From: James Kitchens [Kitchens.James@epamail.epa.gov]
Sent: Wednesday, September 19, 2012 4:27 PM
To: Ullrich, Elizabeth
Cc: Roy Sidle; Jim Bellah
Subject: Re: your renewal request
Attachments: RADMAN2012finalejlk.docm; 2012 SHMS Policy Signed.pdf; NRC LICENSE RESPONSE09192012fin.pdf

Importance: High

Q-5

Ms. Ullrich:

Please look at my reply to your email of 9/30 and see if it is sufficient. I'm including a revised copy of the manual, with the suggested statement, and a copy of our Safety and Health Management System Commitment Statement.

10-10146-01
03004004

Thank you,

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ECOSYSTEMS RESEARCH DIVISION
RADIATION SAFETY
PROCEDURE
MANUAL

United States Environmental Protection Agency
Ecosystems Research Division
960 College Station Road
Athens, GA 30605-2700

September 2012

It is the purpose of the Ecosystems Research Division's radiation safety program to provide a basis for the safe and productive use of radioactive materials in environmental research projects within the United States Environmental Protection Agency.

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Appendix C Basis and Rational for the EPA National Radiation Exposure Limits and Action Levels

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NOTE: Procedures may be revised only if 1) the changes are reviewed and approved by the licensee management and the RSO in writing; 2) the licensee staff is provided training in the revised procedures prior to implementation; 3) the changed are in compliance with NRC regulations and the license; and 4) the changed do not degrade the effectiveness of the program.

1. INTRODUCTION AND PURPOSE

1.1 Introduction

The office of Administration and Resources Management, Office of Administration, Safety, Health, and Environmental Management Division (SHEMD), has established the National Radiation Safety Policy and the National Radiation Safety and Health Program for all EPA personnel.

This policy establishes the Agency's position concerning the protection of its workers from the adverse health effects of occupational exposure to ionizing radiation. The policy also establishes an Agency-wide Radiation Safety and Health Program which has as its primary goal the minimization of EPA workers' job-related exposure to ionizing radiation. The program defines the managerial and technical framework and dose limitation system through which this goal is achieved.

A Memorandum of Understanding (MOU), established on January 13, 1991, delineates the authority of SHEMD for overall administration of the Program; the Office of Radiation and Indoor Air (ORIA) Risk Assessment and Federal Guidance Program provides technical assistance and support to SHEMD related to its administration and management

In addition, it is understood that there are particular requirements for each individual Nuclear Regulatory Commission (NRC) license. This is no different for the USEPA Ecosystems Research Division (ERD). The Athens facility license was issued prior to the creation of USEPA National Radiation Safety and Health Practices for Laboratory Work. Therefore, there are undoubtedly small differences in particular items that are addressed in this manual. These differences are procedural and will not subject any personnel to increased risk. They are explained in this document.

1.2 Purpose

The purpose of this document is to establish Standard Operating Procedure for the ERD so that Agency policy and NRC regulations can both be satisfied and that personnel are protected.

No EPA operations in the field are currently covered under our NRC license. Separate licensing and/or amendments are required for use of radioactive materials at off-site locations.

Licensing of this facility is under NRC regulations set forth in 10 CFR 30 (NRC83) et al.

2. ORGANIZATION AND STAFFING

The document "EPA 1440 - Occupational Health and Safety Manual" describes the overall organization and responsibility structure for health and safety of EPA personnel. The items particular to radiation health and safety are delineated in the National Radiation Safety and Health Program Document.

2.1 Organization

Ultimate responsibility for the health and safety of laboratory personnel lies with the Division Director. This responsibility is, in a large part, delegated to the Radiation Safety Office. The Radiation Safety Office is comprised of a Radiation Safety Officer and an Alternate Radiation Safety Officer. The Radiation Safety Officer tends to the everyday function of the Radiation Safety Program and oversees the program and is the program's direct contact with administration.

The Radiation Safety Office has the responsibility of ensuring radiation safety and controlling radionuclides at the laboratory. The office considers all new projects and processes before work begins. The Radiation Safety Office determines and analyzes any radiation hazards that may be associated with the work, and proposes appropriate practices. Prior to the initiation of a project the Principal Investigator presents a completed Laboratory Project/Sample Acceptance form (see Appendix A) and a plan for disposal of any waste generated by the project. Approval is required prior to initiation of the projects use of radionuclides. At this time, further restrictions may be required if necessary to protect the employees, the public, and the environment.

2.2 Personnel Responsibilities

2.2.1 Radiation Safety Officer

The Radiation Safety Officer's (RSO) responsibilities include the following duties.

1. Provide annual training and copies of all radiation safety related material to all employees involved with the use and/or analysis of radioactive materials.

2. Provide a means to safely store radioactive materials, instruments, personnel dosimeters, and related materials.

3. Ensure that all portable survey instruments assigned to the RSO are maintained in effective operating condition and calibration at all times.

4. Direct and supervise radiological monitoring activities at the laboratory.

5. Process all NRC Material License applications, amendment requests, and program updates for the NRC.

6. Monitor radiological practices at the Laboratory to assure regulatory compliance.

7. Approve procurement requests for radionuclides and radioactive materials.

8. Ensure that proper safeguards are in place for the installation of radiation generating equipment.

9. Maintain exposure records on employees to include internal and external dosimetry measurements and make such data available to workers upon request (also required by 10 CFR 19.13, "Notifications and Reports to Individuals").

10. Recommend to the Laboratory Director the termination of hazardous or potentially hazardous radiological operations.

11. Conduct a continuous program of radiation hazard recognition, evaluation, and elimination.

12. Supervise all low-level radioactive waste disposal operations at the Laboratory.

13. Perform annual laboratory surveys that include recording contamination levels, smear locations and counts, and any significant exposure rates that may exist in labs using radioactive materials.

14. Designate radiation areas, surface contamination areas, airborne radioactivity areas, and radioactive material storage areas in the laboratory and install appropriate warning signs, caution signs, labels, signals, and controls (also required by 10 CFR 20, subpart J).

15. Supervise decontamination of personnel, areas, and equipment involved in radiological accidents.

16. Assure that protective clothing and equipment are available for all radiation personnel.

17. Maintenance of a master inventory for the facility and issuance of inventory numbers for incoming shipments.

2.2.2 Principal Researcher

The principal researcher is responsible for the following activities in the laboratory:

1. Maintenance of laboratory records including but not limited to:

   A. Inventory and Summary of Inventory

   B. Monthly contamination surveys

   C. Current laboratory diagrams

   D. Waste disposal records

   E. Personnel working with radioisotopes

F. Submission of the required Health and Safety Protocol (HASP)

2. Posting of notices, signs and radioactive material procedures.

3. Proper storage of waste materials prior to transfer to the RSO.

4. Notification to RSO of radioactive materials ordered.

5. Receipt and survey of radioactive shipments (including transmittal of survey data to RSO).

6. Decontamination of laboratory material prior to removal from the laboratory.

7. Informing all personnel and visitors in the laboratory of potential hazards from the radioisotopes used.

8. Ensuring that all personnel who are working with radioisotopes have adequate training.

9. Perform monthly contamination surveys during months when radioisotopes are used in their facilities.

3. RADIATION TRAINING REQUIREMENTS

NRC licensure requires particular levels of training for personnel and visitors entering or working in areas where radioisotopes are stored or used. All training and dissemination of information shall correspond with an employee's duties, workplace assignments, and responsibilities. The primary goals of the EPA's radiation safety training program are provided in the USEPA Safety, Health, and Environmental Management Division's Safety, Health, and Environmental Management Guidelines,

All principal researchers are required to meet the criteria specified in 10 CFR 33.15. Essentially, this states that principal researchers (authorized users) must:

1. Satisfy general requirements of 10 CFR 30.33; and

2. Hold a college degree at a bachelor level, or equivalent training and experience, in the physical or biological sciences or in engineering; and

3. Have at least 40 hours of training and experience as specified in 10 CFR 33.15(a)(2); and

4. Have established administrative controls and procedures relating to procurement of byproduct material, procedures, recordkeeping, material control and accounting, and management review necessary to assure safe operations.

All employees that will be involved in the use of radioactive materials at the laboratory are required to complete a 16-hour basic radiation training course. This training may be waived by the Radiation Safety Office based on the employee's training and experience histories. An employee who has exempted the 16-hour course must complete training covering the procedures and practices unique to this facility (inventory, waste handling, etc.) within the initial six month period of work with radioisotopes. Every employee who works with radioisotopes is required to complete a refresher course on an annual basis in order to continue working with radioisotopes. Additional courses may be required when necessary.

A two hour safety orientation course is required of all new employees before beginning work, regardless of their duties.

Training specific to cleaning of Electron Capture Detectors (ECDs) is required of all personnel cleaning ECDs. This training can be included in the 16 hour training course or performed in addition to the required 16 hour course.

All radiation training is scheduled and organized by the Radiation Safety Office. All personnel radiation training records are maintained by the RSO and the Laboratory's Personnel Office.

3.1 Basic Radiation Training Course

The topics included in the Basic Radiation Training Course are listed below. Copies of this document, NRC Reg. Guides 8.13 and 8.29, 10 CFR 19 and other radiation safety related material will be included in the course.

1. Fundamentals of Radiation Safety

2. Basic Principles of Radiation Protection

    A. Definition of Basic Terms and Concepts

    B. Reduction of External Exposure to Radiation

        a. Time, Distance, and Shielding

        b. ALARA, Concepts and Principles

        c. Contamination Control

    C. Reduction of Internal Contamination

        a. Modes of Entry

            i. Ingestion

            ii. Inhalation

            iii. Absorption

        b. Respiratory Protection

        c. Protective Clothing

        d. Contamination Control

3. Radiation Monitoring Equipment and Its Uses

    A. Portable

a. Geiger Counter

b. Proportional Counters

c. Ionization Chambers

d. Single and Multichannel Analyzers

e. LiF - Neutron Counters

B. Liquid Scintillation Counters

C. Crystal Scintillation Counters

a. Multichannel Analyzers

b. Single Channel Analyzers

D. Calibration and Inspection of Detection Equipment

4. Radiation Safety Surveys

A. Procedure and Recordkeeping

B. Contamination

a. Methods of Analyses

i. Liquid Scintillation Counting

ii. Other Methods

b. Removable

c. Non-removable

C. Dose Rate Determinations

a. Selection of Detector and Instrument

b. Recordkeeping

5. Radiation Dosimetry

A. Dose Limits

a. NRC, Presidential Recommendations for Federal Employees

b. EPA Limits and Action Levels

B. Personnel Dosimetry

a. External

i. TLDs

ii. Filmbadges

iii. Pocket Dosimeters

C. Cumulative Dose and Annual Dose Reports

6. General Laboratory Practices

A. Sample Ordering and Inventory Procedures

B. Sample Receiving and Survey Procedures

C. Sample Transfers and Contamination Minimalization

D. Location and Use of Safety Equipment

a. Absorbent-Waterproof Backed Paper

b. Shielding Devices

c. Gloves and Labcoats

d. Fume Hoods

e. Respirators

E. Radioactive Waste Procedures

a. Types of Waste

b. Collection and Disposal Procedures

c. Sewer Disposal

i. Determination of Discharge Limits

ii. Chemicals

d. Packaging for Offsite Disposal

e. Overview of Dot Regulations

f. Record keeping

F. Accident Procedures

a. Spills Involving Radioactive Materials

b. Decontamination

c. Notification and Reporting

7. Risks Associated with Occupational Radiation Exposure

A. NRC-Regulatory Guide 8.29, "Instruction Concerning Risks From Occupational Radiation Exposure"

B. NRC-Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure"

8. Examination

9. Course Evaluation

Attendance to all sessions of the course is required. Missed segments may be "made up" within one week of the completion of the course. Successful completion of the course requires a grade of at least seventy percent on the comprehensive final exam. A re-exam may be taken within one week of the completion of the course. Failure to pass the re-exam will necessitate repeating the course to qualify for the training requirement.

