BGSU

Bowling Green State University

Radiation Safety Program

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INTRODUCTION

Foreword

In 1970, the United States Congress established the right of workers to "safe and healthful working conditions" through the Occupational Safety and Health Act. This act created the Occupational Safety and Health Administration (OSHA). House Bill 308 incorporates by reference all federal OSHA standards found in the Code of Federal Regulations (CFR), Title 29 Parts 1910, 1926 and 1928 as Ohio Public Employment Risk Reduction Program (PERRP) standards. All Ohio PERRP standards are found in Chapter 4167 of the Ohio Revised Code and the Ohio Administrative Code.

This program has been established by Bowling Green State University to comply with OSHA's Ionizing Radiation standard, 29 CFR 1910.1096, Ohio Department of Health's Radiation Control regulations, Ohio Revised Code 3701:1, as well as all other state and local regulations.

Objective

The objective of this program is to convey expectations on the safe use and personnel training related to ionizing radiation, such as radioactive material and x-ray generating equipment, to ensure a safe working and community environment.

Applicability

This program applies to all departments, laboratories, and persons at the University or at its off-campus sites, which receive, possess, use, transport, or dispose of radioactive material (including x-ray generating equipment). Persons who use materials or equipment involving ionizing radiation at Bowling Green State University can be divided into four categories: (a) those who use small amounts of radioactive substances that are exempt from licensing requirements, (b) those who are approved to use specific amounts and types of isotopes for education and research, (c) those who are using ionizing radiations emanating from sealed or fixed sources, and (d) those who are using non-radioactive ionizing radiation sources (X-ray machines, electron microscopes and X-ray spectrographs). Health and safety hazards exist in each category and therefore all these activities come under the purview of the Department of Environmental Health and Safety (EHS) at the University.

Responsibilities

Radiation Safety Officer (RSO), is responsible for:

- Insuring that the University satisfies licensing requirements;
- Overseeing the implementation of appropriate radiation protection standards to safeguard personnel;
- Managing the components of the Radiation Safety Program; and,
- Developing and coordinating appropriate training for those who work with ionizing radiation.

Principal Investigators (PIs)/Approved Users, are responsible for:

- Ensuring employees attend required training administered by the RSO;
- Attending Laboratory Safety training (if applicable) and Radiation Safety training (virtually or in-person) at least once annually;
- Regularly inspect their radiation use sites for contamination;

- Promptly correct deficiencies found during Quarterly Radiation Inspections conducted by the RSO;
- Ensure that radioactive materials in their possession are properly secured against unauthorized removal when not in use;
- Ensure that the use of radiation sources by persons under their supervision is done in accordance with Ohio Department of Health regulations and the University Radiation Safety Program;
- Ensure that all persons under their supervision (when appropriate) wear personnel monitoring equipment when using radioactive materials or radiation producing equipment; and
- Maintain an accurate inventory of radioactive materials in their possession and proper documentation and records for any waste generated while working with these materials or instruments.

Researchers/Non-supervisory members of the Radiation Safety Program are responsible for:

- Completely adhering to all requirements set forth in this program;
- Report safety injuries, incidents, and concerns to the PI; and
- Attending training sessions as required.

Program Enforcement

A violation of a university employee's responsibility must be reported to the employee's immediate supervisor for appropriate action.

Accident Reporting

BGSU's electronic Injury/Illness form must be submitted if there is an accident or near-miss incident involving radioactive material and x-rays. This form can be found on EHS's website.

PROCEDURES FOR THE USE OF RADIOACTIVE MATERIALS

Scope

This section outlines the standard safety procedures for work using ionizing radiation. It is expected that all individuals working with radioactive materials, including x-ray generating equipment, are to follow these procedures.

Exemptions

Exempt amounts of radioactive materials are defined as items in form acquired directly from the environment (*e.g. geological samples*), self-luminous radium dials on watches, clocks or other instruments, and radioactive material of activity less than 1 microcurie (not as a sealed source) or less than 10 microcuries (as a sealed source).

The RSO need not approve users and laboratories having exempt amounts. However, the RSO reserves the right to examine laboratories using these materials. Exempt users must follow proper labeling, disposal, operating and safety procedures, including the general radiation protection requirements outlined below. All radioactive isotopes, including exempt amounts, must be included in the annual isotope inventory.

Control of Radiation Exposure: the ALARA principle

Pursuant to OAC 3701:1-38-12(A) and OAC 3701:1-38-13 (A) and (B), the external and internal exposure from each source of radiation shall be controlled in such a way as to provide reasonable assurance that not individual shall receive an absorbed dose more than the values listed in Table 2.1.

Table 2.1 ***Maximum Permissible Dose Equivalent Values for Occupational Exposure***

Category	Rems Per Year
Whole body: head; trunk; arms above elbow; legs above knee; and gonads	5.0
Individual organs (other than the lens of the eye)	50
Lens of the eye	15
Skin of whole body	15
Occasionally exposed individual	0.5
Students, public; uncontrolled areas	0.1

NOTE: The annual occupational dose limits for minors are 10 percent of the annual dose limits specified for adult workers. (Reference: OAC 3701:1-38-12)

The doses referenced in Table 2.1 are in addition to those received by the individual from all sources of ionizing radiation naturally present in the environment and from that administered for medical purposes.

Special precautions must be taken for female workers of child-bearing age. In accordance with OAC 3701:1-38-12 (H), the maximum permissible dose for a declared pregnant female during the entire pregnancy must not

exceed 0.5 rem, and separate records for these individuals must be maintained in accordance with OAC 3701:1-38-20 (I).

Irrespective of the dose limits specified above, procedures shall be implemented to ensure that all exposure to ionizing radiation from normal operations is kept As Low As Reasonable Achievable (ALARA). The ALARA principle means that, even if doses are below allowances, and procedures reasonably can be implemented which can make them lower, then those procedures should be implemented. Conforming with the ALARA principle implies that a regular review of personnel exposure and operating procedures takes place. The University is committed to this principle and will provide support and assistance to researchers and lab workers with its implementation.

Compliance with Regulations of Governmental Agencies

The use, storage, transportation, and disposal of radioactive materials must conform with the applicable regulations of the State of Ohio. Regulatory authority for the use of radioactive materials and radiation generating devices resides with the Ohio Department of Health through their Bureau of Radiation Protection. Applicable regulations are found in the Ohio Administrative Code, Section 5, 3701:1-38, which are incorporated herein by reference.

Registration of Performance Areas and Workers

Each room or laboratory in which radioactive material is to be handled or stored must be registered with the RSO and approved for this use. Individuals who wish to use radioactive materials on a one-time basis, and who are not approved users for the isotope, will submit an "Application for Use of Radioactive Materials" form to the RSO (*see Appendix 1*). The RSO must approve the application prior to the individual using the radioactive material.

One-time users must work under the direct supervision of an Approved User. The authorized user is responsible for making available to those working under their direct supervision the pertinent training and instruction on isotope use.

Each person who may handle radioactive material or who may be exposed to external radiation (except for prescribed medical purposes) more than 10% of the applicable maximum permissible dose values set forth in Table 2.1 of this program, must receive training and instruction on isotope use or radiation generating devices prior to beginning work such materials/equipment.

Individuals wishing to be placed on the University's Radioactive Material License will submit a "Radiation User Qualifications" form to the RSO (*see Appendix 2*). The RSO will review the application and, if approved, submit a request to the Ohio Department of Health for an amendment to the license. All persons using radioactive sources and/or substances within the University are responsible for adhering to the procedures outlined in the University Radiation Safety Program and, ultimately, to provisions of the State of Ohio as prescribed in OAC 3701:1-38.

Radiation Surveys and Monitoring

Each laboratory using radioactive material must have appropriate radiation detection instruments to enable personnel to monitor for radiation exposure and surface contamination.

The RSO conducts quarterly safety inspections of laboratories and spaces that use radioactive materials and radiation sources. These inspections include leak tests, radiation surveys, swap wipe tests of areas where radioisotopes are used, a check of operating procedures and security measures, signs and safety equipment, and a review of records (*see Appendix 3*). These quarterly inspections are published electronically and submitted to the Approved User and the department chair. Approved users may request their authorized users to have access to these reports by contacting the RSO. Approved users are responsible for correcting any deficiencies found in a reasonable time frame, and to note such corrections on the electronic report. The RSO will review all corrections or perform an on-site re-evaluation, to ensure all items are addressed properly.

Researchers using x-ray machines must annually conduct equipment monitoring for stray radiation, and at least every six months conduct tests to ensure that safety devices, such as interlocks, lights, and alarms are in proper working order. This is usually conducted by the RSO on a quarterly basis. A log recording the date of monitoring, activity found from equipment, points of leakage, and the name of the surveyor will be kept. These items are recorded electronically and are shared with the Approved User and their department chair. Approved users may request their authorized users to have access to these reports by contacting the RSO. Approved users are responsible for correcting any deficiencies found in a reasonable time frame, and to note such corrections on the electronic report. The RSO will review all corrections or perform an on-site re-evaluation, to ensure all items are addressed properly. If the user suspects abnormally high readings, problems with the equipment, or have shut down the equipment for long-term maintenance (greater than one month) throughout the year, they should contact the RSO.

