DL-051497_01

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

Mail Stop 926A
May 14, 1997

File
Lic # 45-15923-01

United States Nuclear Regulatory Commission
Region II
Attn: Earl G. Wright
101 Marietta Street, N. W., Suite 2900
Atlanta, GA 30323-0199

License No. 45-15923-01
Expiration Date: November 30, 2000

Dear Mr. Wright:

Enclosed you will find two copies of the Radiation Safety Manual that has been prepared for the U.S. Geological Survey in Reston, VA.

Sincerely,

Charles W Naeser

Charles W. Naeser
Radiation Safety Officer

cc: Curt Larsen, MS 953
Gary Kramer, MS 246
Wayne Martin, MS 953
RSO Files

RADIATION SAFETY MANUAL

FOR

UNITED STATES DEPARTMENT OF INTERIOR

U.S. GEOLOGICAL SURVEY
NATIONAL CENTER

RESTON, VIRGINIA

APRIL, 1997

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U.S. DEPARTMENT OF INTERIOR

U.S. GEOLOGICAL SURVEY

UNITED STATES DEPARTMENT OF THE INTERIOR

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I. FOREWORD

This radiation safety manual establishes policies and practices for the Radiation Safety Program at the United States Geological Survey (USGS), National Center located in Reston, Virginia, which has been issued a materials license number 45-15923-01 as amended on January 24, 1997 and which expires on November 30, 2000. In addition, the USGS has also been issued the following licenses by the U.S. NRC, Source Material License number SMB-237 with an expiration date of March 31, 1998 and a Special Nuclear Materials License number SNM-1330 which expires on May 31, 2000.

The affected Center operates at the following site:

United States Geological Survey National Center Campus
12201 Sunrise Valley Drive
Reston, Virginia 20192

A key element and fundamental principle underlying this document is the commitment to maintaining radiation exposures *as low as reasonably achievable* (ALARA). Fundamental radiation protection philosophy can be summarized by the following: *No occupational exposure of workers or exposure to the public should occur without the expectation of an overall benefit from the activity causing the exposure.*

The USGS is firmly committed to having a Radiation Safety Program of the highest quality. The USGS's commitment applies to all activities that manage radiation and radioactive materials and that may potentially result in radiation exposure to USGS personnel; members of the general public; and the environment. **Personal radiation exposure shall be maintained ALARA.** Radiation exposure of the work force, clients and other visitors, and the public shall be controlled to ensure that any radiation exposure is well below regulatory limits, and no radiation exposure occurs without commensurate benefit.

Each person who uses, handles and transports radioactive material is expected to demonstrate an informed, disciplined, and cautious attitude toward radiation and radioactivity. Excellent performance is evident when radiation exposures are maintained well below regulatory limits, contamination is minimal, radioactivity is well controlled, and radioactive spills or uncontrolled releases are prevented. Continuing improvement is expected and essential to excellence in radiation safety. Excellence is achieved and maintained by management commitment and worker involvement in the Radiation Protection Program.

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II. INTRODUCTION

Workers at the United States Geological Survey (USGS), National Center, use radioactive nuclides in a variety of ways. These materials present unique health hazards both to the user and to others who might unwittingly come in contact with these materials. For this reason, the Nuclear Regulatory Commission (NRC) has been given authority to control the use of radioactive by-product materials from nuclear reactors. USGS is authorized to use such by-product materials under NRC license #45-15923-01 which is available to everyone for inspection in the office of the Radiation Safety Officer (RSO). To keep this license, as well as for general safety reasons, radioactive materials must be used and disposed of according to specified safe procedures.

Laws pertaining to the use of radionuclides are set forth in a number of documents such as Section 183 of the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974. Specific protection standards are published in Part 20 of Title 10 (Energy) of the Code of Federal Regulations (hereafter referred to as "10 CFR 20"), Standards for Protection Against Radiation. USGS's NRC license contains specific conditions and limitations applicable to our institution. Other regulations, e.g., 10 CFR 19, as well as various NRC Regulatory Guides also contain important information, and are available in the RSO's office. To ensure that users at this institution know what is required to comply with these laws and regulations, this USGS Radiation Safety Manual has been prepared.

This Manual covers the duties and responsibilities of those who use radionuclides at the USGS, training of users, precautions in the use and handling of materials, exposure limits, monitoring, decontamination, methods of waste disposal, and record keeping. Adherence to procedures outlined in this Manual will keep us in good standing with the NRC and ensure that radionuclides are handled in a safe and proper manner. **USGS operates under the philosophy that all exposures to radiation should be kept "As Low As Reasonably Achievable"; this principle is known as ALARA.**

The NRC has jurisdiction only over by-product materials from nuclear reactors. Possession and use of radionuclides (such as Sodium-22) produced by accelerators and precautions with X-ray apparatus do not come under the provisions of the license. They are, however, covered by OSHA regulations and this Manual applies to their use. If a person receives exposure from licensed and unlicensed materials, NRC regulations and reporting requirements must be followed.

As detailed in NRC regulations contained in 10 CFR 19 and 10 CFR 20, employees have certain rights to obtain information and also to file complaints if they feel they have been discriminated against for bringing safety concerns to the NRC or their employer. Details about these issues and several others relating to the rights of workers are contained in NRC Form 3 entitled "Notice to Employees." Copies of NRC Form 3 are posted at several locations around USGS and a copy is also included as Appendix B of this Manual.

III. DUTIES AND RESPONSIBILITIES

A. RADIATIONS SAFETY OFFICER (RSO)

The duties, responsibilities, and authority of the USGS Radiation Safety Officer are as follows:

1. General supervision of all health physics activities, including both personnel and environmental monitoring.

2. Furnishing consulting services to personnel at all levels of responsibility on all aspects of radiation protection.

3. Developing and maintaining the calibration of survey instruments.

4. Instructing personnel in the nature and properties of ionizing radiation and the proper procedures for the use of radioactive materials; or arranging and supervising for such instruction by qualified specialists.

5. Supervision of the records of storage and waste disposal; making periodic checks of the records kept by authorized users.

6. Maintaining current inventory of all radioactive materials at USGS and ensuring that possession limits given in the NRC license are not exceeded.

7. Receiving all requests for acquisition of radioactive materials and countersigning those orders which comply with the current policies and procedures. Maintaining a log of all approved requests.

8. Supervising receipt and delivery of all shipments of radioactive materials received at the institution; supervising packaging and shipping of all radioactive materials leaving the institution.

9. Ensuring that leak tests are made on all sealed sources at least once every six months, as required by license conditions, and keeping the records of the results of such tests.

10. Supervision of storage and disposal of all radioactive wastes.

11. Supervising decontamination in case of contaminating incidents and accidents.

12. Maintaining other records not specifically designated above.

13. Submitting the required reports to the NRC on any cases of overexposure to radiation at USGS.

14. Preparing and submitting application for renewal of the NRC license when the expiration date approaches and applications for any desired amendments.

B. AUTHORIZED USERS

Authorized users are those staff members who, in the judgment of the Radiation Safety Officer (RSO) have sufficient training and experience with radionuclides to use them safely without supervision. They bear ultimate responsibility for ensuring that Individual User Responsibilities are discharged by those under their control, and are further responsible for:

1. Adequate planning. Before an experiment is performed, the authorized user should determine the types and amount of radiation or radioactive material to be used. This will generally give a good indication of the protection required. The procedure must be well outlined. In many cases, before the procedure is actually performed with radioactive materials, it should be rehearsed so as to preclude slip-ups or unexpected circumstances. In any situation where there is appreciable radiation hazard, the RSO shall be consulted before proceeding. Establish and document a job hazard analysis for each task using radioactive material.

2. Instructing those employees for whom they are responsible in the use of safe techniques and in the application of approved radiation safely practices. Making sure the exposure of anyone under 18 years of age is kept under the prescribed limits.

3. Furnishing the RSO with information concerning individuals and activities in their areas, including pertinent changes in personnel working on projects.

4. Contacting the RSO whenever major changes in operational procedures, new techniques, alterations in physical plant (e.g., the removal of a radiochemical fume hood) or when new operations which might lead to personnel exposure are anticipated.

5. Complying with the regulations governing the use of radioactive materials, as established by the NRC and the local and state regulatory requirements.

    a. Using correct procedures for the procurement of radionuclides by purchase or transfer.

b. Seeing that areas where radionuclides are kept or used, or where radiation fields may exist are properly posted.

c. Seeing that each sign carries the name of the personnel currently responsible for the associated area.

d. Assuring that radioactive waste materials are disposed of in accordance with procedures given in the section of this Manual on Disposal of Radioactive Wastes.

e. Keeping all required records current. These are

(1) Surveys of work areas for contamination.

(2) Records of receipt of radionuclides.

(3) Records of removal of radionuclides from shipping containers.

(4) Records of disposal of radioactive waste.

(5) Summaries of liquid waste disposal record entered in USGS sanitary sewerage disposal record.

(6) Inventory reports for radionuclides on hand.

6. Taking steps to prevent the transfer of radioactive materials to **unauthorized individuals**. This includes the proper disposition of radioactive materials possessed by terminated workers.

Keeping stocks of radionuclides stored in a safe manner with adequate shielding to keep exposure to a minimum.

Returning all unused radioactive materials, film badges, survey instruments, and shielding equipment to the RSO upon termination of employment or use of radioactive material.

C. VISITING SCIENTISTS AND/OR GUEST WORKERS

Visiting scientists and/or guest workers, regardless of training and experience, are permitted to use radioactive materials only under the direct supervision of an authorized user. Any exceptions to this policy, as applicable to long-term guest workers (over 3 months), must be approved by the Radiation Safety Officer (RSO). Where appropriate, these persons should be provided with temporary film badges, and/or TLD's.

D. INDIVIDUAL USERS

It is the responsibility of every user, when working with radioactive materials, to follow the policies and procedures given in Section III of this Manual and in addition:

1. Keep exposure to radiation as low as reasonably achievable (ALARA), and specifically below the maximum permissible exposure allowed in 10 CFR 20.1201 as detailed elsewhere in this Manual.

2. Report accidental inhalation, ingestion, or injury involving radioactive materials to the supervisor and the RSO and carry out the RSO's recommended corrective measures. The individual shall cooperate in any and all attempts to evaluate exposure. Accident reporting form DI-134 should also be utilized.

3. Carry out decontamination procedures when necessary and take steps to prevent the spread of contamination to other areas.

4. Comply with requests from the RSO to submit urine samples for radioassay. Requests for these tests will be made in the case of workers using significant quantities of beta or gamma emitters.

5. Exchange film badges and/or TLD's each month when called upon to do so.

6. Attend training sessions arranged by the Radiation Safety Officer (RSO).

IV. POLICIES AND PROCEDURES

In order to comply with the regulations delineated in 10 CFR20, a number of policies and procedures are in effect at USGS. The purpose of these policies and procedures is to ensure that radioactive materials are used safely and that exposures are kept "as low as reasonably achievable (ALARA)."