As part of the overall training program, all employees involved in the use of radioactive materials and radiation-generating equipment are required to familiarize themselves with 10 CFR 20, Applicable National Institute of Standards and Technology Handbooks, NCRP publications, State and local regulations on radiation control, and 29 CFR 1910 with emphasis on parts 1910.96 and 1910.97. Employees must also familiarize themselves with NRC Regulatory Guides 8.13 and 8.29 during safety training and new employee orientation.

3.2 Ancillary Training

Ancillary personnel receive as a minimum a four hour safety training course. Included in this course are:

1. Proper procedures for working in a radiation laboratory.
2. Personnel protection including radiation exposure reporting and monitoring.
3. Possible health effects of radiation.
4. Exposure minimalization.
5. Radioisotope handling, storage, and waste procedures.
6. Emergency procedures and notification.
7. Individual laboratory procedures.
8. Radiation safety procedures as outlined in the Health and Safety Manual.

This initial training will be followed up with a health and safety annual refresher course.

3.3 Incidental Ancillary Training

Personnel who may enter the laboratory but do not work in that area, particularly support personnel (i.e. janitors, electricians, etc.), will receive a minimum one hour safety training course. Included in this course are the basics of radiation safety and what they may and may not do in the laboratory. This initial training will be followed up with an annual refresher.

3.4 Refresher Training

All personnel working in radiation laboratories will receive annual health and safety training pertinent to their work. This will be no less than a one half hour course in the case of incidental ancillary personnel and no less that a one hour course for radiation workers.

4. RADIATION MONITORING REQUIREMENTS

4.1 External Radiation Exposure

All laboratory workers who could receive significant occupational radiation exposure while conducting their duties will be issued a film badge or a TLD. This badge must be worn at all times when entering or occupying an area of potential radiation exposure. When not in use the badge will be stored in a manner such that it is not exposed to either ionizing radiation or excessive levels of non-ionizing radiation such that will adversely effect the exposure reading.

Film badges and TLD reports are kept on file at the Radiation Safety Office. The recorded doses will be furnished to individuals annually and upon written request (required by 10 CFR 19.13, "Notification and Reports to Individuals").

Other monitoring devises may be used if necessary for accurate assessments of exposure.

4.1.1 Radiation Dose and Exposure Records

Worker radiation dose and exposure records are generated and maintained to provide appropriate reports to the worker and to management. The dose records are kept on file at the Radiation Safety Office and are furnished to individuals on an annual basis and upon their written request, as required by 10 CFR 19.13, "Notification and Reports to Individuals".

4.2 Internal Radiation Exposure

Internal radiation exposure results from the ingestion, inhalation, or absorption of radionuclides into the body. Internal radiation monitoring is accomplished by performing in-vitro or in-vivo bioassay measurements. The principal bioassay techniques are: 1) Urinalysis; 2) Fecal analysis; 3) Nose swipes; 4) In-vivo organ counting; and 5) Whole-body counting.

4.2.1 Urinalysis

A baseline urinalysis is required of all personnel whose duties require entrance to laboratory areas where there is a potential for internal radiation exposure that can be detected by urinalysis. An example would be personnel working with significant quantities of tritiated compounds (> 10 mCi per

week). Urinalysis will not be performed on personnel exposed to sealed sources (unless they are determined to be actively leaking) or X-Ray producing devices.

Generally, the first voiding in the morning is used for the baseline measurement. Collection of urine samples is coordinated by the RSO and the analyses are performed by the RSO. The results of the urinalyses are maintained by the RSO and are included in the exposure data for the individual. For individuals suspected of receiving an internal exposure, coordination and follow-up of the urinalysis is conducted by the RSO.

Dependent on the radioisotope to be monitored and the means of exposure a 24 hour composite urine sample may be collected for analysis. This will be determined on an individual basis by the Radiation Safety Officer.

Examples of radionuclides measured in urine are thorium, tritium, strontium-90, radium-226 + 228, and plutonium 239 + 240.

4.2.2. Fecal Analysis

Fecal analyses are not performed routinely, but only when urine sampling is not adequate or appropriate to quantify the intake or dose for the radionuclide and/or chemical form of interest. Sample collection and analysis is coordinated by the RSO.

4.2.3 Nasal Smears

Nasal smears may be required from individuals who work in areas where there is a potential for an inhalation or particulate exposure to certain radionuclides. Nasal smears are often required from individuals after respirator use to check for positive evidence of ineffective respirator protection. If the analysis of nasal smears is positive, prompt decontamination measures and additional bioassay procedures may be necessary.

4.2.4. In-Vivo Monitoring

In-vivo monitoring (whole-body or partial-body counting) is the detection and quantification of radioactive materials in an individual's body by measuring the photons emitted from the body or organs within the body. Thus, it is sensitive only to photon- emitting radionuclides. Whole-body counting is often employed after a potentially contaminating event or as a follow-up to a positive result of another bioassay procedure. Partial-body counting of certain organs can indicate the body's overall burden of certain radionuclides. An example of this is radioiodine counting in the thyroid.

When a whole-body count of a worker is deemed necessary by the RSO, the logistics of obtaining the measurement is coordinated by the EPA Regional Radiation Program Manager or, in the case of a contractor, the RSO in conjunction with the contract management.

4.3 Laboratory Monitoring And Surveys

4.3.1 Instrument Surveys

The external radiation exposure in laboratory areas is monitored by conducting radiation surveys. Radiation surveys are conducted using Geiger-Mueller (GM) counters, ionization chambers, micro-R meters, BF_3 neutron counters, gas proportional counters, and alpha scintillation probes, as appropriate. These surveys are performed by

the RSO and trained EPA workers. The majority of surveys performed at the ERD are to measure beta exposures. Appendix F should assist in determination of the proper survey instrumentation.

When a survey is performed in a potentially contaminated area, the instrument and detector should be enclosed in a protective, disposable bag. Care should be taken so that the protective cover does not adversely affect instrument readings. For example, do not use a thin lead foil in an area where there is a chance of "hard" beta radiation. The beta interaction with the dense metal will produce bremsstrahlung (braking radiation), an X-Ray radiation. Also, do not shield detectors from low energy radiation sources such as tritium or carbon-14. A thin plastic bag can absorb significant quantities of radiation to adversely effect readings. When surveying alpha, beta, or low energy X-Ray radiation the sensitive portion of the probe must be uncovered.

Each person is responsible for monitoring his/her person, clothing, and shoes with the appropriate hand-held survey instrument before leaving an area if there is a potential for contamination. Please note that when monitoring for low energy beta emitting radioisotope contamination (ex. Tritium, C-14, etc.) wipe samples of areas of possible contamination are collected and analyzed by liquid scintillation counting. The Radiation Safety Office must be notified immediately if personnel contamination is detected.

4.3.2 Laboratory Monitoring

Radioactive surveys are to be performed by the researcher or his/her designee on a monthly basis, after each experiment, if the materials used exceed the total quantity specified in Appendix C of 10 CFR 20, and whenever necessary to determine contamination in the work area. Whenever work with radioisotopes is in excess of these levels, surveys are performed at the end of each work day. Indicated below are selected isotopes from the list that are commonly used in laboratories.

Material	Microcuries
Calcium-45	10
Carbon-14	100
Chlorine-36	10
Hydrogen-3	1,000
Iodine-125	1
Phosphorus-32	10
Sulfur-35	100

Copies of the monthly surveys and laboratory diagrams are kept by the researcher and reviewed by the Radiation Safety Officer during inspections. Surveys will include monitoring of laboratory bench tops, fume-hood surfaces, glassware, equipment, tools, etc.

The RSO shall have a floor plan of each laboratory that uses radionuclides. During the annual survey of each lab, the RSO will record on the floor plan all smear locations, significant exposure or count rates, and any other pertinent information. An example laboratory radiological survey form with a laboratory floor plan is shown in Figure 4-1. These are retained in the RSO's files.

The RSO will direct any changes or decontamination necessary as a result of the survey, and the personnel involved will be responsible for any required action. The RSO will perform special monitoring tasks, such as

taking necessary air samples and checking hoods and drains for radioactivity prior to repair.

Surface contamination, fixed plus removable, can be measured with a hand-held survey instrument that measures the appropriate type of radiation. The results are reported in units of disintegrations per minute per 100 square centimeters, dpm/100 cm^2 or mR/hr. The average dpm/100 cm^2 is obtained by measuring over an area no larger than a square meter. For an object with surface area less than 100 cm^2, the dpm is determined for the total surface of the object. Measurements reported in mR/hr will be reported in a simular manner.

Geiger-Mueller pancake probes that present a known active area to the surface (generally about 16 cm^2) and calibrated with National Institute of Standards and Technology (NIST) traceable standards are used to measure surface contamination for beta/gamma activity. The counts measured by the probe are converted to dpm/100 cm^2 by using the appropriate efficiency (cpm/dpm) and geometry (active probe area/100 cm^2) factors. Similarly, alpha surface contamination is monitored using an alpha-scintillation probe of known active area and calibrated using NIST traceable standards. Monitoring with both type probes should be conducted holding the probe within 0.5 cm of the surface.

Anytime a radiation survey is conducted in a potentially contaminated area, the instrument and detector (probe) should be bagged in plastic to prevent it from becoming contaminated. For gamma-ray surveys, the entire detector can be bagged in plastic; however, when surveying for alpha or beta activity, the sensitive portion of the probe must be uncovered. Although the surveyor should always take care not to touch even a covered detector to a potentially contaminated surface, special care must be exercised when using a probe with an uncovered detector surface.