Following each use of radioactive materials, researchers will routinely conduct laboratory surveys including checks for contamination of work areas, benches, tables, sinks, etc. A log will be kept recording: the date, activity and location of contamination, names of surveyor and Approved User/principal investigator, and actions taken. If problems are found within the laboratory, the principal investigator should contact the RSO.

Sealed Sources

Each registered sealed source shall be tested for leakage and/or contamination at intervals not to exceed six months, or prior to each use. In the absence of a certificate from a transferor indicating that a test has been made within six months prior to a transfer, a sealed source received from another person shall not be put into use until tested.

The test shall detect the presence of 0.005 microcurie of radioactive material on the test sample. The test sample shall be taken from the surfaces of the device in which the source is mounted of stored on, where one might expect contamination to accumulate.

Records of leak test results shall be maintained for inspection by ODH.

If the test reveals the presence of 0.005 microcuries or more of removable contamination, the source will be immediately withdrawn from use and must be decontaminated and repaired or disposed of in accordance with NRC regulations. A report shall be filed within five days or the test with ODH describing the equipment involved, the test results, and the corrective action taken.

Tests for leakage and/or contamination shall be performed by the licensee, RSO, or other persons specifically authorized by the RSO to perform such service.

Personnel Monitoring

The University has implemented a radiation dosimetry program to monitor the dose equivalents received by those persons working with sources of ionizing radiation. The monitors provide a permanent personal record of external exposure to radiation that the user may have received during the period of use. Benefits of the monitoring program include: alerting the RSO of equipment mishandling and/or of equipment malfunctions; generating occupational exposure history records for the individual and a reference in the event of future industrial or legal claims; and providing a quantitative basis for evaluating laboratory procedures and a means of assessment for meeting the ALARA component of the University's radiation safety program. Persons working in laboratories with radioisotopes or with radiation generating equipment can request a dosimetry badge free of charge by completing a "Request for Dosimetry Badge" form (*see Appendix 4*).

Personnel monitoring equipment is required for:

- Persons in or entering restricted areas who are likely to receive 10 percent of the applicable permissible dose values set forth in Table 2.1 of this manual;
- Individuals under 18 years of age who enter a restricted area and are likely to receive more than 5 percent of the applicable permissible dose values set forth in Table 2.1 of this manual; and
- Individuals who enter a high radiation area.

Personnel monitoring equipment is NOT required for personnel who are using closed beam analytical units, per OAC 3701:1-66-02 (G)(6). However, regulatory leak testing and inspections will still be followed to ensure exposure limits are consistently similar to background levels. If a closed beam analytical device fails an inspection, dosimeters will be required for users of that device.

Infrequent users: If desired, spare personnel monitors can be placed in some laboratories for use by visitors or infrequent users of radioactive materials. Only one person can be assigned a temporary badge and/or ring during the monthly monitoring period, and the Maximum Permissible Dose (MPD) Equivalent Values for such persons is limited to 10 percent of the MPD for an ordinary radiation worker. The principal investigator is responsible for keeping records of the name, sex, birth date, dates of exposure, and corresponding badge number (if applicable) of any person using a temporary dosimetry badge, and a copy of this information must be submitted with the used monitors of each month.

Pregnant females: Special precautions must be taken for pregnant women. All female users should be informed that the recommended MPD for pregnant women during the gestation period is 10 percent of the ordinary MPD for other workers. If a pregnancy declaration is made and the woman so requests, her dosimetry records will be separately maintained. If the accumulated dose of the individual already exceeds 10 percent of MPD at the time of declaration, she will be so informed and given an opportunity either to work elsewhere during the remainder of the pregnancy or to proceed with the personal knowledge of her exposure.

Collection: On approximately the first of each month all dosimetry badges and rings, used or not, are collected by the RSO. Control badges are kept in the Environmental Health and Safety office, combined with the collected badges, and returned to the service provider for analysis.

Exposure: The dosimetry badges presently in use will record a radiation exposure of 1 millirem or more of gamma and 10 millirem or more of hard beta radiation. If an exposure of 10 percent or more of the monthly averaged MPD is indicated on a badge, the user will be contacted and asked to complete a "Radiation Exposure

Report" (*see Appendix 5*). This report provides a written explanation of how the exposure might have been obtained and provides a basis for recommendations of revised procedures to prevent further exposure.

This procedure is for the benefit of the user and may detect malfunctions in the equipment, personal protective equipment and/or shielding. Inquiries will commence immediately after the exposure analysis is received from the analysis service company.

The personnel monitors used at BGSU are thermoluminescence detectors (TLD rings) for fingers, and Luxel solid-state whole-body dosimetry badges for the torso. The RSO will distribute whole body badges and rings to persons utilizing x-ray equipment (if required) and whole-body badges only to those using radioisotopes with hard beta and/or gamma emissions. The badges and rings will be worn always when working with non-exempt x-ray equipment and other sources of ionizing radiation. Body badges must be worn in the area between the neck and the waistline. Rings will be worn on the dominant hand. Rings are to be worn under gloves with the label facing the palm of the hand. If using lead aprons while working with radiation sources, badges will be worn underneath the apron.

When not in use, all badges and rings are to be kept away from all radiation sources. Badges should be stored in a secure place in the laboratory known both to the user and the RSO. Like lab coats, gloves, and goggles, dosimetry badges are not to be shared with others nor taken home or out of the workplace.

PERSONNEL MONITORS ARE TO BE WORN ONLY BY THE ASSIGNED INDIVIDUAL

Dosimetry records are maintained by the University RSO and will be reported to individuals annually or more frequently upon request. Upon termination of employment at BGSU, dosimetry records are archived by the University. These records will be given to the employee or can be transferred to another employer upon request.

Storage or Radioactive Material

Radioactive material must be kept or stored in a manner that will provide minimum exposure to personnel. Suitable storage precautions will be taken against fire, explosion, flood, or unauthorized removal. Volatile materials shall be appropriately labeled and stored in chemical fume hoods with adequate filtering and ventilation.

Transportation of Radioactive Material

To comply with regulations, radioactive material to be transported outside of the University property boundaries must be packaged in accordance with Department of Transportation regulations. The RSO will advise on the requirements for packaging, radiation control, measurements, and documentation needed for such shipments.

Except for the transfer of radioactive materials during standard laboratory procedures, transportation of radioactive material within BGSU property boundaries must be in conformity with the following:

- The material shall be transported in a closed shatterproof container that is properly labeled.
- The measured dose rates shall not exceed:
    - 200 millirem/hour at any point on the external surface of the container
    - 10 millirem/hour at one meter from any external surface of the package

- The transferable surface contamination as measured by a wipe-test shall not exceed 600 dpmo/300 cm^2 of alpha activity, and 6600 dpm/300 cm^2 of beta plus gamma activity.

Caution Signs and Labels

In conformity with OAC 3701:1-38-10, each laboratory storing or using radioactive material will be posted with appropriate signs as follows:

- A notice of where a copy of the institutional materials license or certificate of registration is located;
- A notice of where a complete copy of the Ohio Administrative Code, OAC 3701:1-38, can be found;
- Any notice of violation involving working conditions;
- The Ohio Department of Health "Notice to Employees" issued by the Bureau of Radiation Protection; and
- A listing of emergency contacts and telephone numbers.

Each container holding radioactive material of the types and amounts prescribed in OAC 3701:1-38-18, must have a durable, clearly visible label bearing the three-bladed radiation symbol and the words: "CAUTION RADIOACTIVE MATERIAL". These labels must also state the quantities and kinds of radioactive materials in the containers and the date of measurement of the quantities.

General Radiation Protection Requirements and Precautions

General research safety procedures, as outlined in the Laboratory Safety and Chemical Hygiene Guide, are to be followed in laboratories using radioactive material or radiation generating equipment. Some of these procedures include:

- No smoking, eating, drinking, applying of cosmetics, chewing of gum, or storing of food for human consumption.
- Sandals, open-toed shoes, or bare feet are not allowed in the laboratory.
- No mouth pipetting.
- Approved exhaust ventilation is required when performing operations that might produce airborne contaminants (i.e. evaporations, sanding or grinding, transfers of unsealed powdered or volatile radioactive material).
- Proper personal protective equipment (PPE) such as: gloves, lab coats, and safety goggles are required to be used when handling radioactive materials. After handling unsealed radioactive material, hands must be washed before leaving the laboratory. Exposed hair, skin, and clothing should be surveyed for possible contamination.
- Materials and equipment will be surveyed prior to removal from a potentially contaminated area.

Ordering Radioactive Materials

All orders for radioactive materials must follow Purchasing Department procedures and guidelines, including approval from the RSO, to ensure that the requested materials and quantities are authorized by the license for use by the requesting user and that institutional possession limits are not exceeded. Only Approved Users may order radioactive materials, and only the isotopes, chemical forms, and quantities for which the user is currently approved for will be allowed. If changes to an Approved Users' isotope or quantity designation is required, requests must be sent to the RSO within a reasonable time frame (preferably one month or more).

Orders for radioactive materials must be made via Falcon's Purch with the appropriate tag (ex. RADIOACTIVE MATERIALS) in the body of the requisition. Information required at the time of requisition includes, but is not limited to:

- Vendor's name
- Isotope name and/or symbol
- Activity in millicuries
- Chemical form
- Approved User's Name
- User's signature/confirmation
- Safety Data Sheet (SDS)
- Location where material is to be delivered

After completion, the requisition should be sent to the RSO and Purchasing for approval.