A. RADIATION DOSE LIMITS

1. OCCUPATIONAL DOSE LIMITS FOR ADULTS (10 CFR 20.1201[a])

The annual **occupational** dose limits for adults are

a. An **annual** limit, which is the more limiting of (i) the total effective dose equivalent being equal to 5 rems (0.05 Sv); or (ii) the sum of the deep-dose equivalent and the committed dose equivalent to any individual or organ other than the eye being equal to 50 rems (0.5 Sv);

b. The **annual** limits to the lens of the eye, to the skin, and to the extremities, which are (i) an eye dose equivalent of 15 rems (0.15 Sv), and (ii) a shallow-dose equivalent of 50 rems (0.5 Sv) to the skin or to any extremity.

2. OCCUPATIONAL DOSE LIMITS FOR MINORS (10 CFR 1207)

The **annual** occupation dose limit for minors are 10% of the annual dose limits specified for adults.

3. DOSE TO AN EMBRYO/FETUS (10 CFR 1208)

The dose to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, shall not exceed 0.5 rem (5 mSv).

Embryos and fetuses are at special risk from exposure to ionizing radiation. In order to address this issue, the NRC has published NRC Regulatory Guide 8.13 (revised December 1987). This guide provides detailed information about this topic and is included as Appendix J to this Manual. Women who are pregnant or are of childbearing age should review the information in this Guide.

4. DOSE LIMITS FOR INDIVIDUAL MEMBERS OF THE GENERAL PUBLIC (10 CFR 1301)

(a) The dose to an individual member of the public from the licensed operation shall not exceed 0.1 rem (1 mSv) in a year exclusive from the

licensee's disposal of radioactive material into the sanitary sewerage system.

(b) The dose in any unrestricted area from external sources does not exceed 2 mrem (0.02 mSv) in any one hour.

B. TRAINING AND EXPERIENCE RECORDS

1. Each person who expects to be working with radioactive material at USGS must fill out a Training and Experience Form (Appendix H). The Radiation Safety Officer (RSO) will review these forms and determine which individuals qualify as "Authorized Users." Blank forms can be obtained from the Radiation Safety Officer (RSO) and completed forms should be returned to the RSO.

2. Each person is also required by 10 CFR 20 to obtain his radiation exposure history from all of his previous employers so that a cumulative exposure history is available at USGS. Blank forms are available from the Radiation Safety Officer (Appendix I).

C. OBTAINING APPROVAL TO USE RADIONUCLIDES IN A RESEARCH PROJECT

1. Projects utilizing radionuclides can only be initiated after a project proposal has been submitted to and approved by the RSO. Furthermore, **each proposal must be sponsored by an Authorized User**. The Authorized User signing off on the form is ultimately responsible for the safe use of radionuclides in the various projects.

2. A project proposal form (Appendix E) must be completed so that the RSO can evaluate safety aspects and make sure that the Principal Investigator is competent to follow proper procedures and has considered all aspects of the project. The information detailing the project should be sufficient so that the RSO can make this assessment, but need not be exhaustive.

   a. The Principal Investigator should prepare a typed project proposal form, have it signed by the responsible Authorized User and give it to the RSO from the respective laboratory.

   b. Each major type of experiment requires a different form but similar experiments can be grouped, e.g., you could combine all experiments involving in vitro labeling of nucleic acids with ^{32}P, but would need a different one for radiolabeling proteins with ^{125}I or labeling proteins or nucleic acids with ^{35}S.

c. **Rememoer, if you are not an Authorized User, you must have an Authorized User sponsor your projects, and that person bears the ultimate responsibility. As noted the Authorized User must sign the form.**

d. The LD RSO will review the applications, inform you if additional information is required, and inform you of the projects' approval.

3. **No radionuclides will be ordered for an individual unless an approved project proposal is on file.**

4. If new personnel are assigned to or dropped from a project, the form should be amended to show this.

D. TECHNIQUES AND PROTECTIVE MEASURES

1. Protective clothing is to be worn whenever contamination is possible, i.e., a lab coat and gloves, at a bare minimum. This clothing must not be worn outside the laboratory area.

2. Change gloves when contamination is suspected.

3. Use protective barriers and other shields whenever necessary.

4. Use mechanical devices whenever their use will assist in reducing exposure.

5. Use pipette-filling devices. **Never pipette solutions by mouth.**

6. Work in an approved hood or glove box unless it has been decided after careful consideration that it is safe to work in the open.

7. Use the following special precautions when working with aerosols, dusts and gaseous products:

   a. Procedures involving aerosols, dusts or gaseous products, or procedures which might produce airborne contamination shall be conducted in a hood, dry box or other suitable closed system.

   b. All releases from such systems shall not exceed the maximum permissible concentration in air for the radionuclide in question. See 10 CFR 20 Appendix B, Table 2 for maximum permissible concentrations. However, where practical, traps should be incorporated in the experimental setup to ensure that environmental releases are as low as possible.

c. Radioactive gases or materials with radioactive gaseous decay products must be stored in gas-tight containers and must be kept in areas having approved ventilation.

d. Hoods to be used for radionuclide work should be tested by the safety office to ensure that they meet the minimum requirements (preferably 150 linear ft/min across the face, with the sash at reasonable working height). They should not be used for airborne radioactivity work if flow is below 100 linear ft/min.

8. **Autoclaves**: Avoid autoclaving radioactive materials if possible. If necessary to use an autoclave on radioactive materials, make sure if is vented to the outside. Perform the autoclaving in such a manner so as to minimize the chance of producing aerosols or boiling the material over into the autoclave (use trays lined with absorbent pads). Survey the autoclave for contamination with a survey meter and/or a wipe test following a run.

E. SURVEYING AND MONITORING

1. Personnel working with gamma emitters or with beta emitters having a maximum energy $\geq$0.2 MeV will be required to wear film badges or TLD's.

2. After working with gamma emitters or beta emitters (with energy max $\geq$0.2 MeV), a person should check hands, shoes, and body with a survey meter. Or lower energy beta emitters, check for contamination by rubbing a small filter paper between the palms and counting the paper in a suitably calibrated liquid scintillation counter.

3. Remove all protective clothing before leaving the laboratory to smoke, eat, drink, etc.

4. **DAILY CONTAMINATION SURVEYS.** Areas where radioactive materials are being used must be checked at least once a day for contamination whenever any radionuclide is used. A survey meter may be used for materials which it will detect; otherwise conduct a wipe test. A written log record must be maintained of these surveys including results which are entirely negative. Any contamination observed should be clearly marked and decontamination procedures started immediately and continued until area is demonstrated to be free of contamination (results must be recorded). If no contamination is observed, a notation may be made simply stating that no contamination was noted. **THESE DAILY SURVEYS ARE AN NRC REQUIREMENT; FAILURE TO PERFORM AND TO RECORD THEM MAY HAVE DIRE CONSEQUENCES!**

3. Wash hands and arms thoroughly before handling any object which goes to the mouth, nose, or eyes.

H. STORAGE AND TRANSPORTATION

1. Guidelines for maximum activities in individual laboratories:

   a. Class 1 (very high radiotoxicity, e.g., ^{90}Sr, ^{210}Po, etc.) 10 μCi or less.

   b. Class 2 (high radiotoxicity, e.g., ^{125}I, ^{59}Fe, etc.) - 100 μCi or less.

   c. Class 3 (moderate radiotoxicity, e.g., ^{22}Na, ^{32}P, etc.) - 1 mCi or less.

   d. Class 4 (slight radiotoxicity, e.g., ^{51}Cr, ^{14}C, ^{3}H, etc.) - 10 mCi or less.

2. Shielding of sources:

   a. Radioactive sources or stock solutions in laboratories shall be shielded in such a manner that the radiation levels in any occupied area will not expose individuals in the area to more than 100 mrem in any five consecutive days.

   b. Various shielding materials are available on loan from the RSO.

3. Transporting radioactive materials:

   a. Use double containment--surround inner container with unbreakable outer container.

   b. Transport "high activity" materials on a lab cart in a suitable tray.

4. Containers (e.g., lucite boxes in -20°C freezers) in which materials are transported or stored shall bear a durable, clearly visible "Caution Radioactive Materials" label (or piece of radioactive warning tape) indicating the chemical form and activity of the radionuclides in the container and the date of measurement where applicable.

5. Use and Storage of radioactive materials is limited to restricted areas and as a result storage of radioactive materials in halls, corridors, etc., is not permitted. Every effort should be made to store radionuclides and labeled materials in labs and other areas designated for use and storage of radioactive materials.

6. It is permissible to store **strictly limited** quantities of radioactive materials in labeled freezers, etc., in unrestricted areas, but this equipment must be kept locked and a special sign must be affixed. These limits are very low: 1.0 mCi of ^{3}H, 0.10

mCi of ^{14}C, 0.01 mCi of ^{32}P, 0.10 mCi of ^{35}S, 1.0 mCi of ^{51}Cr and 0.001 mCi of ^{125}I. Contact the RSO for additional information.

I. ORDERING, RECEIVING AND ACCOUNTING FOR RADIONUCLIDES

1. ORDERING RADIOACTIVE MATERIALS

a. All orders for radionuclides must be approved by the RSO before being ordered. When an order is submitted to the RSO, a USGS RADIONUCLIDE INVENTORY RECORD FORM (Appendix C) must be completed and **signed by the Authorized User** and sent to the RSO (currently Room M5926a).

b. **The order must also be entered into the procurement system. If this is not done, the order will not be placed!**

c. The RSO or his designee assigns a permanent Inventory Number, records the number in his file and authorizes purchase of the radionuclide. The purchasing agent returns the Invetory Record to the person placing the order. Upon receipt of this approved form, the investigator should file it until the order arrives.

