can be reviewed and transmitted to the RSC members for their consideration. The RSC will determine if it is feasible, if it can be done safely, and whether the expected results justify the research. If the proposal is acceptable, RSC members will also determine where the animals will be housed (the place approved is the Animal Care Facility). Most small animal work will be carried out in the Animal Care Facility and, if this is the case, the director of the facility will be apprised of the research. He/she may promulgate additional precautionary measures that would be conducive to satisfactory safety practices. The rules set up for all campus personnel utilizing radiation, as outlined in this Radiation Safety Manual, must be followed. In addition, the following rules pertain specifically to animals wherein radioisotopes have been incorporated, and, they must be observed.

1. All animals that have been administered radioactive materials should be isolated from the animals that do not contain radioactive materials.
2. The room or other area where animals containing radioactive materials are housed must be posted with the appropriate radioactive materials caution sign along with "Notice to Employees" and "Emergency Call List" signs. Cages that house animals and contain radioactive materials should be labeled with the appropriate radioactive materials caution signs.
3. Animals containing radioactive materials should be under the cooperative supervision of the principal investigator, the director of the facility and the RSO. This includes cleaning of cages and rooms or units within the Animal Care Facility or other approved care facility.
4. Animal care personnel should be instructed in proper procedures for handling and disposing of contaminated wastes from the cages. For small animals, the bottom of the cages should be lined with absorbent paper pads with plastic backing.
5. The RSO has central control over methods of disposal of animal carcasses which contain radioactive material, and records on the disposal are to be maintained. These

records also, shall include methods of disposal of radioactive material wastes from these animals including urine, feces, and miscellaneous radioactive material wastes. Following disposal of wastes from the Animal Care Facility, procedures for washing animal cages and collection baskets should be jointly directed by the PI and the RSO.

VI. Records

The following records shall be established and maintained by the Radiation Safety Officer and/or the principal investigator at Tuskegee University.

A. Personal Exposure and Film Badge Log

The radiation exposure record of every person subject to personnel monitoring, as specified in part V-G of this Manual, will be maintained in this file.

B. Inventory of Radioisotopes

An inventory of radioisotopes at Tuskegee University will be kept in a log with both the RSO and the PI, and it will be updated by PIs every six months.

C. Alabama State Licenses for Radioactive Materials or Devices Producing Ionizing Radiation

Licenses for all radioisotopes (exempt or non-exempt, sealed or loose-form) and all devices producing ionizing radiation shall be located at the Radiation Safety Office.

D. Instrument Calibration Log

A record of yearly calibration of each survey instrument shall be carried in a log in the Radiation Safety office for at least two years.

E. Disposal Log

A record of disposal shall be kept with the RSO. A record of disposal by incineration or in the sanitary sewage system shall be kept both in the PI's log and with the RSO.

F. Smear Test Log

A record of smear tests shall be kept with the PI and/or at the Radiation Safety Office. Smear tests of work areas shall be performed at yearly intervals by the RSO. Results of these tests shall be maintained in the Radiation Safety Office.

G. Leak Test Log

A record of leak tests shall be kept with the PI and/or at the Radiation Safety Office. Leak tests of sealed sources in active use shall be performed at six-month intervals. Results of these tests shall be maintained in the Radiation Safety Office. Sealed sources not in active use are marked with a label which indicates that the source must be leak tested before use.

H. General Radiation Survey Log

Surveys of areas not using loose-form radioisotopes, where changes in ionizing radiation levels may occur, shall be taken and recorded by the PI immediately after the change is made. A survey of these areas shall be made and recorded by the RSO at intervals not to exceed twelve months. A record of the dates of such surveys is kept at the Radiation Safety Office.

I. Radiation Safety RSC Minutes

A log of all RSC meetings shall be kept by the RSO who is secretary to the RSC. This log shall be maintained in the Radiation Safety Office.

VII. Emergency Procedures - Accidents

No set of rules can be formulated which will apply to all emergencies which

might arise involving radioactive materials or devices that produce ionizing radiation. In some cases, the principal investigator will be present and will be trained to know what to do. However, in many instances, a person will be alone and the accident will not even have been considered a possibility. In these cases it has been found that there are four key concepts which will help a person make the correct decisions. These four concepts should be applied as indicated below, keeping in mind that the primary consideration is the prevention of injury to human beings; the secondary consideration is the salvage of facilities and equipment.