Receiving and Opening Radioactive Shipments

All radioactive material orders are shipped to and received by the RSO. Upon receipt, packages are monitored with a hand-held survey meter for external radiation levels and are tested for surface contamination via liquid scintillation counting of a swab sample. Per requirements of 49 CFR 173.443, as delineated in OAC 3701:1-50-05(A), limits on removable contamination for packages with alpha emitters are 660 dpm/300 cm^2 and 6600 dpm/300 cm^2 for beta-gamma emitters. If these limits are exceeded, the package is quarantined, and the shipper and researcher are both notified. A form for use in inspection of radioactive packages is included in *Appendix 6*.

The following procedure for opening each package is followed by the RSO or designee prior to delivery to the Approved User:

- Put on gloves to prevent hand contamination.

- Visually inspect the package for any signs of damage (*e.g. wet or crushed*). If damage is noted, stop the procedure and notify the RSO.

- Measure the exposure rate at the package surface at 1 meter. If it is higher than expected, stop and notify the RSO. (The "transport index" noted on the package with "Yellow II" or "Yellow III" labels are the approximate dose rate, in millirem per hour, at 1 meter from the package surface pursuant to OAC 3701:1-50-17(J)(1), the surface dose rate from such packages should not exceed 200 millirem per hour. The dose rate from packages with "White I" labels should be less than 0.5 millirem per hour at the package surface (see OAC 3701:1-50-05).

- Wipe all package surfaces (top, sides, and bottom) with a swab sample. Be sure to wipe areas of the package likely to exhibit contamination (e.g. seams and bottom) and to cover a total area of at least 300 cm^2 (roughly an area of 7 inches x 7 inches). Insert this sample into a vial of scintillation fluid and analyze with the liquid scintillation counter using channel(s) appropriate for the isotope in question. For packages containing beta-gamma sources, if the swab sample exhibits more than 6,600 dpmo of activity (660 dpm for alpha sources), stop the procedure, quarantine the package, and immediately notify the RSO, the shipper, and the user who ordered the material. Otherwise, proceed to the next step.

- Open the package with the following precautionary steps:
    - Remove the packing slip.
    - Open the outer package following the supplier's instructions, if provided.
    - Open the inner package and verify that the contents agree with the packing slip. (NOTE: It may be necessary to use thermal protection gloves when container is shipped in dry ice)

- Check the user request to ensure that the material received is the material that was ordered.

- Make a record of the receipt.

- Deliver the package, and copies of the paperwork, to the Approved User, or a radiation safety trained employee in the laboratory or stockroom.

Upon receipt of a radioactive material package, the Approved User (or the Approved User's designee) will follow the following procedures:

- Put on gloves to prevent hand contamination.

- Visually inspect the package for any signs of damage (e.g. wet or crushed). If damage is noted, stop the procedure and notify the RSO.

- Measure the exposure rate at the package surface at 1 meter and at the package surface. If higher than expected, stop and notify the RSO. (The "transport index" noted on the package with "Yellow II" or "Yellow III" labels are the approximate dose rate, in millirem per hour, at 1 meter from the package surface pursuant to OAC 3701:1-50-17(J)(1), the surface dose rate from such packages should not exceed 200 millirem per hour. The dose rate from packages with "White I" labels should be less than 0.5 millirem per hour at the package surface (see OAC 3701:1-50-05).

- Open the package with the following precautionary steps:
    - Open the outer package following the supplier's instructions, if provided.
    - Open the inner package and verify that the contents agree with the packing slip and with the original requisition. (CAUTION: It may be necessary to use thermal protection gloves when container is shipped in dry ice).
    - Check the integrity of the final source container. Look for broken seals or vials, loss of liquid, condensation, or discoloration of the packing material. If anything is older than expected, stop and notify the RSO.

- If there is any reason to suspect contamination, wipe the external surface of the final source container and remove the sample to a low-background area. Assay the wipe sample to determine

if there is any removable radioactivity. Take precautions against potential spread of contamination.

- Assuming all is in order, place the source container in the agreed upon secured location in the laboratory (locked freezer, etc.) and be sure the storage location is secure.

- Place the associated Radioactive Materials Receipt Log Sheet in the lab notebook or post this sheet in the agreed upon location in the lab for access by users of these materials.

- Monitor the packing material and the empty cartons for contamination with a survey meter before discarding.
    - If contaminated, treat this material as radioactive waste.
    - If not contaminated, remove or obliterate the radiation labels before discarding in ordinary trash.

Radiation Survey Meters

Hand held radiation survey meters suitable for measuring beta and gamma radiation for most isotopes in use at BGSU are supplied by the RSO to each laboratory where such isotopes are used. These meters are calibrated annually by an external service company (i.e. Ludlum), and appropriate stickers indicating the date of calibration and meter sensitivities are included on each meter. Calibration records for each instrument are maintained by the RSO.

Maintaining a working meter with fresh batteries and current calibration ultimately is the responsibility of the Approved User, but the RSO aids with this function. Survey meters are checked by the RSO monthly when dosimetry badges are exchanged in laboratories and are tested or exchanged at the time of quarterly inspection.

Spare survey meters are maintained by the RSO, and a replacement meter can be requested in the event of equipment failure or breakage.

DISPOSAL OF RADIOACTIVE WASTES

Introduction

Radioactive wastes must be disposed of in a manner that protects the health and safety of the public. The means of accomplishing this are outlined in OAC 3701:1-38-19. For the type and amounts of materials used at BGSU, three basic methods of disposal are employed:

1. Discharge to sanitary sewer.
2. Decay in storage.
3. Transfer to an authorized agent for disposal at a licensed radioactive waste disposal facility.

Restrictions and special procedures apply for each disposal method, as prescribed in OAC 3701:1-38-12 and 19.

Disposal to Sanitary Sewer

Radioactive material discharged into laboratory drains must be readily soluble or dispersible in water. Laboratories will designate sinks for disposal of radioactive waste, and only these sinks should be used for this purpose. The sinks will be labeled "FOR USE OF RADIOACTIVE WASTE ONLY". The amounts of radioactivity that can be discharged into the University's sewerage system are limited both in terms of concentration as well as total activity.

Average concentrations of radioactive material discharged into the laboratory drains in any one month when diluted by the average monthly water quantities released by the University to the public sewerage system, must not exceed values listed in OAC 3701:1-38-12, Appendix C, Table III. Based on University average monthly water usage, these concentration limits would allow discharges far more than the total disposal limits permitted under OAC 3701:1-38-19(D)(4). Accordingly, we have chosen to restrict drain disposal based on institutional possession limits and actual usage of isotopes at BGSU. For this purpose, no more than 30 microcuries per day of Carbon-14 or 100 microcuries of Hydrogen-3 may be released by a laboratory into the sewerage system, and no more than 30 microcuries per day total of all other approved isotope. These limits are sufficiently restrictive to ensure that the total activity of radioactive material discharged into the laboratory drains per year remains well below the five curies of Tritium (^{3}H), one curie of Carbon-14(^{14}C) and one curie of all other combined licensed material as required by OAC 3701:1-38-19(D)(4).

Records must be kept of the quantity and kind of radioactive material disposed of into the laboratory drains. Forms to be used to record such disposals are included in *Appendix 7*.

The RSO will maintain a calendar quarterly summary record of the total amount of activity being discharged from the institution, and, if indicated by this record, restrict the amount to be discharged during the latter quarter(s) of the year sufficiently to ensure that less than one curie is discharged per year.

In summary, liquid waste may be disposed via the sanitary sewer system at BGSU provided that the following conditions are met:

- Unless an exception is made by the RSO, each Approved User of radionuclides must use only one sink for the disposal of liquid waste per research group.

- Each sink must be identified as being approved for radioactive waste disposal with the appropriate caution sign displayed.

- The daily limits of radioactive material released must not be exceeded. These limits must be posted on each sink.

- All releases of radioactive material must be followed by flushing the sink with copious amounts of water.

- The liquid waste must be readily soluble or dispersible in water.

- Flammable solvents that are not miscible with water must not be flushed down the drain.

- Radioactive material that can be conveniently decayed in storage (*e.g. P-32 and I-125*) must not be disposed via the sewer.

- High concentrations of radioactive material should not be disposed of via the sewer system.

Disposal into Waste Collection Containers

All radioactive waste not discharged into the laboratory drains shall be put into special collection containers labeled as "RADIOACTIVE WASTE" according to the following rules:

Isotopes must be disposed of separately in containers specifically marked to receive these materials (*e.g.* ^{32}P, ^{14}C, ^{35}S, ^{125}I, *etc.*). DO NOT MIX ISOTOPES IN THE WASTE STREAM. Short-lived isotopes, such as ^{32}P and ^{125}I will be held for decay-in-storage and ultimately placed in the ordinary trash for landfill. Long-lived isotopes, such as ^{14}C and ^{3}H, are stored temporarily pending transfer to an approved landfill by a certified waste hauler.

The total amount of radioactive material put into any container must be controlled so that the radiation level one foot from the container is less than 5 millirems/hour, and the radiation level at contact with any surface of the container is less than 200 millirems/hour.

Material must not be put into the waste collection containers if there is any possibility of a chemical reaction during storage that might cause an explosion of cause the release of chemically toxic or radioactive gases.

Solutions must be neutralized to a pH range between 4 and 10 prior to disposal into the waste container.