2. RECEIVING SHIPMENTS OF RADIOACTIVE MATERIALS

a. The following procedures are to be performed by the recipient of each shipment of radioactive material. **These procedures are specified in our NRC license and, therefore, must be adhered to. Failure to comply may result in suspension of your privileges to use radionuclides!**

b. Following notification by the Loading Dock, shipments of radioactive materials may be picked up at the receiving location (currently the Room by the user who placed the order or delivered directly to the user. The user should be wearing the appropriate protective clothing (lab coat and gloves) and personal dosimeter. **When you order radionuclides, you should anticipate their arrival.** In many instances, shipments are received on dry ice and failure to pick them up promptly may result in their thawing out.

c. Identify the proper container "pig" and verify that the stated contents agree with the order, as specified on the Radionuclide Inventory Record Form. If there is a discrepancy, compare the stated contents to the packing slip, if the packing slip is available. Discrepancies in the amount of activity received that are greater than plus or minus 50% of the activity listed on the Radionuclide Inventory Record Form and/or the packing slip, and

iii. For ^{125}I, survey the smear with a shield, thin-window NaI (T1) detector. If there is detectable contamination, quantify the smear in the appropriate laboratory instrument and determine the net dpm.

iv. Please note that it is not appropriate to merely survey the "pig" by pointing the survey meter at it because a low level of emissions through the wall may lead to the erroneous assumption that the pig is contaminated. A smear should be taken and then surveyed.

h. If a final source container is found to be contaminated, notify the RSO and record the positive findings in the user's log book. Records shall be in units of disintegrations per minute per 100 square centimeters (dpm/100 cm^2). If no contamination is detected, it is sufficient simply to note in the appropriate space on the inventory record form that the survey results were negative.

i. If removable contamination does not exceed the following guidelines, the Authorized User may use the material. The limits are

Low-risk Beta or Gamma Emitters: 22,000 dpm/100 cm^2
Other Beta or Beta-Gamma Emitters: 2,200 dpm/100 cm^2

j. Shipments having contaminated source vials with contamination that exceeds these limits, but not exceeding ten times these limits, shall have a warning notice inserted in the package before use by the Authorized User.

k. Shipments having contaminated source vials with contamination that exceeds ten times the above limits shall be held by the RSO.

l. The USGS Radionuclide Inventory Record Form shall serve as the permanent record for receipt and survey.

3. ACCOUNTING FOR RADIOACTIVE MATERIALS

a. When aliquots of the radioactive materials are removed from their containers, entries must be made on the Radionuclide Inventory Record Form showing the removal.

b. In the individual lab log book, two records are to be maintained; the Radionuclide Inventory Record Forms (Appendix C) for nuclides being used and the Disposal Record (Appendix D).

i. The Inventory Sheets will record all radionuclides brought into the lab and show how and when they were removed from their container.

ii. The Disposal Record will show how much was lost by decay and how much was discarded via the sanitary sewerage system or into solid waste disposals in the Low-Level Radioactive Waste (LLRW) storage area.

c. Each week, liquid waste disposal records from the individual lab, logs, will be summarized and disposals via the sanitary sewerage system will be recorded in the Lab Sewerage Disposal Log maintained in RSO's Office.

d. At the end of each month, each Authorized User will be furnished with and must complete an Inventory Report to the RSO for all radionuclide acquisitions which are stored in their labs or are under their control.

i. Inventory Records for radionuclides that have been used up and the sheets "zeroed out" may be conveniently handed in at this time.

ii. The completed Inventory Report and "zeroed out" Inventory Records should be provided to the RSO and filed for future reference for federal and state regulatory agencies.

J. DECONTAMINATION AND REPAIRS OF CONTAMINATED EQUIPMENT

1. In general, no radioactive contamination can be tolerated. Exceptions to this will include certain hood trays, dry boxes, stainless steel trays, Kimpak covered surfaces, or other equipment which is used frequently for active work and which will be clearly marked with the standard radiation caution signs or stickers. Any contamination that is not confined to protected surfaces should be reported immediately to the RSO, who will supervise the decontamination of such areas or equipment. For additional information, consult Section O. "Radiation Emergencies."

2. **Radioactive equipment and glassware.** Equipment used to hold or work with radioactive substances shall not be used for other work and shall not be sent from a laboratory to central cleaning facilities, repair shops, surplus, or returned to the source of supply, until demonstrated to be free of contamination (i.e., fixed and removable).

3. **Repair and maintenance of equipment in the laboratory.** Equipment to be repaired by shop and maintenance personnel or by commercial service contractors

shall be demonstrated to be free of contamination (fixed and removable; prior to servicing. At no time shall servicing personnel be permitted to work on equipment in controlled areas without the presence of a laboratory staff member to provide specific information. If it becomes necessary to make emergency repairs on contaminated equipment, the work will be supervised by the RSO, who will assure that the necessary safeguards are taken. It is the responsibility of the laboratory personnel to request this supervision from the RSO.

4. **Clearance procedure for surplus or repair of equipment. The NRC mandates that we protect all workers, as well as the general population, from unnecessary exposure to ionizing radiation. Therefore, all equipment in which radioactive materials have been used or stored must be checked for radioactive contamination before being released for surplus or repair.**

   a. All detectable contamination in accessible portions of the equipment **must be removed.** If measurable contamination remains in inaccessible portions, contact the Radiation Safety Officer for further instructions.

   b. All **"Caution Radioactive Materials"** labels or signs **must be removed** or obliterated after all detectable contamination has been removed.

   c. A form **"CERTIFICATION THAT EQUIPMENT IS FREE FROM HAZARDS"** (available from the RSO) (Appendix L) **must be completed** and attached to the equipment before release. Note that this form requires clearance for biological, chemical, oil, and heavy metal hazards as well. The Stockroom or the Shop will not accept equipment until this form is completed and attached.

   d. Additional regulations apply to gamma counters, liquid scintillation counters, electron microscopes or other equipment containing radiation sources or x-ray generating equipment. The Radiation Safety Officer should be consulted in the event such equipment is involved.

5. There are also clearance procedures that must be adhered to when rooms in which radioactive materials have been used or stored are being vacated or renovated. The Radiation Safety Officer should be consulted under these circumstances.

K. SIGNS AND LABELING

1. Proper marking of laboratories, areas, and equipment.

   a. **A "CAUTION RADIOACTIVE MATERIALS" sign must be conspicuously posted on the doors to laboratory areas where**

radioactive materials are being used or stored. The name and home phone number of the individual responsible for the posted area shall be shown in the designated place on the sign in order to facilitate contact in case of emergency. The supervisor shall be responsible for seeing that the posted information is current. The signs must not be removed from any room except by the RSO following an inspection survey.

b. Storage areas shall be conspicuously marked with a "**CAUTION RADIOACTIVE MATERIALS**" sign. In addition, containers in which materials are transported or stored shall bear a durable, clearly visible label bearing the radiation caution symbol and the words "**CAUTION RADIOACTIVE MATERIALS.**" This label shall also state the quantities and kinds of radioactive materials in the containers and the date of measurement of the quantity.

c. Radiation areas in the laboratory, i.e., areas where radiation levels might expose individuals to 5 mrem in any 1 hour, or in any five consecutive days, a dose in excess of 100 mrem, shall be posted with the sign "**CAUTION RADIATION AREA.**"

d. All equipment contaminated with radioactive material shall be marked with signs, decals, or other conspicuous means. Labeling shall not be required for laboratory containers such as beakers, flasks, and test tubes, used transiently in laboratory procedures during the presence of the user.

4. All signs referred to in this part are available from the RSO.

L. PERSONNEL MONITORING PROGRAM

1. FILM BADGE PROGRAM

a. All workers who use or are in close proximity to gamma-emitters (neutron actirated samples), beta emitters with maximum energy $\geq$ 0.2MeV (e.g., ^{32}P), or radiation producing equipment (e.g., electron microscopes) are required to wear whole body film badges and/or TLD's.

b. Badges and/or TLD's should be obtained before beginning work with radioactive materials. Temporary badges are available from the Safety Officer.

c. Body badges and/or TLD's should be worn on the outer surface of an unshielded part of the body, wrist badges should be worn on the palm side

of the wrist and TLD rings badges should be worn with the label facing the palm of the hand.

d. The whole body and wrist badges are small sheets of film contained in a foil packet. The film becomes darkened in response to exposure to ionizing radiation, however, other factors may also cause darkening of the film and it is therefore necessary to treat the badges with care. When not in use, badges should be stored away from sources of radiation exposure, heat, or chemically stressful environments. **THEY SHOULD NOT BE WORN OUTSIDE OF THE LABORATORY.**

e. Badges and/or TLD's should be promptly exchanged monthly when requested.

f. If a badge and/or TLD becomes inadvertently contaminated, the Safety Officer should be notified so that a replacement can be supplied and a spurious exposure reading avoided.

g. An individual reported to have any exposure on a film badge (10 mrem threshold reading) will receive a memorandum stating the exposure reading. If an exposure of $\geq$ 40 mrem on a whole body badge, or $\geq$ 625 mrem on a wrist or finger badge, is reported, the RSO will conduct an investigation. This investigation will determine the cause of the exposure and implement corrective actions, where possible.

M. RADIATION EMERGENCIES

1. Because it may be difficult for personnel in the laboratory to determine the extent of radiation exposure danger resulting from an accident involving radioactive materials, it is necessary that the RSO be contacted **IMMEDIATELY** if an emergency is suspected. If an emergency should occur after hours, the RSO should be contacted at home. In the event that the RSO is unavailable, another member of the laboratory or the RSO designee should be contacted. The phone extensions and home telephone numbers of the RSO are listed in Appendix A to this Manual. Outlined below are the procedures to be followed in the event such an accident occurs.

2. ACCIDENTAL SPILLS OF RADIONUCLIDES

Spills of radioactive materials may be divided into 2 general categories: (1) major spills, involving significant exposure potential, and (2) minor spills, involving minimal hazard potential. A spill involving a volatile radionuclide, such as

radioiodine, should be regarded as a major spill. A guide to assessing hazards of spills involving selected radionuclides is listed below.

ASSESSING SPILLS: HAZARDS OF RADIOACTIVE MATERIALS

Group 1. Low Hazard. Above 1 mCi, treat as a major spill. ^{3}H, ^{14}C.

Group 2. Medium Hazard. Above 100 μCi, treat as a major spill ^{24}Na, ^{32}P, ^{42}K, ^{51}Cr, ^{55}Fe, ^{59}Fe.

Group 3. High Hazard. Above 10 μCi, treat as a major spill. $^{*22}Na$, $^{*125}I$, ^{129}I, $^{*131}I$, $^{*137}Cs$.

*Emits gamma radiation in significant amounts.

3. MAJOR SPILLS

a. Notify all personnel in the spill area of the accident and restrict access to the contaminated area.

b. Contact the RSO or the RSO designee or another member of the laboratory prepared to provide the following information. (1) the location of the accident, (2) a brief description of the incident including the type of radioactive material and the activity involved, (3) your name and the phone number where you can be reached.

c. Do not attempt to decontaminate the area until the RSO arrives. Secure the laboratory area to prevent access. The RSO will provide instructions and assistance in decontamination and will make arrangements for the provision of special decontamination equipment, if necessary.

d. Individuals who may have been contaminated should be taken to a nearby contamination-free area for contamination evaluation.

e. If appropriate instrumentation is available, an evaluation should be made of personnel contamination. If contamination is found on clothing, the clothing should be removed and held for evaluation by the RSO. If skin is contaminated, wash with mild detergent and water, or shower, if facilities are available. For further information, consult the following section "General Procedures for Decontamination of Personnel."

f. Permit no person to resume work in the area until the RSO has supervised a final survey and given approval.

g. Prepare a complete written report of the accident, listing the individuals involved and the corrective action taken. A copy must be submitted to the RSO within one week.