An estimate of the amount of removable surface contamination per 100 cm^2 is also required. This is determined by wiping the suspected area with dry filter or soft absorbent paper (smear), applying moderate pressure, and assessing the amount of radioactive material on the smear with an appropriate instrument of known efficiency. Dry smears are not always appropriate for tritium; however, smears to detect removable alpha contamination must be dry, as the moisture will attenuate the alpha particles and result in a false negative. When removable contamination is found on objects having a surface area less than 100 cm^2, the activity per unit area should be based on the actual area and the entire surface should be wiped.

Smears are analyzed by using a liquid scintillation counter, calibrated low-background proportional counter, or a scaler with either a zinc sulfide (ZnS(Ag)) screen to evaluate the gross alpha activity or a G-M tube and tray to measure the gross beta/gamma activity. Analyses for low-energy beta emitters like H-3 and C-14 must be performed by liquid scintillation analysis.

Personnel performing contamination surveys must wear adequate protective clothing (at least, but not limited to, lab coats, safety glasses, and protective gloves) while performing the survey.

There may be instances when airborne particulate data are required to detect and evaluate airborne radioactive material in laboratory work locations (particularly with respect to the potential for inhalation exposure), to determine the need for respirator protection, and to assess the control of airborne radioactive material in the workplace as part of the ALARA program. Air particulate samples may be required:

1. in occupied surface-contaminated areas

2. during work which has the potential to cause airborne radioactivity

3. when opening a container to the atmosphere which might release radioactivity

4. whenever airborne radioactivity is observed or suspected

5. whenever requested and justified by a project manager or the branch chief

All airborne sampling and analysis for radioactivity at a laboratory must be approved by the RSO and conducted under the supervision of the RSO, SHEM, or an alternate. Adequate operable air sampling equipment must be maintained by the RSO and/or the SHEM at the laboratory at all times.

5. RADIATION EXPOSURE LIMITS AND ACTION LEVELS

5.1 Exposure Limits

It is EPA's policy that radiation protection programs are designed and implemented to comply with the dose limitation system in Federal Guidance Report No. 11. In accordance with "Standard Operating Safety Guides," the system of dose limitation is established under this plan at locations where external exposure to gamma radiation may exceed 10 to 20 uR per hour above natural background, and at locations that are known or suspected to contain radionuclides in excess of ubiquitous man-made levels or elevated levels of naturally occurring radionuclides.

In keeping with the system of dose limitation, it is EPA's policy that EPA worker radiation protection programs provide assurance that no EPA worker, during the routine performance of duty, will receive a total internal (committed effective dose equivalent) plus external whole body dose exceeding 500 mrem (5 mSv) per year (see Glossary). This policy does not apply to planned special occupational exposures or emergency occupational exposures. The basis and rational for the 500 mrem (5 mSv) per year limit is provided in Appendix C.

This limit is significantly less than that under which a laboratory is licensed by the NRC, 5.0 rem/yr (50 mSv/yr) to the whole body. However, the exposure limit to EPA laboratory workers will be 500 mrem (5 mSv) per year.

5.2 Action Levels For Upgraded Response{tc \l 25 ".2 Action Levels For Upgraded Response"}

Action levels are established to: 1) trigger health physics coverage at locations where workers are potentially exposed to elevated levels of radiation or radioactive materials; 2) ensure that no individual receives radiation doses in excess of 500 mrem (5 mSv) per year; and 3) maintain exposures ALARA.

The following action levels for upgraded protection are required, at a minimum, to preclude exposures exceeding 500 mrem (5 mSv) per year and to ensure exposures ALARA.

If measured levels of airborne radioactivity exceed background, bioassay programs should be initiated and protection of personnel upgraded to Level C (i.e., full face, negative pressure, air purifying canister). For the purpose of assessing the radionuclide intake rate in Level C, a decontamination factor of 50 should be assumed for particulates. However, for tritium, the DF should be assumed to be 1.

If measured levels of airborne radionuclides exceed 5 times the Derived Air Concentrations (DACs), personnel protection should be upgraded to pressure demand self-contained breathing apparatus (PD-SCUBA). For the purpose of assessing the radionuclide intake rate in PD-SCUBA protection, a decontamination factor of 10,000 should be assumed. However, for tritium, the DF should be assumed to be 2.

If the external gamma dose rate exceeds 0.25 mrad/hr (2.5 μGy/hr), self- reading pencil dosimeters must be issued and a daily record of exposures maintained. TLDs or film badges may be used if appropriate.

If monitoring programs indicate that an individual received more than 50 mrem (0.5 mSv) in a quarter, the RSO is required to investigate and document the cause of the exposure and, in consultation with the Laboratory Director and appropriate program managers, determine and document whether the exposure is consistent with the person's responsibilities or whether corrective actions are warranted. The laboratory's measurements and personnel monitoring data that would indicate that the 50 mrem (0.5 mSv) per quarter action level may have been exceeded are as follows:

1. Quarterly TLD readings for penetrating radiation in excess of 50 mrad (0.5 μGy).

2. Cumulative daily self-reading pocket dosimeter doses approach 50 mrad (0.5 μGy) within a 13-week period.

3. Bioassay measurements that indicate radionuclide intake during the quarter in excess of 1 percent of the Annual Limit Intake (ALI) in Table 1 of Federal Guidance No. 11.

4. Airborne sampling and measurements that indicate average airborne radionuclide concentration at worker locations, in Level D protection, during the quarter, in excess of 1 percent of the Derived Air Concentrations (DACs) in Table 1 of Federal Guidance No. 11.

5. Airborne sampling and measurements that indicate average airborne radionuclide concentration at worker locations, in Level C protection, during the quarter, in excess of 1/2 the Derived Air Concentrations (DACs) in Table 1 of Federal Guidance No. 11

6. Airborne sampling and measurements that indicate average airborne radionuclide concentration at worker locations, in PD-SCUBA protection, during the quarter, in excess of 100 times the Derived Air Concentrations (DACs) in Table 1 of Federal Guidance No. 11.

6. GENERAL PERSONNEL PROTECTION

6.1 Protective Clothing and Equipment{tc \l 26 ".1 Protective Clothing and Equipment"}

Protective clothing, including but not limited to a laboratory coat, gloves, and safety glasses, must be worn when working with radioactive materials. These items must not be worn outside the laboratory (e.g. in offices, rest rooms, administrative areas, etc.), except when transferring samples or reagents between labs or to storage areas.

Lab coats worn during work with radioactive material must be monitored before being returned to the laundry.

6.1.1 Levels of Protective Clothing
{tc \l 36 ".1.1 Levels of Protective Clothing
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Upgraded protective clothing may be required by the RSO or SHEM to shield or isolate an individual from radiological or chemical hazards that may be encountered during a survey, inspection, work assignment, accident, or clean-up operation. The EPA has established four protection levels based on specific conditions. These

protection levels have been adopted at many radiological facilities and sites. The protection levels are defined below (EPA85; EPA88a).

Level A:

1. Fully encapsulating suit
2. Self-contained breathing apparatus (SCBA)
3. Chemical-resistant, steel toe, and shank boots
4. Boot covers
5. Inner and outer gloves
6. Hard hat (optional)

Level B:

1. One piece, hooded, chemical-resistant splash suit
2. Self-contained breathing apparatus (SCBA)
3. Chemical-resistant, steel toe, and shank boots
4. Boot covers
5. Inner and outer gloves
6. Hard hat (optional)

Level C:

1. One piece, hooded, chemical-resistant splash suit
2. Air purifying respirator with appropriate cartridge
3. Chemical-resistant, steel toe, and shank boots
4. Boot covers
5. Inner and outer gloves
6. Hard hat (optional)

Level D:

1. Coveralls
2. Gloves (optional)
3. Chemical-resistant, steel toe, and shank boots (when appropriate)
4. Safety glasses and chemical splash goggles (optional)
5. Boot covers (optional)
6. Hard hat (optional)

Procedures for donning and doffing protective clothing are provided in EPA Field Standard Operating Procedures (FSOP) Number 4 - Site Entry (EPA85).

An effective program must address the human element. The work environment temperature dramatically affects the worker wearing protective clothing. The resistance to breathing offered by respirators and the appreciable weight of some units define the amount of time that respirator protection can be used daily. Other factors, such as the need for flexible clothing that will not impede movement or limit body action, influence the selection of protective equipment. Acknowledgment of the human stress factor is important, for it will determine the amount of

cooperation and strict adherence to the safety guidelines that can be expected from the worker.

Conditions within a work area should be continuously monitored and the level of protection upgraded or downgraded based upon a change in area conditions or findings of investigations.

All protective clothing and equipment, including respirator maintenance, will be provided by the laboratory Safety, Health, and Environmental Manager (SHEM).

6.1.2 Respiratory Protection{tc \l 36 ".1.2 Respiratory Protection"}

If the source of airborne contamination cannot be eliminated, respiratory protection is required. The protective action levels for respirator use are discussed in Section 5.2. Respiratory protection should also be considered if there is a potential for airborne contaminants due to the nature of the work.

There are two basic categories of respiratory protection: air purifying protection and air-supplied protection. The former filters the breathing atmosphere by removing the hazardous components. Restrictions on air purifying protection include the following (DOE87):

1. The contaminant must be positively identified both qualitatively and quantitatively

2. An approved filtering device that can effectively remove the contaminant of concern must be selected

3. Continuous air monitoring of the work area must be performed to ensure that the capability of respiratory equipment is not exceeded

4. The oxygen concentration must be monitored when the work area is a confined space to ensure that it does not fall below prescribed levels (i.e. 19.5 percent)

Air-supplied respiratory protection is the highest level of respiratory protection. However, most air tanks supply only 30 minutes of air under ideal conditions, presenting a possible logistical problem, and they can be very stressful if used over long periods.

Requirements for respirator use include annual fit testing, periodic (biennial) retraining, and annual physical examinations by a qualified physician. EPA workers using a full-face air purifying respirator must have successfully passed a respirator fit test within the last 12 months. Documentation of satisfying these requirements is maintained by the RSO and SHEM. The SHEM is responsible for planning, coordinating, and scheduling of these requirements.

6.2 Personal Precautions

The potential risk posed by radiological hazards in laboratory areas is minimized by imposing various restrictions. The following controls will be strictly observed by all EPA workers in laboratory areas.

1. Keep all laboratories neat and clean. Keep all work areas free of equipment and materials not required for the immediate procedure.

2. Wash hands and arms thoroughly before handling any object that goes to the mouth, nose, or eyes. Hands

must be washed whenever leaving the laboratory after handling radioactive materials, e.g., before taking samples to the counting room. Hands must be monitored whenever contamination is suspected and decontaminated immediately, if necessary.

3. Do not work with radioactive materials if there is a break in the skin below the wrist unless the wound is so protected that radioactive materials cannot gain access to the body. Cover the break with tape (plastic or adhesive) and wear a rubber glove.

4. Eating is not allowed in any chemistry laboratory, the sample preparation room, or any area where radioactive materials are used. Food containers are not permitted in the laboratory work areas. Refrigerators shall not be used jointly for foods and radioactive materials, samples, or chemicals.