Volatile compounds shall not be put into a radioactive material waste collection container, unless the procedure has been specifically authorized by the RSO.

Highly reactive materials must be reacted to completion prior to disposal into the waste container.

Animal tissue or excreta solid shall not be put into a radioactive material waste collection container, unless the procedure has been specifically authorized by the RSO. Special disposal procedures should be arranged with the RSO prior to the start of work that will produce this kind of waste material.

A record must be kept of the estimated activity and kinds of radioactive material disposed into the solid waste collection containers. A summary disposal record must be presented to the RSO at the time of collection of the container.

Release into Ventilation Exhaust System

Unless otherwise authorized by the RSO, the 24-hour average concentration of radioactive material entering the duct system of each laboratory must not exceed the limits of OAC 3701:1-38-12, Appendix C, Table II.

The RSO must be notified immediately if there is a release into the environs of airborne radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed the limits specified for such materials.

Determinations of the average concentration of radioactive material may be made with respect to the point where the material leaves the exhaust duct. Concentrations may not be averaged over a period longer than one day, without prior authorization of the RSO.

Exempt Waste Disposal

The following licensed radioactive materials may be disposed of as if they were not radioactive (Ref. OAC 3701:1-38-19(G)):

- 0.05 microcurie (1.85 kBq), or less, of Hydrogen-3 or Carbon-14 per gram of medium used for liquid scintillation counting.

- 0.05 microcurie (1.85 kBq), or less, of Hydrogen-3 or Carbon-14 per gram of animal tissue, averaged over the weight of the entire animal.

Waste Not Otherwise Covered

The RSO must be notified prior to the start of work which will produce radioactive waste material not covered by the above regulations. Isotopes may not be ordered, and work may not begin, until the user and RSO have agreed upon a waste disposal procedure.

EMERGENCY PROCEDURES

Overview

In the event of personal radiation exposure or accidental release of radioactive material more than the amounts listed in this program, the RSO must be notified immediately. This section covers emergency procedures involving:

- Serious injury with contamination,
- Minor injury with contamination, and
- Contamination without injury.

Serious Injury with Contamination Involved

Notification: Dial 911 (Public Safety)

Tell person who answers:

- Somebody has been seriously injured in the _____ building, room _____.
- Radioactivity is involved.
- Your name.
- Telephone extension being used.

Care of the injured:

- Apply first aid if necessary.
- Stay with the injured person until physician or emergency assistance arrives.
- Advise on extent of injured person's contamination.

Contamination control while waiting for help:

For a localized, non-volatile spill:

- Rope off or guard the spill area against entry.
- Assemble potentially contaminated people in one area and monitor them for contamination.
- Wait for the RSO.

For a release of powered, volatile or gaseous material:

- Evacuate personnel from room immediately, turning off any laboratory apparatus that needs constant attention.

- Assemble personnel immediately outside of the room and instruct them to stay in one location to prevent the spread of contamination.

- Close and lock the doors of room to prevent entry. If hood fans are off, try to seal the accessible openings into the laboratory to prevent further spread of the radioactive material.

- Isolate the adjacent corridor against traffic and spectators.

- Wait for the RSO to arrive.

Minor Injury with Contamination Involved

Notification: Dial 911 (Public Safety)

Tell the person who answers:

- Somebody has been seriously injured in the _____ building, room _____.

- Radioactivity is involved.

- Your name.

- Telephone extension being used.

Care of the injured:

- Apply first aid if necessary.

- Survey clothing for contamination.

- Remove significantly contaminated clothing and, if necessary, clothe the injured person in an uncontaminated laboratory coat.

- Escort injured person to the Emergency Room of the Wood County Hospital. Notify medical personnel of the contamination.

Contamination control:

For a localized, non-volatile spill:

- Rope off or guard the spill area against entry.

- Assemble potentially contaminated people in one area and monitor them for contamination.

- Assign a responsible person to control the area and wait for the RSO.

For a release of powered, volatile or gaseous material:

- Evacuate personnel from room immediately, turning off any laboratory apparatus that needs constant attention.

- Assemble personnel immediately outside of the room and instruct them to stay in one location to prevent the spread of contamination.
- Close and lock the doors of room to prevent entry. If hood fans are off, try to seal the accessible openings into the laboratory to prevent further spread of the radioactive material.
- Isolate the adjacent corridor against traffic and spectators.
- Assign a responsible person to control the area and wait for the RSO to arrive.

Contamination Incident Without Injury

Notification: Dial 911 (Public Safety)

Tell the person who answers:

- Radioactive material has been spilled in the _____ building, room _____.
- Your name.
- Telephone extension being used.

Contamination control:

For a localized, non-volatile spill:

- Rope off or guard the spill area against entry.
- Assemble potentially contaminated people in one area and monitor them for contamination.
- Wait for the RSO.

For a release of powered, volatile or gaseous material:

- Evacuate personnel from room immediately, turning off any laboratory apparatus that needs constant attention.
- Assemble personnel immediately outside of the room and instruct them to stay in one location to prevent the spread of contamination.
- Close and lock the doors of room to prevent entry. If hood fans are off, try to seal the accessible openings into the laboratory to prevent further spread of the radioactive material.
- Isolate the adjacent corridor against traffic and spectators.
- Wait for the RSO to arrive.

Notifications and Reporting

Requirements of notification for incidents and reports involving licensed materials are listed in OAC 3701:1-38-21. In general, reportable incidents include (1) stolen, lost, or missing materials, (2) excess doses, (3) release of material outside restricted areas, or (4) loss of control or accidental release of materials. Contact the RSO prior to, and for guidance in reporting to the Ohio Department of Health. Report any non-routine contamination incidents, including all incidence of personnel contamination. Report any persistent contamination.

Furthermore, if any updates to this program or other BGSU policies occur, affected personnel will be notified via e-mail and an updated version will be posted to the Environmental Health and Safety webpage.

Decontamination Procedures

Personnel:

- Remove loose contamination. Use care to prevent the spread of contamination and be extra careful around wounds.
- Wash contaminated areas. Use a mild soap or detergent initially; use a mild abrasive soap for more persistent contamination.

Persistent Contamination:

- After washing hands, clipping the fingernails may be helpful in reducing contamination at finger tips.
- Contact the RSO for additional assistance.

Equipment and Buildings:

Decontamination

- Isolate contaminated area
- Clean with damp towel and cleaner
- Resurvey
- Repeat cleaning if required

Decay

- Allow to decay, protect with absorbent paper and warning signs
- For longer half-life, seal with paint or wax

APPENDIX 1 – APPLICATION FOR USE OF RADIOACTIVE MATERIALS

Appendix 1

APPLICATION FOR USE OF RADIOACTIVE MATERIAL

BGSU procedures require that the following items be completed prior to commencing research or instructional work using radioisotopes. Complete the following and return this form to the Radiation Safety Officer, c/o Department of Environmental Health & Safety, 101G Huntington Building.

Name:_____ Department:_____

Lab Room Number:_____ Telephone:_____

Dates Materials are to be Used: _____ through _____

Radionuclide(s) to be used: _____

Maximum activity anticipated to be held in the laboratory at any given time: _____ millicuries

Physical/Chemical Form:_____

Have you completed the BGSU User Qualification Form?

Have you read and do you understand:

a. Administration and Procedures from the BGSU Radiation Safety Manual (Sections 1 and 2) No

b. OAC 3701:1-38 No

c. Section 10 of the Manual, Guide to Radiation Safety in the Laboratory No

d. Section 3 of the BGSU Radiation Safety Manual regarding disposal of waste No

Has your laboratory been posted and labeled in accordance with Sec. 2.13 of the BGSU Radiation Safety Manual?

Have you held or scheduled a laboratory training session on safety for all personnel expected to frequent the area?

Date held/to be held:_____

Briefly describe:

a. Laboratory monitoring technique to be used.

b. Special precautions to be taken against accidental exposure to lab workers

c. Proposed disposal method.

(cont'd over)

Briefly describe the experiment or activity you will be performing, including procedures used in handling materials, chemical/physical form of isotope, dilution procedures (if any), maximum activity used in a procedure and any other information pertinent to radiation safety in your laboratory. It is not necessary to repeat information already provided in other sections above.

I understand this information will be maintained and used by the Radiation Safety Office and. is subject to inspection by the Ohio Department of Health.

_____ Date:_____

Applicant Signature

RSO Use Only

Approved: YES ☐ NO ☐ Date:_____

APPENDIX 2 – RADIATION USER QUALIFICATIONS

Appendix 2

RADIATION USER QUALIFICATIONS

Name:_____ Department:_____

Laboratory Room #_____ Telephone: _____

	Type of Training _____	**Where Training Occurred** _____	**Duration of Training (clock hours)** _____	**Date Ended** _____	**Indicate whether training was formal or on-the-job** _____
Principals and practices of radiation protection					
Radioactivity measurement, standardization, monitoring techniques and instruments					
Instrumentation, mathematics and calculations basic to the use and measurement of radioactivity					
Biological effects of radiation					

Experience with radiation (actual use of isotopes or equivalent experience)

Isotope	Max Amount Used (mCi)_	Where	Duration	Ending Use

I understand this information is subject to inspection by the Ohio Department of Health. The information will be maintained by the BGSU Radiation Safety Office as required by Federal and State regulations.