4. MINOR SPILLS

a. Notify all personnel in the spill area of the accident and restrict access to the contaminated area.

b. Contact the RSO or the RSO designee or another member of the laboratory. Be prepared to provide the following information: (1) the location of the accident, (2) a brief description of the incident including the type of radioactive material and the activity involved, (3) your name and the phone number where you can be reached.

c. Individuals who may have been contaminated should be taken to a nearby contamination-free area for contamination evaluation.

d. If appropriate instrumentation is available, an evaluation should be made of personnel contamination. If contamination is found on clothing, the clothing should be removed and held for evaluation by the RSO. If skin is contaminated, wash with mild detergent and water, or shower, if facilities are available. For further information, the following section "General Procedures for Decontamination of Personnel."

e. Confine the spill as rapidly as possible. Before proceeding, however, individuals must obtain protective clothing (disposable gloves, goggles, lab coats or coveralls, and shoe covers). Obtain the necessary decontamination materials from the RSO if not available in the immediate laboratory area. Use a G-M survey meter or wipe surveys as appropriate to periodically check contamination levels as the spill area cleanup proceeds.

f. Clean up the spill using toweling moistened with detergent and water (commercial decontaminating agents are available). To prevent spreading contamination, always clean from the outer edges towards the center of the spill. In the case of liquid spills, use absorbent paper or solid absorbent, and deposit soaked cleanup material in an impervious radioactive waste container or plastic bag. If the spill is dry or powder material, carefully place a moistened towel over the spill to prevent airborne spread.

g. Continue decontamination until activity is reduced to background levels.

h. Monitor all personnel involved in the cleanup and assure that they have been decontaminated. If items of clothing cannot be decontaminated, hold for evaluation by the RSO.

i. Prepare a complete written report of the accident, listing the individuals involved and the corrective action taken. The survey results must be included and a copy be submitted to the RSO within one week.

5. GENERAL PROCEDURES FOR DECONTAMINATION OF PERSONNEL

a. For decontaminating skin surfaces, it is most effective to begin with a simple washing procedure and progress to more involved procedures until the contamination is reduced to an acceptable level. The following is a list of the recommended decontamination sequence:

(1) Notify supervisor immediately after contaminating accident.

(2) Wash body area involved thoroughly for two or three minutes, repeatedly "soaping" and rinsing. Consideration should be given to the chemistry of the contaminant and an attempt made to find a suitable agent for dissolving it. Any cleansing agent may be used, but synthetic detergents are preferred to soaps. Avoid prolonged use of any one decontamination procedure. Irritation of the skin may impede the success of more suitable procedures. Avoid the use of organic solvents. They may make the skin more permeable to radioactive contaminants.

(3) If this procedure is not immediately and completely effective, notify the RSO. Special decontaminating agents such "Versene," "Radiacwash," etc., may be used under the direction of the RSO.

b. Between each step of the procedure, the contamination should be checked to determine if contamination is still present. If a milder procedure is effective, do not use a harsher one. Chemical treatment is to be used only when absolutely necessary, and then only under the direction of the RSO. Under no circumstances should the skin surface be abraded or broken.

c. If a person's eyes are splashed with radioactive materials, immediately flush the eyes with copious amounts of water.

6. RADIONUCLIDE SPILLS INVOLVING OTHER HAZARDS

If a spill involves other hazardous agents in combination with a radioactive material (infectious agents, toxic chemicals), the RSO should be consulted to determine if special decontamination procedures or equipment are necessary for personnel safety. In general, the biological or chemical hazard will be treated first.

7. FIRES INVOLVING RADIOACTIVE MATERIALS

In the event of a fire involving a laboratory that contains radioactive materials, the RSO should be contacted immediately.

V. WASTE DISPOSAL

A. GENERAL CONSIDERATIONS

1. The NRC **strictly** regulates the amounts of radionuclides that may be discarded and the routes by which they may be disposed. These limits have recently been revised in accordance with the new 10 CFR 20 regulations.

2. It is the obligation of every authorized user at USGS to keep the release of radioactive materials into the air and the sewerage as far below the license limits as is practicable (ALARA--"as low as is reasonably achievable") and to insure that radioactive wastes do not enter conventional waste disposal receptacles.

3. It is the obligation of every authorized user at USGS to estimate as accurately as possible the amount of radioactive materials in the waste that is disposed of and to minimize the overall volume.

4. It is the obligation of every authorized user to consider all the components contained in any radioactive waste sample. Special consideration must be given if the samples contain infectious agents, sharped hazardous materials or toxic chemicals.

5. Consequently, it is imperative that all authorized users at USGS be familiar with the proper procedures for dealing with radioactive wastes. **Failure to satisfy the conditions of the NRC regulations could well result in loss of our license or severe penalties!**

6. If you have questions, please consult the RSO.

7. This procedure provides detailed information about this topic and is included as Appendix M to this Manual.

B. SOLID WASTES

1. Solid wastes at USGS are currently disposed of by using a licensed broker to transport Low-Level Radioactive Waste (LLRW) to a licensed disposal facility.

2. When preparing solid waste for disposal by decay the user must physically **segregate <u>each</u> radionuclide into a separate container.**

3. Solid waste may be conveniently held in plastic lined cardboard boxes and/or 55-gallon steel drums appropriately labeled until the container is full. When the container is full, the plastic containing the solid waste should be double-

bagged or tripled-bagged to prevent tears or leaks and care must be taken to ensure that there are no open "sharps." The orange Biohazard bags become brittle in cold weather and larger bags can be difficult to handle if they are completely filled. Thus, these Biohazard bags are not to be used for the external container.

4. A **Caution Radioactive Materials** tag (available from the RSO) identifying the **name of the investigator, the date, the nuclide** and an **estimate of the activity in millicuries** should be affixed to the bag. Contact the RSO for storage of waste material in the Hot Rockshed and/or additional information for help.

5. Disposal of solid wastes is becoming very expensive. Consequently, noncontaminated gloves, pipet tips, absorbent paper, etc., should not be mixed with the radioactive solid waste. Thus, make sure that gloves, pipet tips, etc., are in fact contaminated before you toss them into the radioactive waste container.

6. The "pigs" in which certain radionuclides (e.g., ^{32}P) supplied contain lead, a toxic heavy metal. After verification that they are not contaminated, the lead should be removed from such pigs and discarded as a heavy metal. If you wish, you may bring the lead to the RSO and he will take care of the final disposition. Under no circumstances must the lead be allowed to enter either the normal or radioactive waste stream.

C. LIQUID WASTES

1. At the present time, our NRC license permits liquid wastes to be disposed of via the sanitary sewerage system. The values enumerated in this section are based on the new NRC regulations effective in May 1991. The **annual** limit for disposal is 5 Ci of ^{3}H, 1 Ci of ^{14}C, and 1 Ci of all other radionuclides combined.

2. However, for convenience, **daily** disposal limits for USGS have been calculated on the basis of values specified in 10 CFR 20 Appendix B. Table 3. If you have questions about additional nuclides, contact the RSO before proceeding.

3. To enable the RSO to monitor the aggregate disposal and avoid the risk of exceeding any of the limits, anyone putting more than 10% of the daily limit of activity into the sanitary sewerage system in one day must obtain approval from the RSO. In practice, however, disposals have always been well below this 10% limit.

4. Aqueous solutions may be disposed of in an appropriately designated sink in the investigator's lab. An ample volume of water should be used to flush the solution

down the drain and the sink should be surveyed to insure that no removable contamination remains.

5. The nuclide and an estimate of the amount disposed of **in millicuries** must be logged in the lab and also in the USGS Lab Sewerage Disposal Log located in the laboratory. This Log is the official record. Consequently, if the user elects to use the sink in his/her own lab, a weekly entry must be made in Log detailing the disposals.

6. Glass containers or bottles should **not** be used for liquid waste accumulation and storage. Sturdy plastic ones are much better.

7. The composite disposal records are periodically checked to make sure that the limits are not exceeded.

D. SCINTILLATION VIALS AND GAMMA COUNTING TUBES

1. The NRC Regulations allow for the disposal of scintillation vials containing less than 0.05 μCi per gram (i.e., < 1.1×10^5 dpm per ml) of ^3H or ^{14}C without regard for the radioactivity. Thus, vials containing allowed levels may be simply disposed of as if it were not radioactive and need not be placed with the radioactive waste. Nevertheless, a record of their disposal should be maintained in the investigator's disposal records.

2. Other scintillation vials must be handled as solid waste. Again, segregate based on short or long half-life.

3. Only those scintillation cocktails that are biodegradable and have a high flash point may be used. The 2 cocktails currently approved by the RSO for use are **"READY SAFE," "BIOSAFE II," and ECOLUME.** If there is a specific requirement to utilize other cocktails, a memorandum must be submitted to the RSO detailing the specific application required, the reasons why the mandated cocktails are unsuitable and how the issue of storage and disposal of any resulting **"mixed waste"** will be addressed.

4. To minimize glass in the radioactive waste stream, only plastic scintillation vials and gamma counting vials are acceptable for use at USGS

E. MIXED OR MULTI-HAZARD WASTES

1. **A waste that contains any combination of radioactive, biohazardous, and chemically hazardous materials is referred to as multi hazard or mixed**

waste. Because of the nature of the research at USGS, biologically hazardous waste is not generated.

2. **Examples of mixed radioactive wastes are ones that contain: carcinogens, mutagens (ethidium bromide), pyrophoric compounds, reactive or toxic chemicals, nonaqueous liquids and solvents (oils, phenol and $CHCl_3$), heavy metals (mercury, lead, silver), corrosives (strong acids and bases).**

3. **These wastes are exceptionally difficult to deal with and there are currently no disposal sites in the United States certified to accept them. Consequently, every effort must be made to minimize the generation of such mixed wastes. Often this can be accomplished by careful planning.**

4. **Under no circumstances should such nonradioactive hazards enter the radioactive waste stream and under no circumstance should radioactive materials be allowed to enter the toxic or hazardous waste stream!**

5. If you anticipate generating any such wastes, contact the RSO prior to initiating the procedure.

VI. RADIATION PRODUCING EQUIPMENT

A number of instruments in the laboratory produce radiation when they are in operation. Therefore, special precautions are required by personnel when using these instruments or working around x-ray generating equipment and machines. Electron microscopes, when properly installed and with all shielding in place, keep the radiation confined within the instrument. In addition, once the beam hits a target, radiation is scattered in all directions and at various energies, and will produce radiation exposure outside the direct beam path.

The following policies and operator responsibilities will apply to radiation producing instruments and equipment at USGS.

A. POLICIES FOR RADIATION PRODUCING EQUIPMENT

1. All operating personnel and personnel in the immediate area will be required to wear a film badge and TLD or other personnel monitoring device.

2. Areas in which radiation producing machines are located or are being used shall be posted with the characteristic **CAUTION RADIATION** sign. In addition, the controls shall bear a decal with the statement: **CAUTION RADIATION--THIS EQUIPMENT PRODUCES RADIATION WHEN ENERGIZED.** Labels and decals are available from the RSO.