5. Smoking or chewing tobacco is not allowed in any laboratory area.

6. Non-experimental animals are not allowed in any work area.

7. No children under the age of 18 are allowed in laboratories or other areas where radioactive materials are present without the prior approval of the RSO.

8. Loitering in radiation areas or in the sample receiving and preparation room is prohibited.

9. Alcoholic beverage and illegal drug consumption is prohibited in all areas of the Laboratory.

10. Personnel returning to work following tests or therapy with radioisotopes require a physician's concurrence.

11. All posted, written, and verbal radiological control instructions must be obeyed.

6.3 Medical Monitoring

Individuals who in the performance of their duties must encounter situations or materials which may present a potential health hazard must undergo medical examinations to determine, to the extent possible, the degree to which such activity may alter their health status. The medical monitoring program determines the medical status of employees who wear respiratory protection or encounter heat and physical stress in the work place.

A baseline medical examination is required prior to employment for work in radiochemical laboratories. Baseline bioassay (urine) measurements are required at that time (see Section 4.2.1)if deemed necessary. Annual physical examinations are required during the employment period. An advising physician can require periodic physicals at shorter than 12-month intervals. These examinations are mandatory for wearing respiratory protection and must be documented. At employment termination, an exit physical examination is required, which may again include bioassay measurements. Except for differences in the bioassay measurements, the medical monitoring requirements for entering a radiological area are no different than requirements for entering any hazardous materials area.

Individuals are entitled to seek medical attention and testing as a follow-up to injury or possible exposure above established EPA exposure limits.

7. ACCIDENT PROCEDURES

The emergencies most likely to be encountered at a radiation laboratory are spills, fires, or explosions that can cause radioactive materials to be spread around the laboratory. These procedures are general; any specific emergency will call for adaptations and changes.

7.1 Spills

The preferred practice is to prevent or, at a minimum, contain any spill that occurs. The following procedures should be followed, when appropriate, to reduce the risk of spills and contamination of the work place.

1. Use double containers and/or leak proof trays when transferring radionuclides in solution from one area to another. A cart should be used when transferring samples between laboratories.

2. Use protective coverings and lids.

3. Use unbreakable containers to store radionuclides, if possible.

4. Use extreme caution in transfers -- try a dummy run to test the procedure.

5. Use a glove box or hood for dusty materials and operations.

6. Do not pipette by mouth. Use rubber bulbs, syringes, or pipettors.

7. Always plan the procedure to be used. Know what you are going to do before you do it and have a safety plan developed before beginning work.

8. Use absorbent water proof backedpaper to cover the working area to absorb the radioactive materials in the event of a spill, and replace it when it gets wet or torn.

9. Check for contamination with lab survey instruments and/or smear the work area after completing procedures where contamination may have occurred.

10. Store liquid radioactive materials in trays capable of containing the entire volume should a spill or breakage occur.

11. Notify the RSO immediately in the event of a spill containing radionuclides.

7.1.1 Minor Spill Procedures

Minor spills involving no radiation hazard to personnel.

1. Immediately notify all other persons in the room.

2. Notify the SHEM and RSO. The RSO will verify that no radioactive materials were involved in the spill.

3. Permit only the minimum number of persons necessary to deal with the spill into the area.

4. Confine the spill immediately.

Liquid Spills

- Consult the Material Safety Data Sheets (MSDS) for required protective clothing and equipment.
- Don protective gloves, lab coat, shoe covers, and respirator as required.
- Maximize ventilation in the room.
- Dam the spill with absorbent material.
- Neutralize as required.
- Drop absorbent paper on the spill.

Dry Spills

- Consult MSDS for required protective clothing and equipment.
- Don protective gloves, coveralls, and respirator as required.
- Dampen thoroughly, taking care not to spread the contamination. (NOTE: Water may generally be used except where chemical reaction with the water would generate an air contaminant or excessive heat. Consult MSDS for appropriate wetting agent.)

5. Decontaminate the area. (NOTE: Disposal plan for decontamination materials must be approved by the RSO and SHEM. See Section 12.)

6. Monitor all persons involved with the spill and clean-up operations.

7. A complete history of the accident and subsequent remedial or protective measures must be submitted to the SHEM, RSO, and the Laboratory Director as soon as possible.

7.1.2 Major Spill Procedures

Major spills involving potential radiation hazard to laboratory personnel.

1. Notify all persons not involved in the spill to vacate the room at once. Limit the movement of displaced persons to confine the spread of contamination.

2. Notify the RSO and SHEM as soon as possible.

3. Evaluate the non-radioactive hazards associated with the spill. If required, consult MSDS for appropriate action.

4. If the spill is on the skin, flush skin thoroughly with tepid water and wash with soap and water.

5. If the spill is on clothing, monitor and/or discard outer or protective clothing at once.

6. Take immediate steps to decontaminate personnel involved, as necessary.

7. Decontaminate the area (see Section 12).

8. A complete history of the accident and subsequent remedial or protective measures must be submitted to the SHEM, RSO, and the Laboratory Director as soon as possible.

Personnel involved in decontamination must use adequate protective equipment to avoid the risk of external and/or internal contamination.

7.2 Injuries To Personnel Involving A Radiation Hazard

1. Wash minor wounds immediately under tepid running water.

2. Report all radiation accidents in which personnel are involved (wounds, over-exposure, ingestion, inhalation) to the RSO as soon as possible.

3. If deemed necessary, the Laboratory Administrative Officer, RSO, SHEM or Laboratory Director will call a physician qualified to treat radiation injuries.

4. No person involved in a radiation injury shall return to work without the approval of the attendant physician and the RSO.

5. Prepare a complete history of the accident and subsequent related activity and submit to the RSO and SHEM.

7.3 Fires Or Other Major Emergencies

1. Immediately notify all other persons in the room and building and then evacuate, if necessary.

2. Notify the SHEM and the RSO who, in turn, will notify the fire department of any radiological hazard, if necessary.

3. Monitor all persons involved in combating the emergency.

4. Following the emergency, the RSO will monitor the area and determine the protective devices necessary for safe decontamination.

5. Decontaminate (see Section 12).

6. No person shall return to work without the approval of the RSO and SHEM.

7. Prepare a complete history of the emergency and subsequent related activity and submit to the RSO, SHEM, and the Laboratory Director.

8. RADIOACTIVE MATERIALS HANDLING

The following practices are to ensure the safety of all personnel involved in the receipt, preparation, and analysis of radioactive samples. These practices must be followed for all samples received and analyzed at an EPA laboratory. For the purpose of this document "**package**" is defined as the shipping container in which a sample is received and "**sample container**" is defined as the inner container that provides the primary containment of a particular sample.

Only personnel having approved and documented training by the Radiation Safety Officer (RSO) may receive and sign for samples.

8.1 Accepting Delivery Of Packages

Samples can be received only at a designated loading dock area which should be in close proximity to the sample preparation area. Samples brought to any other location by a carrier must be redirected to the appropriate loading dock. Samples are never accepted in the lobby. All packages labeled RADIOACTIVE-I, II, or III (see Appendix D) require immediate notification of the RSO or the alternate RSO.

In the event that the RSO or alternate RSO are unavailable, individuals designated as authorized users and/or supervisors of users of radioactive materials in the laboratory NRC license (maintained by the RSO and the Office of the Director) can be consulted for assistance.

A sample packing slip or manifest is required and must be presented at the time of receipt, and the approximate activity of the shipment should be compared to the approved purchase request or other documentation. If the total activity of the shipment exceeds the quantity requested, the RSO or alternate RSO should be called prior to acceptance of the package from the carrier.

Packages suspected to contain leaking sample containers should be placed in plastic bags and/or on plastic trays as soon as practical before entering the sample preparation area. The RSO or alternate RSO must be notified for assistance.

8.2 Package Monitoring

8.2.1 Exceptions

All packages containing samples for analysis received at an EPA laboratory must be monitored for external contamination and surface exposure rate except:

1. packages known to contain routine environmental samples
2. packages known to contain bioassay samples
3. Packages known to contain only radon and associated decay products in charcoal media

8.2.2 Removable Contamination Survey

The level of non-fixed radioactive contamination on a package or sample container must be determined by wiping an area of 100 square centimeters (10 cm x 10 cm or approximately 4 in x 4 in) of the external surface with an absorbent material or "smear," and performing radioanalytical analysis of the smear.

Care must be taken during the analysis of smears for the presence of alpha emitters and very low energy beta emitters such as tritium. When performing alpha analysis on smears, it is essential that the smear is dry. A wet smear will prevent the detection of the alpha particles and result in a false negative. The detection of low energy beta emitters like tritium and carbon-14 must be performed by liquid scintillation analysis of the smear. Personnel performing the contamination survey should don adequate protective clothing (at least, but not limited to, lab coat,

safety glasses, and appropriate gloves) before performing the survey.

8.2.2.1 Procedure

1. Select the most appropriate location on the package or sample container to yield a representative assessment of the non-fixed contamination present. The bottom, sides, and around the opening are usually appropriate.

2. Using moderate pressure, wipe an area of approximately 100 square centimeters (4" x 4") with a cotton or paper smear.

3. Complete the information requested on each inventory sheet.

4. Analyze the smear in the appropriate instrument for a predetermined time, usually 2 to 5 minutes.

The count rate of the smear is converted to dpm/cm^2 by dividing the count by the efficiency.

The amount of removable radioactivity on a single smear is compared to action levels in order to determine the required action. Contamination survey action levels used at EPA's Ecosystems Research Division are given in Table 8-2.

Table 8-2. Contamination survey action levels.

Contaminant	Permissible Limit	Action Required
alpha emitting radionuclides	2.2 dpm/cm^2 (220 dpm/100 cm^2)	if greater than, contact RPO
beta/gamma emitting radionuclides	22 dpm/cm^2 (2200 dpm/100 cm^2)	if greater than, contact RPO

If removable alpha contamination exceeds 220 dpm/cm^2 or beta/gamma contamination exceeds 2200 dpm/100 cm^2 of package surface, the RSO or the alternate RSO must notify the carrier, the shipper, the NRC, and the Department of Transportation (DOT).

8.2.3 Exposure Rate Survey

An external exposure rate survey of the package is required within three (3) hours after the package is received. This survey is performed to detect possible violations of Department of Transportation (DOT) packaging and labeling regulations, as well as to determine the possible presence of gamma and some beta emitting radionuclides that may require special handling. This data must be included on the inventory form.

8.2.3.1 Procedure

A measurement of the exposure rate of a package surface will be conducted on all package sides by placing the appropriate probe within 0.5 cm of the surface and moving the probe along the package at a rate not to exceed 10 centimeters per second. The exposure rate survey should be conducted initially with the meter on the lowest scale

setting and fast response time. Adjust the scale upward as required to maintain the readings on the scale. After surveying each side, the exposure rate shall be written on the side of the surveyed package. A background measurement must be taken at the location prior to monitoring the package.