Signature _____

Applicant

Date:

APPENDIX 3 – QUARTERLY SURVEY OF RADIATION AND X-RAY GENERATING EQUIPMENT LABORATORY

Appendix 3

QUARTERLY SURVEY OF RADIATION AND X-RAY LABORATORIES

Quarterly Inspection Questions for Laboratories Using Radioactive Materials

#	Question	Recommendation
	RADIATION	
1	Answer YES to this question and note what meter is being used to perform investigational radiation readings.	Please enter the Brand, Model, Serial Number, and last Calibration Date.
2	Before conducting readings, has the Ludlum meter been calibrated within the past year?	Ludlum meter should not be used if not calibrated within the past year.
3	What is the reading at the first point in the lab? (Note: Type in what location in the lab was surveyed).	This is the first reading.
4	What is the reading at the second point in the lab? (Note: Type in what location in the lab was surveyed).	This is the second reading.
5	What is the reading at the third point in the lab? (Note: Type in what location in the lab was surveyed).	This is the third reading.
6	What is the reading at the fourth point in the lab? (Note: Type in what location in the lab was surveyed).	This is the fourth reading.
7	What is the reading at the fifth point in the lab? (Note: Type in what location in the lab was surveyed).	This is the fifth reading.
8	What is the reading at the sixth point in the lab? (Note: Type in what location in the lab was surveyed).	This is the sixth reading.
9	What is the reading at the seventh point in the lab? (Note: Type in what location in the lab was surveyed).	This is the seventh reading.
10	What is the reading at the eighth point in the lab? (Note: Type in what location in the lab was surveyed).	This is the eighth reading.
11	What is the reading at the ninth point in the lab? (Note: Type in what location in the lab was surveyed).	This is the ninth reading.
12	What is the reading at the tenth point in the lab? (Note: Type in what location in the lab was surveyed).	This is the tenth reading.
13	Is the first wipe test sample free of contamination? (Note: Type in what location in the lab was surveyed and the wipe test results with Background and Standard Sample).	This survey will test P-32, H-3, C-14, S-35, and I-125.
14	Is the second wipe test sample free of contamination? (Note: Type in what location in the lab was surveyed and the wipe test results with Background and Standard Sample).	This survey will test P-32, H-3, C-14, S-35, and I-125.
15	Is the third wipe test sample free of contamination? (Note: Type in what location in the lab was surveyed and the wipe test results with Background and Standard Sample).	This survey will test P-32, H-3, C-14, S-35, and I-125.
16	Is the fourth wipe test sample free of contamination? (Note: Type in what location in the lab was surveyed and the wipe test results with Background and Standard Sample).	This survey will test P-32, H-3, C-14, S-35, and I-125.

17	Is the fifth wipe test sample free of contamination? (Note: Type in what location in the lab was surveyed and the wipe test results with Background and Standard Sample).	This survey will test P-32, H-3, C-14, S-35, and I-125.
18	Is the sixth wipe test sample free of contamination? (Note: Type in what location in the lab was surveyed and the wipe test results with Background and Standard Sample).	This survey will test P-32, H-3, C-14, S-35, and I-125.
19	Is the seventh wipe test sample free of contamination? (Note: Type in what location in the lab was surveyed and the wipe test results with Background and Standard Sample).	This survey will test P-32, H-3, C-14, S-35, and I-125.
20	Is the eighth wipe test sample free of contamination? (Note: Type in what location in the lab was surveyed and the wipe test results with Background and Standard Sample).	This survey will test P-32, H-3, C-14, S-35, and I-125.
21	Is the ninth wipe test sample free of contamination? (Note: Type in what location in the lab was surveyed and the wipe test results with Background and Standard Sample).	This survey will test P-32, H-3, C-14, S-35, and I-125.
22	Is the tenth wipe test sample free of contamination? (Note: Type in what location in the lab was surveyed and the wipe test results with Background and Standard Sample).	This survey will test P-32, H-3, C-14, S-35, and I-125.
23	Is the eleventh wipe test sample free of contamination? (Note: Type in what location in the lab was surveyed and the wipe test results with Background and Standard Sample).	This survey will test P-32, H-3, C-14, S-35, and I-125.
24	Is the twelfth wipe test sample free of contamination? (Note: Type in what location in the lab was surveyed and the wipe test results with Background and Standard Sample).	This survey will test P-32, H-3, C-14, S-35, and I-125.
25	Is the thirteenth wipe test sample free of contamination? (Note: Type in what location in the lab was surveyed and the wipe test results with Background and Standard Sample).	This survey will test P-32, H-3, C-14, S-35, and I-125.
26	Is the fourteenth wipe test sample free of contamination? (Note: Type in what location in the lab was surveyed and the wipe test results with Background and Standard Sample).	This survey will test P-32, H-3, C-14, S-35, and I-125.
27	Is the fifteenth wipe test sample free of contamination? (Note: Type in what location in the lab was surveyed and the wipe test results with Background and Standard Sample).	This survey will test P-32, H-3, C-14, S-35, and I-125.
28	Are areas of activity clearly marked?	Areas of activity, or areas that radioactive material is used, should be marked with radioactive tape.
29	Are lab coats and gloves in use?	Lab coats and gloves are to be in use when working with radioactive material.
30	Are laboratory doors and radioactive storage cabinet doors secured properly?	Laboratory and radioactive material access should be strictly enforced to only those who have authorized access and training.
31	Are meters present in the laboratory calibrated within the past year? (NOTE: Please enter the type of meter, serial	All radiation detection meters must be in-calibration.

	number, and last date of calibration. Also note if a meter has been swapped out with a new meter).	
32	Are radioactive waste containers empty (disposal not needed)?	EHS/RSO can assist with proper disposal of radioactive material.
33	Are waste containers adequate in the lab?	Waste containers need to be in good working condition in the lab.
34	Has the emergency contact information posted outside of the laboratory been updated within the past academic year?	Emergency contact information must be audited at least once every academic year to ensure that personnel are still relevant to the lab.
35	If required, are dosimetry badges in use?	Dosimetry badges are to be in use by authorized personnel who are trained and working in radiation labs.
36	If used, are sink disposal records maintained properly?	Sink disposal records are to be filled out properly. Sink disposal limits can be found in the BGSU Radiation Safety Manual on the EHS website under "Radiation Safety".
37	Is an updated copy of the BGSU Radiation Safety Manual present within the lab?	Updated copies of the BGSU Radiation Safety Manual can be found on the EHS website under the "Radiation Safety" tab.
38	Is an updated copy of the Ohio Department of Health "Notice to Employees" poster available in the lab?	An updated copy of the ODH "Notice to Employees" poster must be posted in the lab at all times. Updated copies can be found on the ODH website.
39	Is an updated version of the Ohio Department of Health License for Radioactive Material present in the lab?	An updated version of the RAM License should be posted within the lab at all times. The RSO can assist.
40	Is appropriate shielding in place?	Shielding, such as lead pigs/bricks and Plexiglas shields for example, should be available in the lab.
41	Is emergency contact information posted outside of the laboratory?	Emergency contact information must be posted outside of the laboratory for multiple personnel who manage the space.
42	Is the lab free of any other minor deficiencies? (Note: If not, please enter the deficiency in.)	This is to indicate any miscellaneous minor deficiencies present in the lab.
43	Is the lab free of any other urgent deficiencies? (Note: If not, please enter the deficiency in.)	This is to indicate any miscellaneous urgent deficiencies that need to be taken care of right away.
44	Is the lab free of the use of food or drink?	Food and drink are strictly prohibited in any BGSU laboratory.
45	Is the material inventory maintained in the lab?	Material Inventory should be maintained each time product is received or used.
46	Is the Material Logbook complete?	The Material Logbook must be completed when working with radioactive material.
47	What is the background reading outside the hallway of the lab?	This is the background reading.
48	What isotopes are used in this laboratory?	Isotopes used in the laboratory are to be in accordance with what the permit allows and with the correct PI. (Condition #12 of License)