3. The structural shielding requirements of any new installation, or an existing one in which changes are contemplated, shall be discussed with the Radiation Safety Officer (RSO), prior to initiating any design changes or work locations and/or areas.

4. Radiation surveys will be made of all new installations and all existing installations after every change that might increase the radiation hazard.

5. Unless measurements indicate that they are not needed, protective aprons shall be worn by all personnel within the room or area who are frequently or habitually exposed to radiation.

6. If safe use of the installation depends upon mechanical restriction of the orientation of the radiation beam, or upon limitations in the output of the unit, then these restrictions shall be rigidly followed.

7. Shutter mechanisms and interlocking devices should not be tampered with and shall be inspected at frequent intervals to ensure proper operation.

8. All protective devices that may become defective due to use or abuse, such as protective lead aprons or gloves, should be inspected for radiation leakage at least every 6 months, or whenever the integrity of the equipment is suspected.

9. A manually reset cumulative timing device shall be used which will either indicate elapsed time or turn off the apparatus when the total exposure reaches a certain previously determined limit.

10. Personnel specifically responsible for such equipment shall ensure that all workers in the area are monitored in accordance with the requirements for the specific unit.

11. All interlocks, visual and audible warning devices, and monitoring equipment shall be inspected for proper operation at six month intervals by the RSO or his designee.

12. **An x-ray audit/inspection shall be conducted annually on the X-Ray Radiation Safety Program as well as the x-ray generating equipment and machines presently in use at the various USGS facilities located in the Washington, D.C. metropolitan area.**

13. **An annual radiation safety training program shall be conducted for individuals and personnel assigned to the operation and use of x-ray generating equipment and machines presently used at the various USGS facilities located in the Washington, D.C. metropolitan area.**

B. OPERATOR'S RESPONSIBILITIES

1. Notify the RSO when there is any change in the setup, i.e., new equipment installed, changes in shielding, change in output of radiation, or change in usage of the unit.

2. Request and wear appropriate monitoring devices. Always wear the assigned monitoring device (e.g., film badge and/or TLD) when working with the unit. Whenever protective lead aprons are work, the body monitor should be worn on the outside of the apron at the neckline.

3. Keep exposure as low as reasonably achievable (ALARA).

4. Clear the area of all nonessential personnel. The operator should insist that all nonessential personnel leave the exposure area before operating the unit, and that all essential personnel be adequately shielded.

5. Observe any restrictions on the use of the unit recommended by the Radiation Safety Officer (RSO).

6. Notify the supervisor and the RSO immediately of any accidental exposures to radiation.

7. Attend an annual radiation safety training program.

VII. APPENDICES

APPENDIX A

EMERGENCY PHONE CALL UNIT

APPENDIX A

EMERGENCY PHONE CALL LIST

NAMES AND PHONE NUMBER OF KEY PERSONNEL

Dr. Charles Naeser (Radiation Safety Officer, RSO)	Extension. 6964 Home phone: (703) 713-6869
Dr. Elizabeth Jones Principle Investigator and User	Extension. 7556 Home phone: (301) 598-0338
Mr. Gary Kramer Safety Office	Extension: 7556 Home phone: (301) 598-0338
Emergency Notification	Extension: 7222

TELEPHONE NUMBER OF REGION II NUCLEAR REGULATORY COMMISSION
(800) 577-8510

APPENDIX B

NOTICE TO EMPLOYEES

NRC FORM-3

NRC FORM 3
(1 96)

UNITED STATES NUCLEAR REGULATORY COMMISSION
Washington, DC 20555-0001

NOTICE TO EMPLOYEES

STANDARDS FOR PROTECTION AGAINST RADIATION (PART 20); NOTICES, INSTRUCTIONS AND REPORTS TO WORKERS; INSPECTIONS (PART 19); EMPLOYEE PROTECTION

WHAT IS THE NUCLEAR REGULATORY COMMISSION?

The Nuclear Regulatory Commission is an independent Federal regulatory agency responsible for licensing and inspecting nuclear power plants and other commercial uses of radioactive materials.

WHAT DOES THE NRC DO?

The NRC's primary responsibility is to ensure that workers and the public are protected from unnecessary or excessive exposure to radiation and that nuclear facilities, including power plants, are constructed to high quality standards and operated in a safe manner. The NRC does this by establishing requirements in Title 10 of the Code of Federal Regulations (10 CFR) and in licenses issued to nuclear users.

WHAT RESPONSIBILITY DOES MY EMPLOYER HAVE?

Any company that conducts activities licensed by the NRC must comply with the NRC's requirements. If a company violates NRC requirements, it can be fined or have its license modified, suspended or revoked.

Your employer must tell you which NRC radiation requirements apply to your work and must post NRC Notices of Violation involving radiological working conditions.

WHAT IS MY RESPONSIBILITY?

For your own protection and the protection of your co-workers, you should know how NRC requirements relate to your work and should obey them. If you observe violations of the requirements or have a safety concern, you should report them.

WHAT IF I CAUSE A VIOLATION?

If you engaged in deliberate misconduct that may cause a violation of the NRC requirements, or would have caused a violation if it had not been detected or deliberately provided inaccurate or incomplete information to either the NRC or to your employer, you may be subject to enforcement action. If you report such a violation, the NRC will consider the circumstances surrounding your reporting in determining the appropriate enforcement action, if any.

HOW DO I REPORT VIOLATIONS AND SAFETY CONCERNS?

If you believe that violations of NRC rules or the terms of the license have occurred, or if you have a safety concern, you should report them immediately to your supervisor. You may also report violations or safety concerns directly to the NRC. However, the NRC encourages you to raise your concerns with the licensee since it is the licensee who has the primary responsibility for ensuring and maintaining nuclear power plants and other commercial uses of radioactive materials.

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WHAT IF I WORK WITH RADIOACTIVE MATERIAL OR IN THE VICINITY OF A RADIATION SOURCE?

If you work with radioactive materials or near a radiation source, the amount of radiation exposure that you are permitted to receive may be limited by NRC regulations. The limits on your exposure are established in sections 20.1201, 20.1207, and 20.1208 of title 10 of the Code of Federal Regulations (10 CFR 20), depending on the part of the regulations to which your employer is subject. These limits are the maximum allowable limits, and your employer should also keep your radiation exposure as far below these limits as "reasonably achievable."

HOW I GET A RECORD OF MY RADIATION EXPOSURE?

Yes. Your employer is required to inform you of your dose annually if you are exposed to radiation for which monitoring was required by the NRC. In addition, you may request a written report of your exposure when you leave your job.

HOW ARE VIOLATIONS OF NRC REQUIREMENTS IDENTIFIED?

NRC conducts regular inspections of licensed facilities to ensure compliance with NRC requirements. In addition, your employer and the contractors conduct their own inspections to ensure compliance. No inspections are performed that require disturbance with doors may result in criminal prosecution by a Federal official.

WHAT I TALK WITH AN NRC INSPECTOR?

Yes. NRC inspectors want to talk to you if you are involved about radiation safety or have other safety concerns about licensed activities, such as the handling of nuclear materials or operations at your facility. You can also call the NRC and tell them what you want to say to inspectors. The NRC will follow up on complaints to protect your identity unless appropriate and practical.

MAY I REQUEST AN INSPECTION?

Yes. If you believe that your employer has not corrected violations involving radiological working conditions, you may request an inspection.

Your request should be addressed to the nearest NRC Regional Office and must describe the alleged violation in detail. It must be signed by you or your representative.

HOW DO I CONTACT THE NRC?

Talk to an NRC inspector on-site or call or write to the your will NRC Regional Office in your geographical area (see map below). If you call the NRC's toll-free SAFETY HOTLINE during normal business hours, your call will automatically be directed to the NRC Regional Office for your geographical area. If you call after normal business hours, your call will be directed to the NRC's Headquarters Operations Center, which is manned 24 hours a day.

CAN I BE FIRED FOR RAISING A SAFETY CONCERN?

Federal law prohibits an employer from: 1. or otherwise discriminating against you for bringing safety concerns to the attention of your employer or the NRC. You may feel the least or discriminated against because your:

- ask the NRC to enforce its rules against your employer;
- refuse to engage in activities which violate NRC requirements;
- provide information or are about to provide information to the NRC or your employer about violations of requirements or safety concerns;
- are about to ask for, or testify, help, or take part in an NRC, Congressional, or any Federal or State proceeding.

WHAT FORMS OF DISCRIMINATION ARE PROHIBITED?

It is unlawful for an employer to fire you or discriminate against you with respect to pay, benefits, or working conditions because you help the NRC or take a safety issue or allegation directly to your employer. As a protected activity, employees of licensees and contractors are protected under Section 211 of the Energy Reorganization Act (ERA) of 1974 as U.S.C. 5851) against discrimination and harassment by employers or co-workers who bring safety concerns directly to their employer or to the NRC. Employees who believe they have been discriminated against for engaging in protected activities may file a complaint with the Department of Labor (DOL) within 180 days of the alleged discrimination. Filing an allegation with the NRC does not extend the 180 day filing requirement. Employees who file complaints with DOL may request a hearing before an Administrative Law Judge (ALJ) of the Department of Labor's Office of Administrative Law Judges. The ALJ will issue a decision after the hearing. Either party may appeal the ALJ's decision to the Administrative Review Board (ARB) in Washington, DC. The ARB will issue a decision after reviewing the record and briefs submitted by the parties. If the ARB finds that discrimination occurred, it may order the employer to take corrective action, such as reinstating the employee, paying back wages, and restoring lost benefits. The ARB may also impose civil penalties on the employer. Employees who file complaints with DOL may request that the NRC delay its investigation until DOL has completed its investigation. If the NRC agrees to the request, it will monitor the DOL investigation. If DOL finds that discrimination occurred, the NRC may take enforcement action against the employer. Employees who believe they have been discriminated against for engaging in protected activities may also file a complaint with the U.S. Department of Labor (DOL) pursuant to Section 211 of the ERA. Your complaint must describe the being or discrimination and must be filed within 180 days of the occurrence. Filing an allegation, complaint, or request for action with the NRC does not extend a requirement to file a complaint with the DOL within 180 days. You must file the complaint with the DOL. The NRC cannot file the complaint for you.

Send complaints to:

Office of the Administrator
Wage and Hour Division, Room S3502
Employment Standards Administration
U.S. Department of Labor
Constitution Avenue, NW
Washington, DC 20210

or any local office of the DOL Wage and Hour Division. Check your telephone directory under U.S. Government listings.

WHAT CAN THE DEPARTMENT OF LABOR DO?