A. CONFINE

Restrict dispersal of the radioactivity as much as possible:

1. Cover liquid spills with absorbent material to limit the spread of contamination.
2. Set the container upright if your hands are protected.
3. If fans, ventilators, or air conditioners are operating in the area, they should be shut off. Preferably this should be done by someone not involved in the contaminated area.
4. Mark off contaminated area with chalk, marker, rope, etc., and restrict traffic to that area.
5. Do not allow anyone to leave the contaminated area without first being monitored to be sure they are not contaminated.

B. CALL

Notify people concerning the accident:

1. Notify all persons in the area in which the spill occurred.
2. Notify all persons not involved in the spill to vacate the room.
3. Notify the proper authorities so that they can offer assistance.
    a. The PI knows what is being worked with and is in the best position to know how to handle problems encountered. He or she should be notified.
    b. The RSO must be made aware of the accident and should be present for

decontamination checks. In general, all radiation accidents involving personnel (wounds, overexposures, ingestion, inhalation) should be reported to the RSO as soon as possible. If the RSO is not available, the Emergency Call List should be followed. This list shall be posted in all areas where radioisotopes are utilized.

c. The Tuskegee University Campus Fire and Security Division should be notified immediately, if a fire or accident involving injury to personnel is involved.

d. Investigators from the Alabama State Board of Health Division of Radiological Health are available, if their assistance is required. Normally the RSO or chairman of the RSC will place this call.

C. CLEAN

Clean up following the accident:

1. Personnel

a. Wash hands first, if they are contaminated as a result of the accident. Put on rubber gloves to prevent contamination of the hands

b. When body surfaces become contaminated, it is important that the contamination be removed as soon as possible to prevent its spread to other surfaces and to eliminate it as a source of internal contamination by way of ingestion, absorption, inhalation, and wound contamination. Washing with normal soap and detergent is the best initial approach. However, the decontamination procedure should not increase penetration of the radioactivity into the body by excessive abrasion of the skin. Decontamination of unabrased skin should be done initially with a mild soap or detergent and water. If necessary, a soft brush and an abrasive soap or complexing agent may be used. Clipping of the fingernails may remove a significant amount of contamination remaining on the hands after washing.

c. If contamination is in the area of a wound, a physician should supervise the decontamination operation. Wounds suspected of contamination should be irrigated

profusely with tepid water and cleaned with a swab.

d. Clothing that is significantly contaminated should be removed and stored in plastic bags until the activity has decayed to an acceptable level of (approximately 200 dpm per 100 square cm).

e. Depending on the level of radioactivity involved in the accident, the cleansing water is disposed of down the drain or collected by the RSO.

2. Facilities

a. Start decontamination procedures as soon as possible. Cleaning agents normally used in the laboratory should be adequate. Start at the periphery of the contaminated area and work inward, systematically reducing the area. Absorbent paper or paper towels should be used to soak up any liquid. Disposable plastic or rubber gloves should be used to place these materials and other disposable contaminated materials into plastic bags in the solid radioactive waste container. Remote handling tongs may be necessary, if this is a major spill (in which case, the RSO will supervise).

b. Once the disposable materials have been taken care of, wash and scrub the area to remove contamination. A normal detergent or manufactured cleaning agent may be used. Washing, scrubbing and drying may have to be repeated a number of times in order to reduce the contamination.

D. CHECK

Check to determine if contamination is still present.

1. Personnel or facilities suspected of being contaminated should be monitored with a survey meter, to identify problem areas as long as hard beta or gamma radiation is involved. Some degree of fixed contamination may occur; however, the maximum limits suggested for hands, body surfaces, or personnel clothing and

shoes for beta and gamma activity are 0.1 mR/hr at 2 cm.

2. Personnel or facilities suspected of being contaminated with low energy beta emitters should be monitored by smear or swipe tests to check the effectiveness of the decontamination procedures.
3. Personnel or facilities should be cleaned again, if the contamination level exceeds twice the background level.
4. A written Accident Report (Form RS 106-2) must be submitted to the RSO within three days of an accident that involves ionizing radiation regardless how small the quantity.