Quarterly Inspection Questions for X-Ray Generating Equipment

#	Question	Recommendation
	X-RAY	
1	Are all interlocks, signs, lights, and labels working properly?	All interlocks, signs, lights, and labels are to be inspected according to OAC and working properly.
2	Are dosimeters for authorized personnel available in the lab?	Dosimeters, per the BGSU Radiation Safety Manual, are required for individuals working with XRDs.
3	Are engineering and procedural controls adequate and no undue stray radiation attributable to the unit?	This determination is based off of the inspection reading with the Fluke meter and by comparing spare dosimetry records on a monthly basis.
4	Before conducting readings, has the Fluke meter been calibrated within the past year?	Fluke meter should not be used if not calibrated within the past year.
5	Has the emergency contact information posted outside of the laboratory been updated within the past academic year?	Emergency contact information must be audited at least once every academic year to ensure that personnel are still relevant to the lab.
6	Is an updated copy of the BGSU Radiation Safety Manual present within the lab?	Updated copies of the BGSU Radiation Safety Manual can be found on the EHS website under the "Radiation Safety" tab.
7	Is an updated copy of the Ohio Department of Health "Notice to Employees" poster available in the lab?	An updated copy of the ODH "Notice to Employees" poster must be posted in the lab at all times. Updated copies can be found on the ODH website.
8	Is an updated copy of the Ohio Department of Health Radiation Protection Rules (OAC Ch. 3701:1-28 and 3701:1-66) available in the lab?	An updated copy of the ODH regs should be available in the lab at all times. Updated regulations can be found on the ODH website.
9	Is emergency contact information posted outside of the laboratory?	Emergency contact information must be posted outside of the laboratory for multiple personnel who manage the space.
10	Is the lab free of any other deficiencies? (Note: If not, please enter the deficiency in.)	This is to indicate any miscellaneous urgent deficiencies that need to be taken care of right away.
11	Is the most recent "Certificate of Registration" posted within the lab?	Updated copies of the "Certificate of Registration" can be found by contacting the Radiation Safety Officer.
12	Using the Fluke meter, what is the reading at the doorway of the laboratory?	This will be considered the doorway reading.
13	Using the Fluke meter, what is the reading at this location?	PSLB 116: Above chiller. PSLB 215: At computer desk. Overman 272: At computer desk.
14	Using the Fluke meter, what is the reading at this location?	PSLB 116: In front of computer desk. PSLB 215: On countertop near XRD. Overman 272: Bookshelf next to XRD
15	Using the Fluke meter, what is the reading at this location?	PSLB 116: Near N Wall by sink. PSLB 215: On countertop near South end Overman 272: On top of XRD.
16	Using the Fluke meter, what is the reading in front of the XRD?	This will be considered the reading in front of the XRD.
17	Using the Fluke meter, what is the reading outside of the laboratory?	This will be considered the background reading.
18	Who represented the department during the inspection?	A department representative is required during a Quarterly X-Ray Inspection.

APPENDIX 4 – REQUEST FOR DOSIMETRY BADGE FORM

Appendix 4

REQUEST FOR DOSIMETRY BADGE

Radiation dosimetry badges are provided free of charge to persons working with radioisotopes and to workers using radiation generating equipment such as x-rays. Badges are replaced monthly and are sent for analysis to an independent agent who provides personal exposure records for each badge holder. Certain information is required in order for you to be included in our dosimetry reporting service. Please complete this page and return it to the address below. If you have previously participated in a dosimetry program, either at BGSU or elsewhere also complete the reverse of this form.

Name:_____ Date of Birth: _____
(MM/DD/YY)

BGSU ID Number: _____

Dominant Hand: (check one) ☐ Left ☐ Right Gender: ☐ Male ☐ Female

Isotopes to be used or anticipated source(s) of radiation exposure: _____

Building and room number where work is to be performed: _____

Name of laboratory director or immediate supervisor: _____

FOR PREVIOUS BADGE HOLDERS:

If you have previously worn a dosimetry badge, either here or elsewhere, records of previous occupational exposures will be needed. In order to facilitate obtaining this information, please fill in the reverse of this form with the address of the most recent location where a dosimetry reporting service was used. In addition, please sign the authorization block on the back so the information may be released to us.

When complete, return this form to:

Radiation Safety Office
Department of Environmental Health & Safety
101C Huntington Building
Bowling Green State University
Bowling Green, Ohio 43403
(419) 372-2173

(cont'd over)

Previous Dosimetry Service

Most Recent Employer:_____

Address:_____

_____

_____

_____

Dates of Employment

From:_____

To:_____

AUTHORIZATION

Authorization for the release of my radiation exposure history to Bowling Green State University is hereby given.

Name:_____
Please Print

Signed:_____
Date:_____

APPENDIX 5 – RADIATION EXPOSURE REPORT

Appendix 5

RADIATION EXPOSURE REPORT

The purpose of personnel radiation monitoring is to measure occupational exposures and to aid in the detection of unnecessary radiation dosages and/or equipment malfunctions. If an exposure of 10% or more of the monthly averaged Maximum Permissible Dose (MPD) is obtained, the approved user is required to complete this written explanation of how this dose might have occurred. Even for exposures less than 10% of MPD, but significantly higher than average compared to other workers performing similar activity, this report should be filed. This is necessary not only to protect the individual concerned but also to maintain institutional efforts to minimize radiation exposures consistent with the ALARA principles of our license.

Name:_____

Department_____

During the period from _____to _____ , your personnel radiation monitoring devices (badge and/or ring #) indicated an exposure of _____ millirem.

The maximum permissible dose for ionizing radiation is 5 rems per calendar year (whole body), or about 400 millirems per month, and the average dose of persons on this campus who perform similar functions in other labs is _____ millirems per month.

The fact that this dosimetry badge reflected an exposure higher than normal suggests that either an unusual event may have occurred or that improper laboratory procedures may have used while working with the radiation producing materials or equipment. In either event, and understanding of the events which could have led to this exposure is necessary in order to take action to prevent future exposure. Accordingly, please answer the questions on the reverse of this form, and return this statement as quickly as possible to:

Radiation Safety Officer
Department of Environmental Health & Safety
101C Huntington Building, BGSU

Feel free to call if you have questions or need further clarification.

(cont'd over)

Describe the procedures leading to the exposure.

Do you know how the excess exposure occurred? Explain why or why not.

Describe what has been done since the incident or list suggestions which might help to prevent the reoccurrence of such an exposure.

Other comments:

Signed:_____ Date:_____

APPENDIX 6 – RADIOACTIVE MATERIAL RECEIPT INSPECTION

Appendix 6

RADIOACTIVE MATERIAL RECEIPT INSPECTION

NOTE: Gloves must be worn to handle package until wipe test results have been completed.

Date: _____ BGSU PO Number: _____

Isotope: _____ Physical form of material: _____

Quantity received: _____ mCi

Visual inspection of package:
_____

Verification of shipping manifest with purchase order: _____

Gross survey of package with hand held survey meter:

Exposure Rate

At surface of package: _____ mR/hr

3 feet from package: _____ mR/hr

Wipe test result, outside of package: _____ CPM *cf.* Blank sample: _____ CPM

Condition of source container:
_____

Was dry ice present at check-in time: _____

Verification of label on source container with shipping manifest: _____

Material receipt entered in institutional notebook and log record: _____

Package delivered to: _____

Comments:_____

_____

Form completed by: _____

APPENDIX 7 – SINK DISPOSAL RECORD OF RADIOACTIVE WASTE

Appendix 7

SINK DISPOSAL OF RADIOACTIVE WASTE

Laboratory Director/Approved User:_____

Bldg._____ Room Number:_____

Disposal Limits:

C-14	30 microcuries per day
H-3	100 microcuries per day
All other approved	30 microcuries per day.

Date	Radionuclide	Estimate of Maximum Possible Activity	Initials
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

APPENDIX 8 – RADIOACTIVE MATERIAL PHYSICAL INVENTORY

Quarterly Physical Inventory of Radioactive Material

Inventory Date: _____

*Approved User:*_____ *Department:* _____

*Reported by:*_____

Table 1: Physical Inventory of Radioactive Material

Isotope Information					**Amounts (millicuries)**				
(1) Location of Isotope	*(2) Isotope*	*(3) Receipt date*	*(4) BGSU PO #*	*(5) Chemical/physical form*	*(6) Originally Received*	*(7) Remaining Stock Available For Use*	*(8) On Hand As Prepared Samples*	*(9) On Hand As Solid Waste*	*(10) Disposed Down Sink*

Directions

Complete this form using material inventory as of the date shown at the top of the page. For columns labeled “Amount”, enter activity (in millicuries) based on fractions of the amount originally received. Do NOT account for isotope decay. The first row of the above table has been highlighted as an example. Ignore this row when you complete your own report.

Column (1): Identify the isotope using the notation P-32, S-35, etc.

Column (2): To obtain this date, refer to the *Radioactive Material Use and Disposition Log* that accompanied the material when it was delivered to the lab.

Column (3): Refer to the *Radioactive Material Use and Disposition Log* for this number.

Column (4): Indicate, for example, whether material is solid, liquid, or gas, and chemical form such as aqueous solution, tritiated thymidine, labeled ATP, CGP, RIA kit, *etc.*

Column (5): Amount "Originally Received" refers to the activity of the sample (in millicuries) at the time of receipt. This is indicated on the *Radioactive Material Use and Disposition Log.*

Column (6): Amount "Remaining in Stock" refers to the activity of the material (not accounting for natural decay) still held in the original shipping container and still available for use. This can be determined by subtracting from the original volume the total volume removed (as indicated on the *Radioactive Material Use and Disposition Log),* and by using volume fractions to determine activity of the remaining stock.

EXAMPLE: Suppose that a shipment of ^{32}P-labeled ATP with an activity of 1 mCi and a volume of 50 μl was received in the lab on March 15. By the end of the year, suppose that a total volume of 30 μl had been removed from this container as evidenced through entries on the *Radioactive Material Use and Disposition Log*. The "Remaining Stock" therefore would be
(50 – 30) = 20 μl with an undecayed activity of (20/50) x 1 mCi = 0.4 mCi. Enter this number in column six (6) of the table.

Column (7): Amount "On Hand as Prepared Samples" refers to the amount of material removed from the shipping container that was successfully incorporated into prepared samples. Amounts removed but not incorporated into samples would be included as waste in *Column (8).*

Column (8): "On Hand as Solid Waste" refers to material removed from the shipping container but not incorporated into samples. This would include residue on pipette tips, spill clean up materials, etc., and undoubtedly will involve estimates on the part of the researcher. Samples stored for disposal that no longer are being held for use in experiments also would be included in this category.