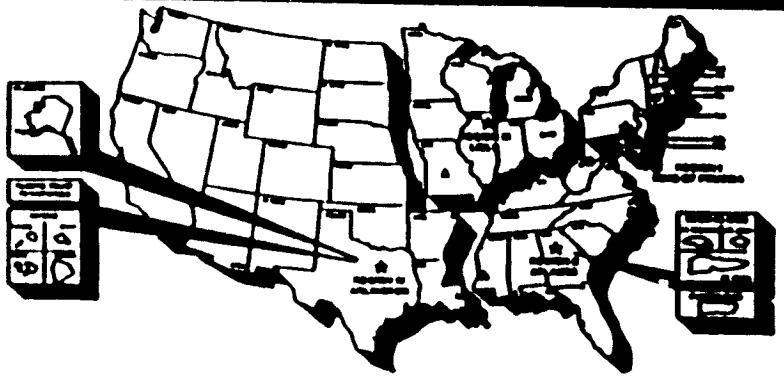
If your complaint involves a violation of Section 211 of the ERA by your employer, if the DOL NOT find NRC, your complaint is processed by obtaining a prompt recovery. The DOL will notify your employer that a complaint has been filed and will investigate your complaint.

If the DOL finds that your employer has unlawfully discriminated against you, it may order that you be reinstated, award back pay to be compensated for any injury suffered as a result of the discrimination.

WHAT WILL THE NRC DO?

The NRC will evaluate each allegation of harassment, intimidation, or discrimination. Following this evaluation, an investigation may be conducted by the Office of Investigations may determine that such actions occurred. Based on this investigation, and if applicable, the progress of the DOL will arrange a prompt and a decision. If the evidence obtained is sufficient to support an action by the NRC, the NRC may issue a Notice of Violation to the employer. The employer may be required to take corrective action, such as reinstating the employee, paying back wages, and restoring lost benefits. The NRC may order the employer to take these actions before the DOL process is completed, if it is necessary to ensure that the employer does not transfer assets out of the reach of the DOL. The NRC may also impose civil penalties on the employer. The NRC will normally wait for the DOL to complete its investigation before it begins its own investigation. If DOL finds that discrimination occurred, the NRC may take enforcement action against the employer. Employees who believe they have been discriminated against for engaging in protected activities may also file a complaint with DOL. The NRC will normally wait for the DOL to complete its investigation before it begins its own investigation. If DOL finds that discrimination occurred, the NRC will consider the actions of the DOL investigation.

If the NRC or DOL finds that unlawful discrimination has occurred, the NRC may issue a Notice of Violation to your employer, propose a fine, or recommend, modify, or rescind your employer's NRC license.



* * Callaway Plant Site in Missouri and Grand Gulf Plant Site in Mississippi are under the purview of Region IV.

UNITED STATES NUCLEAR REGULATORY COMMISSION REGIONAL OFFICE LOCATIONS

A representative of the Nuclear Regulatory Commission can be contacted by employees who wish to register complaints or concerns about radiological working conditions or other matters regarding compliance with Commission rules and regulations at the following addresses and telephone numbers.

REGIONAL OFFICES

REGION	ADDRESS	TELEPHONE
I	U.S. Nuclear Regulatory Commission, Region I 475 Allendale Road King of Prussia, PA 19406-1415	(610) 337-5000
II	U.S. Nuclear Regulatory Commission, Region II 101 Marietta Street, NW., Suite 2900 Atlanta, GA 30323-0199	(404) 331-4503
III	U.S. Nuclear Regulatory Commission, Region III 801 Warrenville Road Lisle, IL 60532-4351	(630) 829-9500
IV	U.S. Nuclear Regulatory Commission, Region IV 611 Ryan Plaza Drive, Suite 400 Arlington, TX 76011-8064	(817) 860-8100
VISALIA FIELD OFFICE	U.S. Nuclear Regulatory Commission 4430 South Lamb Visalia, CA 93277-9520	(209) 733-9590

To report safety concerns or violations of NRC requirements by your employer, telephone

NRC
SAFETY HOTLINE
1-800-695-7403

To report incidents involving fraud, waste, or abuse by an NRC employee or NRC contractor, telephone

OFFICE OF THE
INSPECTOR GENERAL
HOTLINE
1-800-233-3497

APPENDIX C

RADIONCULIDE INVENTORY RECORD

APPENDIX C

RADIOCUCLIDE INVENTORY RECORD

ISOTOPE	Chem[illegible]rm: _____ Act[illegible] _____ mCi Ven[illegible] _____ Catalog #: _____ P.O. #: _____ Auth[illegible]er: _____ Date: _____	INVENTORY NUMBER

Received By: _____ Date: _____

Activity: _____ mCi Volume: _____

Concentration: _____ mCi/ml As of: _____

Package Survey Results: _____

Date	Activity on Hand			Removed		Balance Remaining		User
	Vol.	Act. (mCi)	Conc.	Vol.	mCi	Vol.	Act. (mCi)	Name #

APPENDIX D

RADIONUCLIDE DISPOSAL RECORD

RADIONUCLIDE DISPOSAL RECORD

DATE	INV. NO.	ISOTOPE	MILLICURIES DISCARDED			COMMENTS	NAME	LOGGED
			SEWER	SOLID	VIALS			

APPENDIX E

REQUEST FOR APPROVAL TO USE

RADIONUCLIDES

IN A RESEARCH PROJECT

APPENDIX E

REQUEST FOR APPROVAL TO USE RADIONUCLIDES IN A RESEARCH PROJECT

Authorized User: _____
Last First M.I.

Principal Investigator (if different): _____

Date Submitted: _____ Laboratory Affiliation: _____

Names of individuals working on this project:

1. _____ 2. _____

3. _____ 4. _____

Room(s) in which radionuclides will be stored and use:

Radionuclide(s) to be used: Physical form:

Approximate mCi activity to be used per experiment:

Activity to be monitored and detected by:

Safety and shielding precautions to be employed:

Nature of radioactive wastes generated:

Disposal method for radioactive wastes:

Will infectious or "mixed wastes" be generated? If so, explain how they will be handled and disposed of.

(Use additional pages if necessary)

Reviewed by Radiation Safety Officer

Date _____

Approved _____

APPENDIX F

MONTHLY LABORATORY

CONTAMINATION SURVEY

APPENDIX H

SAMPLES OF RADIATI.

EXPOSURE HISTORY FORM

APPENDIX H

Radiation Safety Officer

_____ _____
(Name) (Date)

_____
(Address)

_____
(City, State, Zip code)

Dear Sirs:

I am now employed at the USGS Laboratories. During the time interval indicated on the bottom of this letter I was employed at your institution.

As required in 10 CFR 20.102 (c) (1), the information regarding my past radiation exposure is necessary to update my Radiation Dosimetry Report. Please send all of my past radiation exposure history to:

U.S. Geological Survey
246 National Center
12201 Sunrise Valley Drive
Reston, VA 20192

Thank you for your cooperation.

Sincerely,

_____
(Signature)

Full Legal Name: _____

Date of Birth: _____

Social Security No.: _____

Dates Employed From: _____ To: _____

NOTE TO EMPLOYEE: YOU MUST COMPLETE ONE OF THESE FORMS FOR EACH PREVIOUS EMPLOYMENT INVOLVING RADIATION EXPOSURE. SUBMIT THE COMPLETED FORM(S) TO THE USGS SAFETY OFFICER.

APPENDIX I

NUCLEAR REGULATORY COMMISSION

REGULATORY GUIDE 8.13

INSTRUCTION CONCERNING PRENATAL RADIATION EXPOSURE

DECEMBER 1987

Revision 2
December 1987

U.S. NUCLEAR REGULATORY COMMISSION

REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 8.13
(Task OP 031-4)

INSTRUCTION CONCERNING PRENATAL RADIATION EXPOSURE

A. INTRODUCTION

Section 19.12, "Instructions to Workers," of 10 CFR Part 19, "Notices, Instructions, and Reports to Workers; Inspections," requires that all individuals working in or frequenting any portion of a restricted area[1] be instructed in the health protection problems associated with exposure to radioactive materials or radiation, in precautions or procedures to minimize exposure, and in the regulations that they are expected to observe. The present 10 CFR Part 20, "Standards for Protection Against Radiation," has no special limit for exposure of the embryo/fetus.[2] This guide describes the instructions an employer should provide to workers and supervisors concerning biological risks to the embryo/fetus exposed to radiation, a dose limit for the embryo/fetus that is under consideration, and suggestions for reducing radiation exposure.

This regulatory guide takes into consideration a proposed revision to 10 CFR Part 20, which incorporates the radiation protection guidance for the embryo/fetus approved by the President in January 1987 (Ref. 1). This revision to Part 20 was issued in January 1986 for comment as a proposed rule. Comments on the guide as it pertains to the proposed Part 20 are encouraged. If the new Part 20 is codified, this regulatory guide will be revised to conform to the new regulation and will incorporate appropriate public comments.

Any information collection activities mentioned in this regulatory guide are contained as requirements in 10 CFR Parts 19 or 20, which provide the regulatory basis for this guide. The information collection requirements in 10 CFR Parts 19 and 20 have been cleared under OMB Clearance Nos. 3150-0044 and 3150-0014, respectively.

B. DISCUSSION

It has been known since 1906 that cells that are dividing very rapidly and are undifferentiated in their structure and function are generally more sensitive to radiation. In the embryo stage, cells meet both these criteria and thus would be expected to be highly sensitive to radiation. Furthermore, there is direct evidence that the embryo/fetus is radiosensitive. There is also evidence that it is especially sensitive to certain radiation effects during certain periods after conception, particularly during the first 2 to 3 months after conception when a woman may not be aware that she is pregnant.

Section 20.104 of 10 CFR Part 20 places different radiation dose limits on workers who are minors than on adult workers. Workers under the age of 18 are limited to one-tenth of the adult radiation dose limits. However, the present NRC regulations do not establish dose limits specifically for the embryo/fetus.

The NRC's present limit on the radiation dose that can be received on the job is 1,250 millirems per quarter (3 months).[3] Working minors (those under 18) are limited to a dose equal to one-tenth that of adults, 125 millirems per quarter. (See § 20.101 of 10 CFR Part 20.)

Because of the sensitivity of the unborn child, the National Council on Radiation Protection and Measurements (NCRP) has recommended that the dose equivalent

[1] Restricted area means any area that has controlled access to protect individuals from being exposed to radiation and radioactive materials.

[2] In conformity with the proposed revision to 10 CFR Part 20, the term "embryo/fetus" is used throughout this document to represent all stages of pregnancy.

[3] The limit is 3,000 millirems per quarter if the worker's occupational dose history is known and the average dose does not exceed 5,000 millirems per year.

to the unborn child from occupational exposure of the expectant mother be limited to 500 millirems for the entire pregnancy (Ref. 2). The 1987 Presidential guidance (Ref. 1) specifies an effective dose equivalent limit of 500 millirems to the unborn child if the pregnancy has been declared by the mother; the guidance also recommends that substantial variations in the rate of exposure be avoided. The NRC (in § 20.208 of its proposed revision to Part 20) has proposed adoption of the above limits on dose and rate of exposure.