For all packages with net exposure rates greater than 0.1mR/h, the maximum exposure rate measured shall be written on the Laboratory Project/Sample Acceptance Form (see Appendix A). If the external exposure rate exceeds 0.5 mrem/hr, as measured with an energy compensated G-M counter or NaI-μR meter, notify the RSO.

All packages marked with a RADIOACTIVE I, II, or III label (see Appendix D) shall also have an exposure rate survey at a distance of one (1) meter from each side of the package and the measurement results are recorded on the Project/Sample Acceptance Form.

Hold the probe one (1) meter from the surface of the package and allow the meter to stabilize for at least 20 seconds before recording the measurement, then move on to survey another side of the package. Note the exposure rate above background for all sides, top and bottom and record the maximum reading. Note the background exposure rate at that location and ensure that no other packages or containers contribute to the exposure rate due to their contents.

If the exposure rate exceeds the level for the particular type of labeling (see Appendix D), record this on the Project/Sample Acceptance Form and notify the RSO or the alternate RSO.

8.3 Container Monitoring

After packages have been monitored, all samples except the type samples outlined in Section 8.2.1 will be removed from their shipping package in a fume hood. When it is not possible to place the shipping container in a fume hood, contact the RSO for guidance.

8.3.1 Removable Contamination Survey

The External surface of each sample container in a package shall be smeared as described in Section 8.2.2, and the activities compared to those outlined in Table 8-2 to determine the required action. This must be done within 3 hours of receipt.

8.3.2 Exposure Rate Survey

A sample container exposure rate measurement must also be made on the external surface of each sample container as described in Section 8.2.3. The exposure rates measured should be compared to those listed in Table 8-3 for determining levels of containment required for opening individual sample containers.

Table 8-3. Exposure-rate survey action levels for opening containers.

Exposure Rate	Action Required
< 100 uR/hr	- Routine sample preparation procedures - Fume hood required

> 100 uR/hr < 2 mR/hr	- Sample preparation must be performed in a fume hood with HEPA filtration
> 2 mR/hr < 10 mR/hr	- Notify RSO
	- Sample preparation must be performed in a glove box

8.4 Sample Screening

After a sample has been received and checked for external contamination and exposure rates, the sample container may be opened in the appropriate containment system (hood, glove box, etc.) as determined by the initial surveys.

If samples are routinely received, a sample screening guide should be created and used to determine appropriate handling and analysis procedures for each individual sample or group of samples of similar activity and origin.

8.5 Procurement Of Radioactive Materials

All purchase orders for radioactive materials must be approved by the RSO in order to properly maintain an inventory of radionuclides at the laboratory. Materials donated or otherwise obtained outside of the normal procurement process must be approved by the RSO or alternate RSO for receipt prior to being shipped to ERD. For all work involving radioactive materials in a solid, liquid, or gas state, other than the use of electron capture detectors, a Health and Safety Research Protocol (HASP) must be on file (see Appendix A). Updates to the inventory are made regularly to include new or deleted isotopes. Employees must inform the RSO of expected changes in the source inventory. The source inventory includes ID number, radionuclide, date of entry, activity (e.g., uCi/ml, uCi/g), amount (e.g., milliliters, grams), location (e.g., room number), half life, and comment.

The procedure for procuring radionuclides is as follows:

1. Discuss all requests for radionuclides with the RSO prior to procurement to determine compliance with NRC/Agreement State license limits and the method of handling, storing, monitoring, and disposing of the material during and after use. All other safety precautions that are to be observed during handling should also be determined.

2. Have the purchase requisition approved by the RSO, and provide a copy of it to him or her.

3. All radionuclides will be delivered to the RSO or designee, who, in turn, will notify the purchaser. Radionuclides must be stored in clearly marked storage areas that have been designated as such by the RSO.

8.6 Storage Of Radioactive Materials

Radioactive materials must be stored so that the measured ionizing radiation level in areas occupied by personnel is less than 100 uR/h (50 mR/quarter÷ for a standard 520 hour work quarter. Areas where radioactive materials are stored must be properly designated and posted as low-level radioactive materials storage areas. These areas, indicated by the radiation symbol, may include the research laboratories and the hazardous materials storage areas.

If additional storage space or shielding is needed, arrangements must be made with the RSO.

8.7 Packaging, Transfer, And/or Shipment Of Radioactive Materials

The RSO will package all radioactive materials for shipment off-site in compliance with the applicable requirements stated in 10 CFR 71, "Packaging and Transportation of Radioactive Materials," and 49 CFR 173 Subpart I, "Radioactive Materials." All transfers of source and by-product material or radioactive waste shipments will also be performed by the RSO. A copy of the receiving institute or facility's license (state or federal) or statement that indicates their ability to possess the material must be on file at the Laboratory prior to shipment.

9. RADIATION-PRODUCING EQUIPMENT

Listed below are recommendations for the use of radiation-producing machines at an EPA laboratory.

a) Notify the RSO of any installation or change in an existing installation of any radiation-producing machine prior to its use. Before start-up, arrange for monitoring equipment and other necessary safety procedures during operational periods.

b) All radiation-producing equipment at the laboratory shall be operated by trained, qualified personnel only.

c) When operating an X-ray machine, dosimeters must be worn by the operator and all other individuals in the area.

d) Current radiation warning signs must be placed to prevent unauthorized personnel from entering the radiation area. In certain instances, other precautions, such as changing card key access to the room the installation of automatic safety devices, may be recommended by the RSO.

e) The operator must never expose himself/herself to the direct beam of an X-ray machine, and must not enter any room while an X-ray machine is operating unless adequately shielded.

f) Observe all restrictions on the use of the machines as recommended by the RSO.

10. RADIOACTIVE WASTE DISPOSAL

All process wastes generated at the laboratory must be analyzed for radioactivity prior to disposal. This is necessary in order to comply with state and federal regulations concerning disposal of radioactive materials by release into the sanitary sewer system, disposal by incineration, or transfer of the waste to a licensed land disposal facility.

It is the responsibility of the employee who generates radioactive waste to notify the RSO when there is a need for disposal. The RSO must be provided with a list of chemicals, concentrations, the volume, and the total activity of the nuclides present. If the concentrations are not known, it is the responsibility of the employee to have the waste analyzed. (see Section 10.2.)

10.1 Solid Low-level Radioactive Wastes

All laboratories that produce solid radioactive waste must be provided with a clearly labeled radioactive waste can.

Each can will be lined with a plastic waste bag (available from the RPO). The bag will be labeled to show the radionuclides present in the waste, the dates of waste accumulation, and the lab in which it was generated. When the solid waste bags are filled, or if the exposure rate at the surface of the waste can exceeds 0.25 mR/h, the RSO, or the alternate RSO, will be contacted to remove the waste from the lab.

Solid wastes should be stored on site in 55-gallon drums until a sufficient volume has accumulated for a radioactive waste shipment to ultimate disposal at a licensed low-level radioactive waste disposal facility.

10.2 Wastes Requiring Analysis

All waste streams must be characterized in order to determine an appropriate means of disposal. Before a new project or process can be initiated, the project officer or branch chief managing the project must present a plan for waste disposal to the RSO. This plan must include a waste volume estimate, the anticipated activity of the waste (specific and total), and the number and frequency of waste samples to be analyzed in order to provide the RSO with adequate information on which to base waste disposal decisions.

When historic data are available for a particular group of samples and the waste streams have been previously analyzed, it may be possible to analyze the waste streams using a representative percentage of samples to verify previously observed trends. When these data are not available, a representative sample from all waste streams must be collected for analysis. Sample screening data, obtained after sample receipt, can be used to select an appropriate sample for waste stream analysis. Samples suspected of containing the highest concentrations of radioactive materials should be selected for waste stream characterization.

10.2.1 Solid Waste Analysis

The analysis of solid wastes (precipitates, resins, soil residue, etc.) may be performed as follows.

1. Deposit approximately 0.1 g of resin, precipitate, soil, etc. on a 2-inch diameter filter or directly on a 2-inch planchet. If a filter is used, place the filter on a 2-inch diameter planchet.
2. Allow the sample to dry under a heat lamp at moderate temperature.
3. Place the sample in a desiccator.
4. Submit the sample to the Radiation Safety Officer for analysis.
5. If a sufficient amount of sample is available, place 10 ml of the dried material in a glass liquid scintillation vial and submit for gamma spectral analysis.
6. Alternatively, samples may be analyzed by liquid scintillation counting. Consult the RSO for proper procedures and approval.

10.2.2 Liquid Waste Analysis

The analysis of liquid wastes (waste acids, solvents, wash waters, etc.) may be performed as follows.

1. Place a 1-mL aliquot of the liquid on a 2-inch planchet.
2. Allow the sample to dry under a heat lamp at moderate temperature.
3. Place the sample in a desiccator.
4. Submit the dried sample to the Radiation Safety Officer for gross alpha/beta analysis.
5. Place 20 ml of the liquid in a scintillation vial and submit the vial to the counting room for specific gamma analysis.

6. Alternatively, samples may be analyzed by liquid scintillation counting. Consult the RSO for approval.

10.2.3 Reporting Waste Analysis Results

All waste analysis results submitted to the RSO must be in writing. A copy of the results will be returned to the employee with recommendations for disposal after evaluation by the RSO. If the waste requires offsite disposal, the RSO will make the appropriate arrangements.

10.3 Waste Disposal

After proper characterization, radionuclides at the laboratory are disposed of by the RSO or the alternate RSO in the following manner:

1. Decay - Disposal by decay is not permitted at ERD

2. Sewer Disposal

   If the radionuclide is water soluble and contains no hazardous constituents, it may be flushed down the drain, provided the activity does not exceed maximum permissible discharge limits specified in 10 CFR, Part 20.2003. If a liquid waste cannot be disposed of by discharge to the sanitary sewer, it will be delivered to the RSO with proper documentation.

A permanent record of all radioactive waste disposals must be maintained on file in the offices of the RSO and the Laboratory Director.

11. POSTING RADIATION AREAS AND LABELING CONTAINERS

11.1 Posting Radiation Areas

1. External Radioactivity - The access to any area or laboratory where radionuclides are used or stored or where radiation-producing machines are operated must be clearly and conspicuously posted with the universal radiation sign. These areas must have controlled access.

2. Airborne Radioactivity - The access to any area or laboratory in which there is a potential for airborne radioactivity must be clearly and conspicuously posted with a sign that identifies the radiological conditions.

3. Surface Contamination - Access to any area or laboratory in which surface contamination levels exceed background must be clearly and conspicuously posted with a sign that identifies the radioactive contaminant and level of contamination.