EXAMPLE: In the above illustration the 30 μl of material removed represents an activity of (30/50) x 1 mCi = 0.6 mCi. Suppose that 90% of this material was successfully incorporated into prepared samples, with 10% remaining as waste either in the form of excess source material, as residue on micropipette tips, spills on waste paper, etc. Then the amount "On Hand as Prepared Samples" would be 0.9 x 0.6 mCi= 0.54 mCi, and the amount "On Hand as Solid Waste" would be 0.1 x 0.6 = 0.06 mCi. Enter these numbers, respectively, in columns (7) and (8) of the table.

Column (9): "Disposed Down Sink" refers to the total activity of the isotope in question that was disposed down an approved sink. Refer to the records of such disposal that are posted above each such sink as indicated on the form, *Sink Disposal of Radioactive Waste*.

Remember, do NOT account for natural decay of isotopes. That calculation will be done collectively by the Radiation Safety Officer prior to submitting the report to the State.

Please return this completed form within two weeks from the date of receipt to the Radiation Safety Office, c/o Dept. of Environmental Health and Safety, 101C Huntington Building.

For further information or assistance, contact the University Radiation Safety Officer.

Environmental Health & Safety
101E Huntington Building
(419) 372-2131

APPENDIX 9 – RADIOACTIVE MATERIAL USE AND DISPOSITION LOG

Appendix 9

RADIOACTIVE MATERIAL USE AND DISPOSITION LOG

Radionuclide: _____ Vendor from whom acquired: _____

Amount: _____millicuries. BGSU PO#:_____

Physical/chemical form: _____ Date received in lab: _____

Record of Material Use

Date	Name of User	Estimated Quantity of Material Used (mCi)

APPENDIX 10– QUANTITY LIMITS FOR RADIOACTIVE MATERIALS

Appendix 10

QUANTITY LIMITS FOR RADIOACTIVE MATERIALS

Limits in millicuries

Material	Per Order*	University Possession
Carbon-14	5	50
Hydrogen-3	15	75
Iodine-125	5	50
Iron-55	5	50
Phosphorus-32	10	150
Phosphorus-33	10	100
Sulfur-35	10	100

* Contact the Radiation Safety Officer if you need to order more than this limit.

Only the isotopes listed above may be ordered. Use of other isotopes will require approval of the Ohio Department of Health.

APPENDIX 11 – UNITED STATES NUCLEAR REGULATORY COMMISSION REGULATORY GUIDE 8.13

U.S. NUCLEAR REGULATORY COMMISSION

Revision 3
June 1999

REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 8.13

(Draft was issued as DG-8014)

INSTRUCTION CONCERNING PRENATAL RADIATION EXPOSURE

A. INTRODUCTION

The Code of Federal Regulations in 10 CFR Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations," in Section 19.12, "Instructions to Workers," requires instruction in "the health protection problems associated with exposure to radiation and/or radioactive material, in precautions or procedures to minimize exposure, and in the purposes and functions of protective devices employed." The instructions must be "commensurate with potential radiological health protection problems present in the work place."

The Nuclear Regulatory Commission's (NRC's) regulations on radiation protection are specified in 10 CFR Part 20, "Standards for Protection Against Radiation"; and 10 CFR 20.1208, "Dose to an Embryo/Fetus," requires licensees to "ensure that the dose to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, does not exceed 0.5 rem (5 mSv)." Section 20.1208 also requires licensees to "make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman." A declared pregnant woman is defined in 10 CFR 20.1003 as a woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

This regulatory guide is intended to provide information to pregnant women, and other personnel, to help them make decisions regarding radiation exposure during pregnancy. This Regulatory Guide 8.13 supplements Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Radiation Exposure" (Ref. 1), which contains a broad discussion of the risks from exposure to ionizing radiation.

Other sections of the NRC's regulations also specify requirements for monitoring external and internal occupational dose to a declared pregnant woman. In 10 CFR 20.1502, "Conditions Requiring Individual Monitoring of External and Internal Occupational Dose," licensees are required to monitor the occupational dose to a declared pregnant woman, using an individual monitoring device, if it is likely that the declared pregnant woman will receive, from external sources, a deep dose equivalent in excess of 0.1 rem (1 mSv). According to Paragraph (e) of 10 CFR 20.2106, "Records of Individual Monitoring Results," the licensee must maintain records of dose to an embryo/fetus if monitoring was required, and the records of dose to the embryo/fetus must be kept with the records of dose to the declared pregnant woman. The declaration of pregnancy must be kept on file, but may be maintained separately from the dose records. The licensee must retain the re-

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This guide was issued after consideration of comments received from the public. Comments and suggestions for improvements in these guides are encouraged at all times, and guides will be revised, as appropriate, to accommodate comments and to reflect new information or experience.

Written comments may be submitted to the Rules and Directives Branch, ADM, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

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quired form or record until the Commission terminates each pertinent license requiring the record.

The information collections in this regulatory guide are covered by the requirements of 10 CFR Parts 19 or 20, which were approved by the Office of Management and Budget, approval numbers 3150-0044 and 3150-0014, respectively. The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

B. DISCUSSION

As discussed in Regulatory Guide 8.29 (Ref. 1), exposure to any level of radiation is assumed to carry with it a certain amount of risk. In the absence of scientific certainty regarding the relationship between low dose exposure and health effects, and as a conservative assumption for radiation protection purposes, the scientific community generally assumes that any exposure to ionizing radiation may cause undesirable biological effects and that the likelihood of these effects increases as the dose increases. At the occupational dose limit for the whole body of 5 rem (50 mSv) per year, the risk is believed to be very low.

The magnitude of risk of childhood cancer following in utero exposure is uncertain in that both negative and positive studies have been reported. The data from these studies "are consistent with a lifetime cancer risk resulting from exposure during gestation which is two to three times that for the adult" (NCRP Report No. 116, Ref. 2). The NRC has reviewed the available scientific literature and has concluded that the 0.5 rem (5 mSv) limit specified in 10 CFR 20.1208 provides an adequate margin of protection for the embryo/fetus. This dose limit reflects the desire to limit the total lifetime risk of leukemia and other cancers associated with radiation exposure during pregnancy.

In order for a pregnant worker to take advantage of the lower exposure limit and dose monitoring provisions specified in 10 CFR Part 20, the woman must declare her pregnancy in writing to the licensee. A form letter for declaring pregnancy is provided in this guide or the licensee may use its own form letter for declaring pregnancy. A separate written declaration should be submitted for each pregnancy.

C. REGULATORY POSITION

1. Who Should Receive Instruction

Female workers who require training under 10 CFR 19.12 should be provided with the information contained in this guide. In addition to the information contained in Regulatory Guide 8.29 (Ref. 1), this information may be included as part of the training required under 10 CFR 19.12.

2. Providing Instruction

The occupational worker may be given a copy of this guide with its Appendix, an explanation of the contents of the guide, and an opportunity to ask questions and request additional information. The information in this guide and Appendix should also be provided to any worker or supervisor who may be affected by a declaration of pregnancy or who may have to take some action in response to such a declaration.

Classroom instruction may supplement the written information. If the licensee provides classroom instruction, the instructor should have some knowledge of the biological effects of radiation to be able to answer questions that may go beyond the information provided in this guide. Videotaped presentations may be used for classroom instruction. Regardless of whether the licensee provides classroom training, the licensee should give workers the opportunity to ask questions about information contained in this Regulatory Guide 8.13. The licensee may take credit for instruction that the worker has received within the past year at other licensed facilities or in other courses or training.

3. Licensee's Policy on Declared Pregnant Women

The instruction provided should describe the licensee's specific policy on declared pregnant women, including how those policies may affect a woman's work situation. In particular, the instruction should include a description of the licensee's policies, if any, that may affect the declared pregnant woman's work situation after she has filed a written declaration of pregnancy consistent with 10 CFR 20.1208.

The instruction should also identify who to contact for additional information as well as identify who should receive the written declaration of pregnancy. The recipient of the woman's declaration may be identified by name (e.g., John Smith), position (e.g., immediate supervisor, the radiation safety officer), or department (e.g., the personnel department).

4. Duration of Lower Dose Limits for the Embryo/Fetus

The lower dose limit for the embryo/fetus should remain in effect until the woman withdraws the declaration in writing or the woman is no longer pregnant. If a declaration of pregnancy is withdrawn, the dose limit for the embryo/fetus would apply only to the time from the estimated date of conception until the time the declaration is withdrawn. If the declaration is

not withdrawn, the written declaration may be considered expired one year after submission.

5. Substantial Variations Above a Uniform Monthly Dose Rate

According to 10 CFR 20.1208(b), "The licensee shall make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman so as to satisfy the limit in paragraph (a) of this section," that is, 0.5 rem (5 mSv) to the embryo/fetus. The National Council on Radiation Protection and Measurements (NCRP) recommends a monthly equivalent dose limit of 0.05 rem (0.5 mSv) to the embryo/fetus once the pregnancy is known (Ref. 2). In view of the NCRP recommendation, any monthly dose of less than 0.1 rem (1 mSv) may be considered as not a substantial variation above a uniform monthly dose rate and as such will not require licensee justification. However, a monthly dose greater than 0.1 rem (1 mSv) should be justified by the licensee.

D. IMPLEMENTATION

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

Unless a licensee or an applicant proposes an acceptable alternative method for complying with the specified portions of the NRC's regulations, the methods described in this guide will be used by the NRC staff in the evaluation of instructions to workers on the radiation exposure of pregnant women.