In 1971, the NCRP commented on the occupational exposure of fertile women (Ref. 2) and suggested that fertile women should be employed only where the annual dose would be unlikely to exceed 2 or 3 rems and would be accumulated at a more or less steady rate. In 1977, the ICRP recommended that, when pregnancy has been diagnosed, the woman work only where it is unlikely that the annual dose would exceed 0.30 of the dose-equivalent limit of 5 rems (Ref. 3). In other words, the ICRP has recommended that pregnant women not work where the annual dose might exceed 1.5 rem.

C. REGULATORY POSITION

Instructions on radiation risks should be provided to workers, including supervisors, in accordance with § 19.12 of 10 CFR Part 19 before they are allowed to work in a restricted area. In providing instructions on radiation risks, employers should include specific instructions about the risks of radiation exposure to the embryo/fetus.

The instructions should be presented both orally and in printed form, and the instructions should include, as a minimum, the information provided in Appendix A (Instructor's Guide) to this guide. Individuals should be given the opportunity to ask questions and in turn should be questioned to determine whether they understand the instructions. An acceptable method of ensuring that the information is understood is to give a simple written test covering the material included in Appendix B (Pregnant Worker's Guide). This approach should highlight for instructors those parts of the instructions that cause difficulties and thereby lead to appropriate modifications in the instructional curriculum.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees regarding the NRC staff's plans for using this regulatory guide.

Except in those cases in which an applicant or licensee proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the NRC will use the material described in this guide to evaluate the instructional program presented to individuals, including supervisors, working in or frequenting any portion of a restricted area.

APPENDIX A

INSTRUCTOR'S GUIDE

EFFECTS ON THE EMBRYO/FETUS OF EXPOSURE TO RADIATION AND OTHER ENVIRONMENTAL HAZARDS

In order to decide whether to continue working while exposed to ionizing radiation during her pregnancy, a woman should understand the potential effects on an embryo/fetus, including those that may be produced by various environmental risks such as smoking and drinking. This will allow her to compare these risks with those produced by exposure to ionizing radiation.

Table 1 provides information on the potential effects resulting from exposure of an embryo/fetus to radiation and nonradiation risks. The second column gives the rate at which the effect is produced by natural causes in terms of the number per thousand cases. The fourth column gives the number of additional effects per thousand cases believed to be produced by exposure to the specified amount of the risk factor.

The following section discusses the studies from which the information in Table 1 was derived. The results of exposure of the embryo/fetus to the risk factors and the dependence on the amount of the exposure are explained.

1. RADIATION RISKS

1.1 Childhood Cancer

Numerous studies of radiation-induced childhood cancer have been performed, but a number of them are controversial. The National Academy of Science (NAS) BEIR report reevaluated the data from these studies and even reanalyzed the results. Some of the strongest support for a causal relationship is provided by twin data from the Oxford survey (Ref. 4). For maternal radiation doses of 1,000 millirems, the excess number of deaths (above those occurring from natural causes) was found to be 0.6 death per thousand children (Ref. 4).

1.2 Mental Retardation and Abnormal Smallness of the Head (Microcephaly)

Studies of Japanese children who were exposed while in the womb to the atomic bomb radiation at Hiroshima and Nagasaki have shown evidence of both small head size and mental retardation. Most of the children were exposed to radiation doses in the range of 1 to 50 rads. The importance of the most recent study lies in the fact that investigators were able to show that the gestational age (age of the embryo/fetus after conception) at the time the children were exposed was a critical factor (Ref. 7). The approximate risk of small head size as a function of gestational age is shown in Table 1. For a radiation dose of 1,000 millirems at 4 to 7 weeks after conception, the excess cases of small head size was 5 per thousand, at 8 to 11 weeks, it was 9 per thousand (Ref. 7).

In another study, the highest risk of mental retardation occurred during the 8 to 15 week period after conception (Ref. 8). A recent EPA study (Ref. 16) has calculated that excess cases of mental retardation per live birth lie between 0.5 and 4 per thousand per rad.

1.3 Genetic Effects

Radiation-induced genetic effects have not been observed to date in humans. The largest source of material for genetic studies involves the survivors of Hiroshima and Nagasaki, but the 77,000 births that occurred among the survivors showed no evidence of genetic effects. For doses received by the pregnant worker in the course of employment considered in this guide, the dose received by the embryo/fetus apparently would have a negligible effect on descendants (Refs. 17 and 18).

2. NONRADIATION RISKS

2.1 Occupation

A recent study (Ref. 9) involving the birth records of 130,000 children in the State of Washington indicates that the risk of death to the unborn child is related to the occupation of the mother. Workers in the metal industry, the chemical industry, medical technology, the wood industry, the textile industry, and farms exhibited stillbirths or spontaneous abortions at a rate of 90 per thousand above that of workers in the control group, which consisted of workers in several other industries.

2.2 Alcohol

It has been recognized since ancient times that alcohol consumption had an effect on the unborn child. Carthaginian law forbade the consumption of wine on the wedding night so that a defective child might not be conceived. Recent studies have indicated that small amounts of alcohol consumption have only the minor effect of reducing the birth weight slightly, but when consumption increases to 2 to 4 drinks per day, a pattern of abnormalities called the fetal alcohol syndrome (FAS) begins to appear (Ref. 11). This syndrome consists of reduced growth in the unborn child, faulty brain function, and abnormal facial features. There is a syndrome that has the same symptoms as full-blown FAS that occurs in children born to mothers who have not consumed alcohol. This naturally occurring syndrome occurs in about 1 to 2 cases per thousand (Ref. 10).

TABLE 1

EFFECTS OF RISK FACTORS ON PREGNANCY OUTCOME

Effect	Number Occurring from Natural Causes	Risk Factor	Excess Occurrences from Risk Factor
		RADIATION RISKS	
		Childhood Cancer	
Cancer death in children	1.4 per thousand (Ref. 5)	Radiation dose of 1000 millirems received before birth	0.6 per thousand (Ref. 4)
		Abnormalities	
		Radiation dose of 1000 millirads received during specific periods after conception:	
Small head size	40 per thousand (Ref. 6)	4-7 weeks after conception	5 per thousand (Ref. 7)
Small head size	40 per thousand (Ref. 6)	8-11 weeks after conception	9 per thousand (Ref. 7)
Mental retardation	4 per thousand (Ref. 8)	Radiation dose of 1000 millirads received 8 to 15 weeks after conception	4 per thousand (Ref. 8)
		NONRADIATION RISKS	
		Occupation	
Stillbirth or spontaneous abortion	200 per thousand (Ref. 9)	Work in high-risk occupations (see text)	90 per thousand (Ref. 9)
		Alcohol Consumption (see text)	
Fetal alcohol syndrome	1 to 2 per thousand (Ref. 10)	2-4 drinks per day	100 per thousand (Ref. 11)
Fetal alcohol syndrome	1 to 2 per thousand (Ref. 10)	More than 4 drinks per day	200 per thousand (Ref. 11)
Fetal alcohol syndrome	1 to 2 per thousand (Ref. 10)	Chronic alcoholic (more than 10 drinks per day)	350 per thousand (Ref. 12)
Perinatal infant death (around the time of birth)	23 per thousand (Refs. 13, 14)	Chronic alcoholic (more than 10 drinks per day)	170 per thousand (Ref. 15)
		Smoking	
Perinatal infant death	23 per thousand (Refs. 13 14)	Less than 1 pack per day	5 per thousand (Ref. 13)
Perinatal infant death	23 per thousand (Refs. 13, 14)	One pack or more per day	10 per thousand (Ref. 13)

For mothers who consume 2 to 4 drinks per day, the excess occurrences number about 100 per thousand; and for those who consume more than 4 drinks per day, excess occurrences number 200 per thousand. The most sensitive period for this effect of alcohol appears to be the first few weeks after conception, before the mother-to-be realizes she is pregnant (Refs. 10 and 11). Also, 17% or 170 per thousand of the embryo/fetuses of chronic alcoholics develop FAS and die before birth (Ref. 15). FAS was first identified in 1973 in the United States where less than full-blown effects of the syndrome are now referred to as fetal alcohol effects (FAE) (Ref. 12).

2.3 Smoking

Smoking during pregnancy causes reduced birth weights in babies amounting to 5 to 9 ounces on the average. In addition, there is an increased risk of 5 infant deaths per thousand for mothers who smoke less than one pack per day and 10 infant deaths per thousand for mothers who smoke one or more packs per day (Ref. 13).

2.4 Miscellaneous

Numerous other risks affect the embryo/fetus, only a few of which are touched upon here. Most people are familiar with the drug thalidomide (a sedative given to some pregnant women), which causes children to be born with missing limbs, and the more recent use of the drug diethylstilbestrol (DES), a synthetic estrogen given to some women to treat menstrual disorders, which produced vaginal cancers in the daughters born to women who took the drug. Living at high altitudes also gives rise to an increase in the number of low-birth-weight children born, while an increase in Down's Syndrome (mongolism) occurs in children born to mothers who are over 35 years of age. The rapid growth in the use of ultrasound in recent years has sparked an ongoing investigation into the risks of using ultrasound for diagnostic procedures (Ref. 19).

APPENDIX B

PREGNANT WORKER'S GUIDE

POSSIBLE HEALTH RISKS TO CHILDREN OF WOMEN WHO ARE EXPOSED TO RADIATION DURING PREGNANCY

During pregnancy, you should be aware of things in your surroundings or in your style of life that could affect your unborn child. For those of you who work in or visit areas designated as Restricted Areas (where access is controlled to protect individuals from being exposed to radiation and radioactive materials), it is desirable that you understand the biological risks of radiation to your unborn child.

Everyone is exposed daily to various kinds of radiation: heat, light, ultraviolet, microwave, ionizing, and so on. For the purposes of this guide, only ionizing radiation (such as x-rays, gamma rays, neutrons, and other high-speed atomic particles) is considered. Actually, everything is radioactive and all human activities involve exposure to radiation. People are exposed to different amounts of natural "background" ionizing radiation depending on where they live. Radon gas in homes is a problem of growing concern. Background radiation comes from three sources:

	Average Annual Dose
Terrestrial - radiation from soil and rocks	50 millirem
Cosmic - radiation from outer space	50 millirem
Radioactivity normally found within the human body	25 millirem
	125 millirem*
Dosage range (geographic and other factors)	75 to 5,000 millirem

The first two of these sources expose the body from the outside, and the last one exposes it from the inside. The average person is thus exposed to a total dose of about 125 millirems per year from natural background radiation.

In addition to exposure from normal background radiation, medical procedures may contribute to the dose people receive. The following table lists the average doses received by the bone marrow (the blood-forming cells) from different medical applications.

X-Ray Procedure	Average Dose*
Normal chest examination	10 millirem
Normal dental examination	10 millirem
Rib cage examination	140 millirem
Gall bladder examination	270 millirem
Barium enema examination	500 millirem
Pelvic examination	600 millirem

*Variations by a factor of 2 (above and below) are not unusual.