11.2 Labeling Containers

1. All containers containing radioactive materials in a laboratory must be clearly labeled, providing the radionuclide, the quantity (uCi) or concentration (uCi/mL) of radioactivity, the volume (mL) or mass (g) present, and the media (e.g., 0.1N HCl).

2. All radioactive sources must be labeled, providing the isotope, type of radiation, and the source strength.

3. The labeling requirements for radioactive material packages and radioactive waste containers are provided in sections 8 and 10, respectively.

11.3 Posting For Hazards Other Than Radioactivity

Posting for safety considerations other than for radioactivity, as required by OSHA, is the responsibility of the Laboratory Safety, Health, and Environmental Manager (SHEM).

12. DECONTAMINATION

12.1 Cleanup

The RSO shall be called for assistance, as soon as practical, whenever a contaminating event (e.g., spill) occurs. The first consideration after personnel safety is to stop the spread of radioactive materials and to start decontamination. Many factors must be considered, including tracking of contamination by personnel, movement of contamination by air currents (hoods, fans, etc.), water, dusting, mopping, and other physical actions.

Successful decontamination calls for planned action. A spur-of-the-moment action or attempt at decontamination can be counter productive. The RSO or the alternate RSO must approve the decontamination plan prior to its implementation.

During cleanup, make full use of instruments and available assistance. Each step of the decontamination process should be monitored. One person should remain at the perimeter of the contaminated area to operate instruments and do other monitoring. Instruments required in the contaminated area must be bagged to minimize the risk of becoming contaminated. Protective clothing, footwear, gloves, and respirators should be used as directed by the RSO during all decontamination efforts.

12.2 Personnel Decontamination

Protective clothing and respirators help prevent the wearer from becoming contaminated or inhaling contaminants. Good work practices help reduce contamination on protective clothing and equipment.

Upon exiting a contaminated area, personnel must be monitored with appropriate survey instruments for radioactive contamination (see Section 4.3.1). If contamination is detected, decontamination measures are implemented. Such measures include: a) removing contaminated articles of clothing; b) scrubbing contaminated areas with soap and water; and c) rinsing thoroughly with water. The RSO or the alternate RSO shall provide guidance during decontamination. In no case are decontamination procedures implemented during a medical emergency if they may aggravate or cause more serious health effects. Prompt life saving first aid and/or medical treatment take precedent over decontamination procedures.

12.3 Equipment Decontamination

All equipment and instruments removed from a contaminated area must be monitored with the appropriate survey instrument(s) for radioactive contamination. In addition, the analysis of smears taken over a predetermined area of the equipment (usually 100 cm^2) is used to detect removable contamination. Equipment contaminated in excess of background must be decontaminated before removal.

Dry cleaning methods (mechanical removal of material) are often implemented prior to liquid cleaning. When dry methods fail to reduce contamination to acceptable levels, equipment must be washed and rinsed with water or, if necessary, special decontaminating solutions. Storing equipment in a relatively uncontaminated area and allowing radioactive decay to reduce the level of contamination is an acceptable procedure for removing short-lived radionuclides. All liquids generated during decontamination procedures must be collected and stored for later analysis to determine if they can be released to the sewer or must be treated for future disposal (see Section 10). Thus, liquid wastes generated from decontamination procedures must be kept to a minimum. In some instances, it may be judged more appropriate to dispose of a contaminated article rather than attempt to decontaminate it.

12.4 Decontamination Records

Complete records must be made of each decontamination event . Copies must be sent to the RSO. In most cases, the RSO will be involved, so a joint report can be filed. A post accident survey and a verification survey after decontamination shall also be included in the report. If required, the Laboratory Director will notify the NRC.

13. EMERGENCY/CONTINGENCY PLANS

The emergency plan for an EPA laboratory, as well as pre-emergency planning and drills, is the responsibility of the Laboratory Safety, Health, and Environmental Manager (SHEM), and should be on file in the offices of the SHEM, RSO, and the Division Director.

REFERENCES

DOE87 Department of Energy, "The Environmental Survey Manual", U.S. Department of Energy, Office of the Assistant Secretary, Environment, Safety, and Health, Office of Environmental Audit, DOE/EH-0053, Vol. 1, August 1987.

EERF89 Eastern Environmental Radiation Facility, "Site Safety Plan For Desert Glow Operations", Eastern Environmental Radiation Facility, Office of Radiation Programs, USEPA, Montgomery, AL, June 1, 1989.

EPA SHEMD Guide 38 Radiation Safety and Health Protection Program, Safety, Health & Environmental Management Division, March 2006

EPA85 Environmental Protection Agency, "Field Standard Operating Procedure (FSOP) Number 4 - Site Entry", Office of Emergency and Remedial Response, Hazardous Response Support Division, 1985.

EPA86 Environmental Protection Agency, "1440- Occupational Health and Safety Manual", U.S. Environmental Protection Agency, Office of Administration, 1986.

EPA88a Environmental Protection Agency, "Personnel Protection And Safety Course-165.2", Course Manual, July 1988.

EPA88b Environmental Protection Agency, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion", Federal Guidance Report

No. 11, U.S. Environmental Protection Agency, EPA 520/1-88-020, September 1988.

NAREL91 National Air and Radiation Environmental Laboratory, "Radiation Safety Manual", Office of Radiation Programs, USEPA, January 1991 (Rev. 1).

NRC75 Nuclear Regulatory Commission, "Notices, Instructions, and Reports to Workers; Inspections", 10 CFR 19, March 3, 1975.

NRC81 Nuclear Regulatory Commission, "Instruction Concerning Risks From Occupational Radiation Exposure", Regulatory Guide 8.29, NRC, Washington, D.C., July 1981.

NRC83 Nuclear Regulatory Commission, "Rules of General Applicability to Domestic Licensing of Byproduct Material", 10 CFR 30, July 15, 1983.

NRC87 Nuclear Regulatory Commission, "Instruction Concerning Prenatal Radiation Exposure", Regulatory Guide 8.13, NRC, Washington, D.C., December 1987.

NRC88 Nuclear Regulatory Commission, "Shippers - General Requirements for Shipments and Packages", 49 CFR 173, January 1988.

NRC91a Nuclear Regulatory Commission, "Standards for Protection Against Radiation" Title 10, Part 20, Code of Federal Regulations, May 21, 1991.

NRC91b Nuclear Regulatory Commission, "Packaging and Transportation of Radioactive Materials", 10 CFR 71, January 1991.

OSHA89 Occupational Safety and Health Administration, "Occupational Safety and Health Standards for General Industry - Hazardous Waste Operations and Emergency Response", 29 CFR 1910.120, September 5, 1989.

OSHA90 Occupational Safety and Health Administration, "Ionizing Radiation Standards", 29 CFR 1910.96 and "Nonionizing Radiation Standards", 29 CFR 1910.97, Chapter XVII, Subpart G, July 1990.

GLOSSARY

When definitions for the same term differ with NRC, both may be presented with the contributor in parenthesis.

Action Level - A quantitative limit of a chemical, biological, or radiological agent at which actions are taken to prevent or reduce exposure or contact.

Acute Exposure - A dose that is delivered to the body in a single event or in a short period of time.

Administrative Control Levels - Limits (e.g., exposure, concentration, contamination), set below the limiting maximum values permitted by regulation, that are determined by a competent authority or the management of an institution or facility. They are not primary limits, and may therefore be exceeded upon approval of competent

authority or management, as situations dictate.

Airborne Radioactivity Area - Any area within a radiological area where the gross alpha or gross beta airborne concentrations exceed the background concentration. (EPA)

An area, room, or enclosure in which airborne radioactive materials exist in concentrations in excess of amounts specified in 10 CFR 20, Appendix C, Table 1, Column 3; or where concentrations exist which, averaged over the number of hours in any week that individuals are in the area, exceed 25 percent of the values specified in Appendix C, Table 1, Column 3. (NRC)

Annual Limit On Intake (ALI) - The quantity of a single radionuclide which, if inhaled or ingested in one year, would irradiate a person represented by reference man (ICRP Publication 23) to the limiting value for control of the workplace.

As Low As Reasonably Achievable (ALARA) - An approach to radiation protection to control or manage exposures (both individual and collective to the work force and general public) as low as social, technical, economic, practical, and public policy considerations permit. ALARA is not a dose limit but a process which has the objective of achieving dose levels as far below applicable limits as reasonably achievable.

By-Product Material - Any radioactive material, except special nuclear material, made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material, and the tailings and wastes produced by the extraction or concentration of uranium and thorium from ore.

Chronic Exposure - Low doses repeatedly received by the body over a long period of time.

Collective Dose Equivalent - The sum of the dose equivalents of all individuals in an exposed population (expressed in units of person-rem or -sievert).

Committed Dose Equivalent - The total dose equivalent projected to be received by a tissue or organ over a 50-year period after an intake of a radionuclide into the body. Does not include contributions from external dose.

Committed Effective Dose Equivalent - The effective dose equivalents that will be accumulated over 50 years following the intake. Does not include contributions from external dose.

Contamination Area - Any area in which the removable surface contamination exceeds 10 dpm/100cm^2 or 100 dpm/100cm^2 gross alpha or gross beta activity, respectively, or total surface contamination (removable and fixed) that exceeds 100 dpm/100cm^2 or 1,000 dpm/100cm^2 gross alpha or gross beta activities, respectively. (EPA)

Controlled Area - Any area to which access is secured and posted in order to protect individuals from exposure to radiation or radioactive materials.

Derived Air Concentration (DAC) - The average concentration of a radionuclide suspended in air that, if inhaled for a 2000-hour working year, would irradiate a person to the limiting radiation dose value for control of the workplace. The DAC is determined by dividing the ALI for any given radionuclide by the volume of air breathed by an average worker during a working year (2,400 m^3).

Dose Conversion Factor (DCF) - The dose equivalent per unit intake of a radionuclide.

Dose Equivalent (H) - The product of absorbed dose in tissue (rads or grays), a quality factor (Q), and other modifying factors (expressed in units of rem or sieverts).

Effective Dose Equivalent (H_E) - The sum over specified tissues of the products of the dose equivalent in a tissue (H_t) and the weighting factor (W_t) for that tissue, i.e., $H_E = \sum W_t H_t$ (expressed in units of rem or sieverts).

EPA Radiation Laboratory - One of the two Office of Radiation Programs' Laboratories: The National Air and Radiation Environmental Laboratory in Montgomery, AL or the ORP - Las Vegas Facility in Las Vegas, NV.

External Exposure - The dose of radiation received by an individual from a source of ionizing radiation outside the body.

Gray (Gy) - The SI unit of absorbed dose. 1 Gy = 100 rads.

Ionizing Radiation - Any radiation capable of displacing electrons from atoms or molecules, thereby producing ions.

Internal Exposure - The dose of radiation received by the internal organs of the body from radionuclides ingested, inhaled, or absorbed into the body.