*Radiation doses in this document are described in two different units. The rad is a measure of the amount of energy absorbed in a certain amount of material (100 ergs per gram). Equal amounts of energy absorbed from different types of radiation may lead to different biological effects. The rem is a unit that reflects the biological damage done to the body. The millirad and millirem refer to 1/1000 of a rad and a rem, respectively.

NRC POSITION

NRC regulations and guidance are based on the conservative assumption that any amount of radiation, no matter how small, can have a harmful effect on an adult, child, or unborn child. This assumption is said to be conservative because there are no data showing ill effects from small doses; the National Academy of Sciences recently expressed "uncertainty as to whether a dose of, say, 1 rad would have any effect at all." Although it is known that the unborn child is more sensitive to radiation than adults, particularly during certain stages of development, the NRC has not established a special dose limit for protection of the unborn child. Such a limit could result in job discrimination for women of child-bearing age and perhaps in the invasion of privacy (if pregnancy tests were required) if a separate regulatory dose limit were specified for the unborn child. Therefore, the NRC has taken the position that special protection of the unborn child should be *voluntary* and should be based on decisions made by workers and employers who are well informed about the risks involved.

For the NRC position to be effective, it is important that both the employee and the employer understand the risk to the unborn child from radiation received as a result of the occupational exposure of the mother. This document tries to explain the risk as clearly as possible and to compare it with other risks to the unborn child during pregnancy. It is hoped this will help pregnant employees balance the risk to the unborn child against the benefits of employment to decide if the risk is worth taking. This document also discusses methods of keeping the dose, and therefore the risk, to the unborn child as low as is reasonably achievable.

RADIATION DOSE LIMITS

The NRC's present limit on the radiation dose that can be received on the job is 1,250 millirems per quarter (3 months).* Working minors (those under 18) are limited to a dose equal to one-tenth that of adults, 125 millirems per quarter. (See § 20.101 of 10 CFR Part 20.)

Because of the sensitivity of the unborn child, the National Council on Radiation Protection and Measurements (NCRP) has recommended that the dose equivalent to the unborn child from occupational exposure of the expectant mother be limited to 500 millirems for the entire pregnancy (Ref. 2). The 1987 Presidential guidance (Ref. 1) specifies an effective dose equivalent limit of 500 millirems to the unborn child if the pregnancy has been declared by the mother; the guidance also recommends that substantial variations in the rate of exposure be avoided. The NRC (in § 20.208 of its proposed revision to Part 20) has proposed adoption of the above limits on dose and rate of exposure.

ADVICE FOR EMPLOYEE AND EMPLOYER

Although the risks to the unborn child are small under normal working conditions, it is still advisable to limit the radiation dose from occupational exposure to no more than 500 millirems for the total pregnancy. Employee and employer should work together to decide the best method for accomplishing this goal. Some methods that might be used include reducing the time spent in radiation areas, wearing some shielding over the abdominal area, and keeping an extra distance from radiation sources when possible. The employer or health physicist will be able to estimate the probable dose to the unborn child during the normal nine-month pregnancy period and to inform the employee of the amount. If the predicted dose exceeds 500 millirems, the employee and employer should work out schedules or procedures to limit the dose to the 500-millirem recommended limit.

It is important that the employee inform the employer of her condition as soon as she realizes she is pregnant if the dose to the unborn child is to be minimized.

INTERNAL HAZARDS

This document has been directed primarily toward a discussion of radiation doses received from sources outside the body. Workers should also be aware that there is a risk of radioactive material entering the body in workplaces where unsealed radioactive material is used. Nuclear medicine clinics, laboratories, and certain manufacturers use radioactive material in bulk form, often as a liquid or a gas. A list of the commonly used materials and safety precautions for each is beyond the scope of this document, but certain general precautions might include the following:

1. Do not smoke, eat, drink, or apply cosmetics around radioactive material.
2. Do not pipette solutions by mouth.
3. Use disposable gloves while handling radioactive material when feasible.
4. Wash hands after working around radioactive material.
5. Wear lab coats or other protective clothing whenever there is a possibility of spills.

Remember that the employer is required to have demonstrated that it will have safe procedures and practices before the NRC issues it a license to use radioactive material. Workers are urged to follow established procedures and consult the employer's radiation safety officer or health physicist whenever problems or questions arise.

*The limit is 3,000 millirems per quarter if the worker's occupational dose history is known and the average dose does not exceed 5,000 millirems per year.

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APPENDIX J

DOCUMENTATION OF RECEIPT

OF

NRC GUIDE 8.13

APPENDIX J

DOCUMENTATION OF NRC GUIDE 8.13

This form must be completed and submitted to the Radiation Safety Officer.

As a woman of childbearing age and an individual using radionuclides or working in an area I where radionuclides are used, I have been presented with a copy of the U.S. NRC Regulatory Guide 8.13 "INSTRUCTION CONCERNING PRENATAL RADIATION EXPOSURE," I understand that I am to read the document and request clarification of any points which are unclear from my supervisor or from the USGS Radiation Safety Officer or his designee.

Please print clearly below:

Data on Individual Receiving Document:

Name _____ Title (Dr., Mr., Ms.) _____

Birtl. Date ____/____/____ SSN _____ Laboratory _____

Work Phone _____ Work Station: Building _____ Room _____

_____ _____ ____/____/____

signature date

Privacy Act Statement: The information collected by this form is essential for maintenance of records for employees potentially exposed to ionizing radiation as required by Codes of Federal Regulation, Title 10. Parts 19 and 20, and by the US Nuclear Regulatory Commission Materials Licence #45-15923-01 granted to USGS. Certain information is protected by the Privacy Act of 1974. Providing your social security account number and birth date is voluntary, however, failure to provide these items may result in your not being permitted to work in areas using radioactive materials. The information collected is used in a system of records to track your radiation exposure, use of radioactive materials and training in radiation safety. The primary user of this information is the Radiation Safety Officer. Routine use may include disclosure of some of this information to those who may assist or provide service to the Radiation Safety Officer or, if necessary, to defend the Government or its employees of USGS in a lawsuit.

APPENDIX K

FORM LETTER FOR DECLARING PREGNANCY

APPENDIX K

FORM LETTER FOR DECLARING PREGNANCY

This form letter is provided for your convenience. To make your declaration of pregnancy, you may fill in the blanks in this form letter and give it to your employer or you may write your own letter.

DECLARATION OF PREGNANCY

To: _____

(Name of your supervisor or other employer representative)

I am declaring that I am pregnant. I believe I became pregnant in _____, _____ (only the month and year need be provided).

I understand that my occupational radiation dose during my entire pregnancy will not be allowed to exceed 0.5 rem (5 millisieverts) (unless that dose has already been exceeded between the time of conception and submitting this letter). I also understand that meeting the lower dose limit may require a change in job or job responsibilities during my pregnancy.

If I find out that I am not pregnant, or if my pregnancy is terminated, I will promptly inform you in writing that my pregnancy has ended. (This promise to inform your employer in writing when your pregnancy has ended is optional. The sentence may be crossed out if you wish.)

_____

(Your signature)

_____

(Your name printed)

_____

(Date)

APPENDIX L

CERTIFICATION FORM

THAT EQUIPMENT IS

FREE FROM HAZARDS

APPENDIX F

MONTHLY LABORATORY CONTAMINATION SURVEY

Please print. Submit one copy and retain one copy for laboratory records.

AUTHORIZED USER	LAST NAME, FIRST INITIAL	PHONE EXT.	BLDG. / ROOM NO.	
SURVEYOR	LAST NAME, FIRST INITIAL	PHONE EXT.	DATE	

DIAGRAM OF LABORATORY. Sketch lab and number at least 10 locations surveyed. Indicate where waste containers and other radionuclides are stored. (If the space is insufficient, use a separate page)

NUCLIDES USED

Indicate nuclides and activity used in this lab since your last monthly survey.
(Place an X in the appropriate box.)

Activity →	< 1 mCi	1-10 mCi	>10 mCi
H-3			
S-35			
C-14			
P-32			
I-125			
Cr-51			
Other			

SMEAR RESULTS (in net DPM)

(Fill in nuclide(s) across the top of the chart.) Indicate under "Remarks" the corrective action taken for locations with > 100 dpm/100 cm²

LOCATION (from diagram)	Nuclide:	Nuclide:	Nuclide:
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

REMARKS: Include explanations of actions taken on smears > 100 DPM / 100 cm2

TYPE OF COUNTER USED TO ANALYZE SMEARS

☐ Liquid Scintillation Counter ☐ Gamma Counter

☐ If nuclides not used in last month, check here and indicate on #.

SURVEYOR'S SIGNATURE

APPENDIX G

TRAINING AND EXPERIENCE IN USE

OF

RADIOACTIVE MATERIALS

APPENDIX G

TRAINING AND EXPERIENCE IN USE OF RADIOACTIVE MATERIALS

NAME:_____ DATE OF BIRTH:_____
Last First M.I.

SOCIAL SECURITY NUMBER:_____ LABORATORY:_____

__ I have previously received formal training in the use of radioactive materials. (Continue on back if necessary)

Where Trained	Length of Course	Dates of Course	Comments

__ I have previously worked with radioactive materials.

Isotope	Maximum Amount	Where Used	Duration	Type of Use	Comments

__ I have completed the video training course "Radiation Safety in the Laboratory" on _____(date) and have had the opportunity to ask for additional information.

__ I have received a copy of NRC Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure," and have had the opportunity to ask for additional information. (Required for women of child-bearing age)

__ I have received a copy of the USGS Radiation Safety Manual.

By signing below, I acknowledge that the above statements are true.

Signed,_____ Date:_____

QUALIFICATIONS OF RADIONUCLIDE USERS

DATE:	PHONE:	MAILCODE:	DIVISION:
NAME:	JOB TITLE:	BIRTHDATE:	SSN:
LIST RADIONUCLIDES TO BE USED:		PRINCIPAL INVESTIGATOR:	

TRAINING AND EXPERIENCE

TYPE OF TRAINING AND COURSE TITLE	SPONSOR/LOCATION	DATES	LENGTH
A. PRINCIPLES AND PRACTICES OF RADIATION PROTECTION COURSE TITLE:			
B. RADIOACTIVITY MEASUREMENTS AND MONITORING TECHNIQUES COURSE TITLE:			
C. MATHEMATICS / CALCULATIONS BASIC TO THE MEASUREMENT OF RADIOACTIVITY COURSE TITLE:			
D. BIOLOGICAL EFFECTS OF RADIATION COURSE TITLE:			

RADIONUCLIDE	MAXIMUM ACTIVITY USED	WHERE	DATES USED	TYPE OF USE

SUPERVISOR'S SIGNATURE: _____

PRINCIPAL INVESTIGATOR'S SIGNATURE: _____