Linear Non-Threshold Concept - The assumption that a dose-effect curve derived from data in the high dose and high dose-rate ranges may be extrapolated through the low dose and low dose-rate range to zero, implying that, theoretically, any amount of radiation will cause some damage.

Lower Limit of Detection (LLD) - The smallest amount of sample activity that will yield a net count sufficiently large as to imply its presence.

NIST - National Institute of Standards and Technology.

Nonradiological Area - Any area within the laboratory which is kept free of surface contamination and/or radiation fields that exceed background levels. (EPA)

Occasionally Exposed Workers - Individuals who do not work routinely with hazardous materials but whose duties may occasionally bring them into areas or situations where exposure may occur. (The same as "occasional radiation workers" when the hazard is radiation or radioactive materials.)

Occasional Radiation Worker - Individuals who do not routinely work with or are in the proximity of radiation generating devices or radioactive materials, but whose duties could occasionally bring them into areas where radiation exposures could occur. Their occupational exposures are routinely kept at less than 10 percent of the occupational dose limits.

Occupationally Exposed Workers - Individuals who have a significant potential for exposure to radiation, toxic materials, or harmful physical agents in the course of their duties. Visitors who enter controlled areas for the purpose of engaging in laboratory work may be classified as occupationally exposed to radiological hazards.

Project Manager - The EPA person responsible for the project.

Quality Factor - The principal modifying factor employed in deriving dose equivalent, H, from absorbed dose, chosen to account for the relative biological effectiveness (RBE) of the radiation in question, but to be independent of the tissue or organ under consideration.

Radiation Area - An area in which the external radiation exposure is 0.25 mrem/hr (2.5 μSv/hr) or greater. (EPA)

An 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 mrem (50 μSv) (5 mrem/hr or 50 μSv/hr), or in any 5 consecutive days a dose in excess of 100 mrem (1 mSv). (NRC)

Radiation Protection Officer (RPO) - The EPA person, often a health physicist, responsible for implementing the laboratory's radiation safety and health plan and for developing and ensuring safe work practices. The duties of this individual are the same as those of a Radiation Safety Officer (RSO).

Radiation Safety Officer (RSO) - The EPA person who ensures that all work activities at the site are conducted in accordance with the requirements of the radiation health and safety plan.

Radiation Workers - In general, individuals who in the performance of their jobs, come into contact with ionizing radiation or have the potential of being routinely exposed to levels above the dose limits for the general population. The annual dose limit for these workers is 5 rem (50 mSv) to the whole body, although the use of administrative control levels reduces the allowable dose to a fraction of this limit. (NRC)

Radiological Area - Any area within the laboratory in which radioactive materials or elevated radiation fields are present or in which access is controlled to protect individuals from radiation or radioactive materials. Radiological areas may include radiation areas, contamination areas, airborne radioactivity areas, and respirator areas.

Reference Levels - Limits which may be expressed in terms of any useful parameter. They are used to determine a course of action, such as recording, investigation, or intervention, when the value of a parameter exceeds or is projected to exceed the reference level.

Regional Radiation Program Manager (RRPM) - An EPA employee, assigned to an EPA regional office, responsible for: 1) maintaining the generic radiation policies, plans, and procedures current within the region; 2) providing radiation technical support to the region; and 3) serving as a radiation technical resource during site specific removal and remedial actions.

Respirator Area - Any area in which respiratory protection is required. This is any area within a radiological area of a DOE facility where actual airborne radioactivity concentrations exceed 2.0 DAC-hours per shift when averaged over one calendar quarter or 8.0 DAC-hours during any single shift.

Restricted Area - Any area for which access is controlled for purposes of protection of individuals from exposure to radiation and radioactive materials.

Safety, Health And Environmental Manager (SHEM) - The EPA person responsible for implementing the laboratory's safety and chemical hygiene plan and for developing safe work procedures. This person, if properly trained, may also act as the Radiation Protection Officer.

Sample Container - The inner container of a shipping package that provides the primary containment of the radioactive material or sample.

SCBA - Self contained breathing apparatus.

Shipping Package - The outer container in which radioactive material or a pontentially contaminated sample is received at the laboratory.

Sievert (Sv) - The SI unit of dose equivalent. 1 Sv = 100 rem = 1 Joule/kg.

SOPs - Standard Operating Practices.

Source Material - Uranium or thorium or any combination of uranium and thorium in any physical or chemical form.

Special Nuclear Material - Plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235, and any other material that the NRC determines to be special nuclear material, but does not include source material.

Uncontrolled Area - Any area in which access is not controlled for purposes of protection of individuals from exposure to radiation and radioactive materials.

Unexposed Worker - Workers involved in duties which do not expose them to radiation, toxic materials, or harmful physical agents.

Weighting Factor (W_t) - A factor indicating the relative risk of cancer induction or hereditary defects from irradiation of a given tissue or organ, used in calculating the effective dose equivalent.

APPENDIX A

HEALTH AND SAFETY RESEARCH PROTOCOL (HASP) FOR RADIOACTIVE MATERIAL RESEARCH

Ecosystems Research Division
Athens, Georgia

PURPOSE

To ensure adequate review of proposed occupational safety and health precautions, procedures and techniques for the use, handling, storage, and waste disposal of radioactive materials utilized in research activities. Additional information addresses environmental concerns and items of interest to the ERD Environmental Management System (EMS). As the principal investigator, you should be most cognizant of the specific or potential hazards associated with agents upon which you are conducting investigations.

This HASP is intended for work with radioactive materials. If the research involves other Hazardous materials you must complete an ERD SHEM Lab Health, Safety, and Environmental Plan or an ERD SHEM Field Health, Safety, and Environmental Plan. These are available at http://firstpage.ath.epa.gov/staging/SHEM/laboratory%20safety/index.html These may be submitted in lieu of this plan.

Suggested online references:
National Toxicology Program (http://ntp-server.niehs.nih.gov/ - Chemical Health and Safety Information);
American Biological Safety Association (http://www.absa.org)- provides a compendium on CDC, NIH, and other agent classifications for select agents; **International Agency for Research on Cancer** (http://www.iarc.fr);

HEALTH AND SAFETY RESEARCH PROTOCOL
FOR HAZARDOUS AGENT RESEARCH
Ecosystems Research Division
Athens, Georgia

Title of Study:_____

_____

Duration:

Principal Investigator:_____

Laboratory, Division, Branch:_____

Location: Office _____ Lab _____

Phone: Office _____ Lab _____

_____ _____

Principal Investigator (Signature) Date
(Principal Investigator must be an EPA employee)

APPROVALS

Branch Chief _____ Date_____

Division Director _____ Date_____

(Obtain signatures above prior to sending to the Safety Office)

RSO _____ Date_____

Laboratory Director _____ Date_____

PART A. PERSONNEL POTENTIALLY EXPOSED TO HAZARDOUS AGENT(S)

A. Personnel Authorized to Use Radioactive material(s): A Personnel Qualification Form must be completed and signed for each authorized person.

1. _____ 6.

2. _____ 7.

3. _____ 8.

4. _____ 9.

5. _____ 10.

Are all personnel working with this study participants in the ERD's Medical Monitoring Program?

Yes_____ No_____. If no, why not?

B. Location(s) where work will be conducted (include storage location).

C. Brief description of study (Research Protocol must be attached).

D. Describe **in detail** all potentially hazardous operations and duration (e.g. describe procedure to weigh materials, where and how weighing will be performed, total quantity weighed, how solvent will be added - outline or flow chart would be helpful).

E. Radioactive material:

1. Common name:

2. Chemical name (and/or scientific name):

3. Quantity (isotope(s) and activity):

   a. To be ordered:

   b. Maximum quantity needed for study:

4. Condition/method of storage:

5. Physical/chemical properties (form, solubility, volatility, vapor pressure, stability, flash point, reactivity).

6. Are special handling procedures required (e.g. weighing of stock in glovebox)?

F. Toxicity:

1. LD_{50} or other (carcinogen, etc.):
(attach copy of reference)

2. Acute symptoms:

3. Chronic symptoms:

G. Protective Equipment required? Yes_____ No_____. What type?
Identify all personal protective equipment to be used for hazards listed. Identify specific hazards with necessary equipment(ex. Type glove needed for particular chemical or type chemical).

H. Precautionary procedures to be used (e.g. controlled access, covered work surfaces, etc.).

Type of hood?

Date of last hood certification?

I. Emergency procedures
In the event of an accident or spill (loss of control):

1. Describe procedures in event of overt personnel exposure (inhalation, ingestion, inoculation):

2. Describe plans for containment to prevent spread of the agent from the immediate area, decontamination procedures and monitoring methods to assure decontamination.

J. Waste disposal

Type of waste:

Volume of waste:
(provide time period, for example : 1 Liter/week solvent waste)

Unused stock (to be disposed of or kept):

K. Attach copy of GHS, or a copy of information found in NIOSH Registry of Toxic Effects of Chemical Substances.

L. Will animals be used in this study? Yes _____ No_____.
If yes, complete Part B.

M. Will process and/or procedures create waste streams that are of environmental significance?
This includes processes that involve use of extraordinary amounts of energy, create significant hazardous waste streams, or generates materials that can be recycled. (Please, describe in detail)

PART B. ANIMAL USE INFORMATION

NOTE: Experiments involving the use of radioisotopes in animals require that a specific amendment be submitted and approved by the NRC prior to initiation of work.

Provide complete information on the following:

A. Species:

Number of animals:

Person dosing animals:

Dosing method:

Location of dosing:

Concentration and dose per animal:

Duration of animal maintenance, where and by whom:

B. Has the planned study been coordinated with Health & Safety Office to discuss technician responsibilities, precautions, and availability of proper housing and space? Yes_____ No_____. If no, explain.

C. Animal diet preparation. If test agent will be incorporated into animal diet, describe method, by whom and where is the diet to be prepared, where will it be stored, what quality assurance will be done and by whom? If so, has this been coordinated with Health & Safety Office to obtain timely delivery?

D. Protective equipment and procedures.

PERSONNEL QUALIFICATION FORM FOR HAZARDOUS AGENT RESEARCH

This form must be completed for each individual working on the protocol listed below.

Name:

Age:

Protocol Title:
List other protocols in which research is conducted:
Research Specific Formal Training (Also include all health and safety courses applicable to this type of work):

Relevant on-the-job training (work with specific hazardous agents related to this research, quantities worked with, and training received on these hazardous materials).

Restrictions (to be completed by Safety Office):

I have read the Health and Safety Research Protocol and agree to comply with all procedures and protective measures outlined in the Protocol.

Signature Date

APPENDIX B

Example Action Levels For Radionuclides
in Urine Assuming Monthly Sampling [a]

	Action Levels[b]		
Radionuclide	Re-Sample	Work Evaluation	Work Restriction
Uranium	15	15-25	25
Isotopic Thorium	0.05	0.1	0.2
Ra-226		0.1	0.51.0
Ra-228		0.1	0.51.0
Sr-90	18	36	72
Pu-239	0.05	0.10.2	
Pu-240	0.05	0.10.2	

[a] Department of Energy, Health and Safety Plan for the Remedial Investigation and Feasibility Study-Feed Materials Production Center, Fernald, Ohio, March 1988.

[b] Units - pC/L except for uranium which are μg/L.

APPENDIX C

THE BASIS AND RATIONAL FOR THE EPA NATIONAL RADIATION EXPOSURE LIMITS AND ACTION LEVELS

It is EPA's policy that radiation protection programs be designed and implemented to comply with the dose limitation system in Federal Guidance Report No. 11. In accordance with "Standard Operating Safety Guides," the system of dose limitation is established under this plan at locations where external exposure to gamma radiation exceeds 10 to 20 uR per hour above natural background, and at locations that are known or suspected to contain radionuclides in excess of ubiquitous man-made levels or elevated levels of naturally occurring radionuclides.

C.1 Radiation Exposure Limits for EPA Workers{tc \l 3 "C.1 Radiation Exposure Limits for EPA Workers"}

In keeping with the system of dose limitation, it is EPA's policy that EPA worker radiation protection programs provide assurance that no EPA worker, during the routine performance of duty, will receive a total internal (committed effective dose equivalent) plus external whole body dose exceeding 500 mrem (5 mSv) per year. This policy does not apply to planned special occupational exposures or emergency occupational exposures.

The EPA considered three alternative approaches to setting a radiation exposure limit for workers. One alternative is to set the exposure limit at the current level established by Federal Guidance Number 11 and the limit set forth in the 10 CFR 20 for occupational exposure. Under this approach, total internal (committed effective dose equivalent) plus external whole body doses would be limited to 5 rem/yr (0.05 Sv/yr). The second alternative is to apply the non-occupational limit of 100 mrem/yr (1 mSv/yr) occasional exposure which, however, can be increased to 500 mrem/yr (5 mSv/yr) with prior permission from the NRC. The third approach is to set different limits for different categories of EPA workers. The rationale for selecting an EPA-wide limit of 500 mrem/yr (5 mSv/yr) follows.

The 5 rem/yr (0.05 Sv/yr) limit has the advantage of consistency with Federal guidance for the protection of workers and grants radiation protection personnel the greatest flexibility in administering the radiation protection program. Using this approach, an administrative limit and an action level can be established to ensure that exposures are maintained in accordance with ALARA principles. An additional advantage is that current radiation protection programs throughout government and industry are based on these limits, and EPA can draw upon this experience and precedent, including implementing procedures. Further, EPA laboratories are currently licensed by the NRC under 10 CFR 30 and, therefore, already have radiation protection programs in place that are consistent with these limits.

The main disadvantage of the 5 rem/yr (0.05 Sv/yr) limit is that the large majority of EPA workers who may be exposed to elevated levels of radiation and radioactive materials should not be considered radiation workers in the same sense as NRC licensees and DOE personnel. The potential for similar kinds of exposure is judged to be much less at EPA, and it is also highly unlikely that any individual will receive doses that approach the occupational limits. Based on experience and the historical record, it is believed that doses to EPA workers can be maintained within the 500 mrem/yr (5 mSv/yr) limit for non-occupational exposures.

In developing this policy, specific consideration was given to personnel working at EPA facilities operating under an NRC license, where the basic radiation exposure limit has been 5 rem/yr (0.05 Sv/yr). Consideration was given to establishing one set of limits for personnel at NRC licensed EPA facilities and another set of limits for

individuals who periodically visit DOE and NRC facilities and Superfund sites. The advantages of this approach are obvious. However, different limits for different EPA workers could create administrative procedures that are difficult to justify, since radiation exposures at NRC licensed EPA facilities are not known to have ever exceeded 500 mrem/yr (5 mSv/yr). Therefore, the 5 rem/yr (0.05 Sv/yr) limit was rejected, and the 500 mrem/yr (5 mSv/yr) limit was selected for all EPA workers.

Consideration was also given to establishing an administrative limit of 100 mrem/yr (1 mSv/yr). Such a limit would be consistent with NCRP guidelines and 10 CFR 20 for non-occupational exposure. Under a 100 mrem/yr (1 mSv/yr) administrative limit, exposures would be controlled to 100 mrem/yr (1 mSv/yr), and exposures approaching 500 mrem (5 mSv) in a given year would be permitted only when necessary. The advantage of this approach is its consistency with current radiation protection guidance for non-occupational exposure. However, such an administrative limit may be too restrictive for many EPA workers. Historically, the types of activities performed by EPA personnel fall within a "gray area" between traditional definitions of occupational and non-occupational exposure. As a result, neither classification is appropriate for EPA personnel. The nature and level of potential for exposure of EPA workers does not approach the potential that exists at other NRC licensed and DOE facilities. It is, however, inappropriate to consider EPA personnel who routinely visit licensed facilities and radioactively contaminated sites as typical members of the general public. On this basis, the 100 mrem/yr (1 mSv/yr) administrative limit was rejected.

C.2 ALARA Considerations{tc \l 3 "C.2 ALARA Considerations"}

In accordance with the optimization principle in Federal Guidance Report No. 11, the radiation protection program for EPA workers will make "... a sustained effort to ensure that the collective dose, as well as the annual, committed, and cumulative lifetime individual doses, are maintained as low as is reasonably achievable (ALARA), economic and social factors being taken into account." The 500 mrem (5 mSv) per year limit, described above, is consistent with this principle. In addition, a 50 mrem (0.5 mSv) per quarter action level is established. If quarterly measurements indicate that an individual received more than 50 mrem (0.5 mSv) in a quarter, radiation protection personnel are required to investigate and document the cause of the exposure and determine and document whether the exposure is consistent with the person's routine responsibilities, or whether some type of corrective action is warranted to reduce further exposures. Notwithstanding the 50 mrem (0.5 mSv) per quarter action level, radiation protection personnel must always maintain exposures ALARA.

APPENDIX D
RADIOACTIVE MATERIALS PACKAGE LABELING CRITERIA

SEE CURRENT IATA AND DOT REGULATIONS

APPENDIX F

ISOTOPE	HALF LIFERADIATION	SHIELDING	DETECTOR	
H-3	12.3 Yr	Beta	N/A	LSC
C-14	5730 Yr	Beta	Plexiglass	LSC + GM*
P-32	14.3 Days	Beta	Plexiglass	GM + ScnP
S-35	87.4 Days	Beta	Plexiglass	GM + ScnP
Ca-45	163 Days	Beta	Plexiglass	GM + ScnP
Cr-51	27.7 Days	Beta, Gamma	Lead	GM + ScnP
Co-60	5.26 Yr	Beta, Gamma	Lead	GM + ScnP
I-125	60.1 Days	Gamma	Lead	GM + ScnP
Cs-137	30.2 Yr	Beta, Gamma	Lead	GM + ScnP

* -Limited utility due to low energy of radiation emissions.

GM -Geiger Counter

ScnP-Scintillation Probe Counter (Multi or Single Channel)

Note: Other detectors may be used for radioisotopes if appropriate.

SEWER DISPOSAL RECORD

MONTH:_____
YEAR:_____
LOCATION:_____

DATE	ISOTOPE	ACTIVITY mCi	VOLUME liters	SPECIFIC ACTIVITY	CHEMICAL	FORM

TOTAL mCi TOTAL liters

_____uCi H-3, _____uCi c-14, _____uCi other

Page _____ of _____

Signature: _____ Date: _____

MONTHLY RADIATION SURVEY FORMS

DATE:___/___/___ COMPLETED BY:_____ BRANCH:_____

BUILDING:_____ROOM:_____ RESEARCHER:_____

COUNTS PER MINUTE

SAMPLE NUMBER	H-3 Eff___ BKDG___ Gross Net	C-14 Eff___ BKDG___ Gross Net	P-32 Eff___ BKDG___ Gross Net	Range___to_____ Eff___ BKDG___ Gross Net
1.	___ ___	___ ___	___ ___	___ ___
2.	___ ___	___ ___	___ ___	___ ___
3.	___ ___	___ ___	___ ___	___ ___
4.	___ ___	___ ___	___ ___	___ ___
5.	___ ___	___ ___	___ ___	___ ___
6.	___ ___	___ ___	___ ___	___ ___
7.	___ ___	___ ___	___ ___	___ ___
8.	___ ___	___ ___	___ ___	___ ___
9.	___ ___	___ ___	___ ___	___ ___
10.	___ ___	___ ___	___ ___	___ ___
11.	___ ___	___ ___	___ ___	___ ___
12.	___ ___	___ ___	___ ___	___ ___
13.	___ ___	___ ___	___ ___	___ ___
14.	___ ___	___ ___	___ ___	___ ___
15.	___ ___	___ ___	___ ___	___ ___

In case of contamination: (1) Decontaminate, (2) Rewipe,
(3) Record results below. [Repeat, if necessary]

___ ___ ___	___ ___	___ ___	___ ___
___ ___ ___	___ ___	___ ___	___ ___
___ ___ ___	___ ___	___ ___	___ ___
___ ___ ___	___ ___	___ ___	___ ___
___ ___ ___	___ ___	___ ___	___ ___

Retain a copy of this form for your files. Submit original to the Radiation Safety Officer.
jlk07172012

Ecosystems Research Division
Safety & Health Policy Statement

The mission of the U.S. Environmental Protection Agency (EPA) is to protect human health and safeguard the natural environment. Integral to this mission is the protection of employee, grantee, contractor, and visitor health and safety.

It is a core value of the Ecosystems Research Division (ERD) to serve as a model in providing a safe and healthful working environment. To accomplish this while supporting the Agency's mission, we must properly manage the risks and exposures to our most valuable resource, our people.

We commit to reduce human risks and exposures from our facilities, our research, and other dynamic operations through the following actions:

- By providing a professional health and safety staff to execute the required programs;
- By complying with all relevant occupational safety and health, fire and life safety, NRC radioactive materials license, and other requirements to which we subscribe;
- By seeking to continually reduce the human risks and exposures resulting from our activities;
- By considering safety, health and environmental impacts in planning, constructing and operating our facilities;
- By incorporating material substitution to use the least hazardous material whenever possible;
- By establishing, tracking and reviewing health and safety performance goals associated with accidents, injuries, or health effects resulting from our day-to-day operations;
- By educating our employees about health and safety requirements and seeking their participation and involvement to continually improve our programs; and
- By striving to continually improve the collective safety, health, and environmental management performance at ERD.

At ERD, we recognize our obligation and opportunity to provide leadership in protecting the human health and safety and promoting employee wellness. With this policy statement, we emphasize the importance of maintaining a safe and healthful working environment.

Gerald Brunson, POS Director
SHMR

8-15-12
Date

Roy C. Sidle, Ph.D.
Division Director

8/15/12
Date