REFERENCES

1. USNRC, "Instruction Concerning Risks from Occupational Radiation Exposure," Regulatory Guide 8.29, Revision 1, February 1996.

2. National Council on Radiation Protection and Measurements, *Limitation of Exposure to Ionizing Radiation*, NCRP Report No. 116, Bethesda, MD, 1993.

APPENDIX

QUESTIONS AND ANSWERS CONCERNING PRENATAL RADIATION EXPOSURE

1. Why am I receiving this information?

The NRC's regulations (in 10 CFR 19.12, "Instructions to Workers") require that licensees instruct individuals working with licensed radioactive materials in radiation protection as appropriate for the situation. The instruction below describes information that occupational workers and their supervisors should know about the radiation exposure of the embryo/fetus of pregnant women.

The regulations allow a pregnant woman to decide whether she wants to formally declare her pregnancy to take advantage of lower dose limits for the embryo/fetus. This instruction provides information to help women make an informed decision whether to declare a pregnancy.

2. If I become pregnant, am I required to declare my pregnancy?

No. The choice whether to declare your pregnancy is completely voluntary. If you choose to declare your pregnancy, you must do so in writing and a lower radiation dose limit will apply to your embryo/fetus. If you choose not to declare your pregnancy, you and your embryo/fetus will continue to be subject to the same radiation dose limits that apply to other occupational workers.

3. If I declare my pregnancy in writing, what happens?

If you choose to declare your pregnancy in writing, the licensee must take measures to limit the dose to your embryo/fetus to 0.5 rem (5 millisievert) during the entire pregnancy. This is one-tenth of the dose that an occupational worker may receive in a year. If you have already received a dose exceeding 0.5 rem (5 mSv) in the period between conception and the declaration of your pregnancy, an additional dose of 0.05 rem (0.5 mSv) is allowed during the remainder of the pregnancy. In addition, 10 CFR 20.1208, "Dose to an Embryo/Fetus," requires licensees to make efforts to avoid substantial variation above a uniform monthly dose rate so that all the 0.5 rem (5 mSv) allowed dose does not occur in a short period during the pregnancy.

This may mean that, if you declare your pregnancy, the licensee may not permit you to do some of your normal job functions if those functions would have allowed you to receive more than 0.5 rem, and you may not be able to have some emergency response responsibilities.

4. Why do the regulations have a lower dose limit for the embryo/fetus of a declared pregnant woman than for a pregnant worker who has not declared?

A lower dose limit for the embryo/fetus of a declared pregnant woman is based on a consideration of greater sensitivity to radiation of the embryo/fetus and the involuntary nature of the exposure. Several scientific advisory groups have recommended (References 1 and 2) that the dose to the embryo/fetus be limited to a fraction of the occupational dose limit.

5. What are the potentially harmful effects of radiation exposure to my embryo/fetus?

The occurrence and severity of health effects caused by ionizing radiation are dependent upon the type and total dose of radiation received, as well as the time period over which the exposure was received. See Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Exposure" (Ref. 3), for more information. The main concern is embryo/fetal susceptibility to the harmful effects of radiation such as cancer.

6. Are there any risks of genetic defects?

Although radiation injury has been induced experimentally in rodents and insects, and in the experiments was transmitted and became manifest as hereditary disorders in their offspring, radiation has not been identified as a cause of such effect in humans. Therefore, the risk of genetic effects attributable to radiation exposure is speculative. For example, no genetic effects have been documented in any of the Japanese atomic bomb survivors, their children, or their grandchildren.

7. What if I decide that I do not want any radiation exposure at all during my pregnancy?

You may ask your employer for a job that does not involve any exposure at all to occupational radiation dose, but your employer is not obligated to provide you with a job involving no radiation exposure. Even if you receive no occupational exposure at all, your embryo/fetus will receive some radiation dose (on average 75 mrem (0.75 mSv)) during your pregnancy from natural background radiation.

The NRC has reviewed the available scientific literature and concluded that the 0.5 rem (5 mSv) limit

provides an adequate margin of protection for the embryo/fetus. This dose limit reflects the desire to limit the total lifetime risk of leukemia and other cancers. If this dose limit is exceeded, the total lifetime risk of cancer to the embryo/fetus may increase incrementally. However, the decision on what level of risk to accept is yours. More detailed information on potential risk to the embryo/fetus from radiation exposure can be found in References 2-10.

8. What effect will formally declaring my pregnancy have on my job status?

Only the licensee can tell you what effect a written declaration of pregnancy will have on your job status. As part of your radiation safety training, the licensee should tell you the company's policies with respect to the job status of declared pregnant women. In addition, before you declare your pregnancy, you may want to talk to your supervisor or your radiation safety officer and ask what a declaration of pregnancy would mean specifically for you and your job status.

In many cases you can continue in your present job with no change and still meet the dose limit for the embryo/fetus. For example, most commercial power reactor workers (approximately 93%) receive, in 12 months, occupational radiation doses that are less than 0.5 rem (5 mSv) (Ref. 11). The licensee may also consider the likelihood of increased radiation exposures from accidents and abnormal events before making a decision to allow you to continue in your present job.

If your current work might cause the dose to your embryo/fetus to exceed 0.5 rem (5 mSv), the licensee has various options. It is possible that the licensee can and will make a reasonable accommodation that will allow you to continue performing your current job, for example, by having another qualified employee do a small part of the job that accounts for some of your radiation exposure.

9. What information must I provide in my written declaration of pregnancy?

You should provide, in writing, your name, a declaration that you are pregnant, the estimated date of conception (only the month and year need be given), and the date that you give the letter to the licensee. A form letter that you can use is included at the end of these questions and answers. You may use that letter, use a form letter the licensee has provided to you, or write your own letter.

10. To declare my pregnancy, do I have to have documented medical proof that I am pregnant?

NRC regulations do not require that you provide medical proof of your pregnancy. However, NRC regulations do not preclude the licensee from requesting medical documentation of your pregnancy, especially if a change in your duties is necessary in order to comply with the 0.5 rem (5 mSv) dose limit.

11. Can I tell the licensee orally rather than in writing that I am pregnant?

No. The regulations require that the declaration must be in writing.

12. If I have not declared my pregnancy in writing, but the licensee suspects that I am pregnant, do the lower dose limits apply?

No. The lower dose limits for pregnant women apply only if you have declared your pregnancy in writing. The United States Supreme Court has ruled (in *United Automobile Workers International Union v. Johnson Controls, Inc.*, 1991) that "Decisions about the welfare of future children must be left to the parents who conceive, bear, support, and raise them rather than to the employers who hire those parents" (Reference 7). The Supreme Court also ruled that your employer may not restrict you from a specific job "because of concerns about the next generation." Thus, the lower limits apply only if you choose to declare your pregnancy in writing.

13. If I am planning to become pregnant but am not yet pregnant and I inform the licensee of that in writing, do the lower dose limits apply?

No. The requirement for lower limits applies only if you declare in writing that you are already pregnant.

14. What if I have a miscarriage or find out that I am not pregnant?

If you have declared your pregnancy in writing, you should promptly inform the licensee in writing that you are no longer pregnant. However, if you have not formally declared your pregnancy in writing, you need not inform the licensee of your nonpregnant status.

15. How long is the lower dose limit in effect?

The dose to the embryo/fetus must be limited until you withdraw your declaration in writing or you inform the licensee in writing that you are no longer pregnant. If the declaration is not withdrawn, the written declaration may be considered expired one year after submission.

16. If I have declared my pregnancy in writing, can I revoke my declaration of pregnancy even if I am still pregnant?

Yes, you may. The choice is entirely yours. If you revoke your declaration of pregnancy, the lower dose limit for the embryo/fetus no longer applies.

17. What if I work under contract at a licensed facility?

The regulations state that you should formally declare your pregnancy to the licensee in writing. The licensee has the responsibility to limit the dose to the embryo/fetus.

18. Where can I get additional information?

The references to this Appendix contain helpful information, especially Reference 3, NRC's Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Radiation Exposure," for general information on radiation risks. The licensee should be able to give this document to you.

For information on legal aspects, see Reference 7, "The Rock and the Hard Place: Employer Liability to Fertile or Pregnant Employees and Their Unborn Children—What Can the Employer Do?" which is an article in the journal *Radiation Protection Management*.

You may telephone the NRC Headquarters at (301) 415-7000. Legal questions should be directed to the Office of the General Counsel, and technical questions should be directed to the Division of Industrial and Medical Nuclear Safety.

You may also telephone the NRC Regional Offices at the following numbers: Region I, (610) 337-5000; Region II, (404) 562-4400; Region III, (630) 829-9500; and Region IV, (817) 860-8100. Legal questions should be directed to the Regional Counsel, and technical questions should be directed to the Division of Nuclear Materials Safety.

REFERENCES FOR APPENDIX

1. National Council on Radiation Protection and Measurements, *Limitation of Exposure to Ionizing Radiation*, NCRP Report No. 116, Bethesda, MD, 1993.

2. International Commission on Radiological Protection, *1990 Recommendations of the International Commission on Radiological Protection*, ICRP Publication 60, Ann. ICRP 21: No. 1-3, Pergamon Press, Oxford, UK, 1991.

3. USNRC, "Instruction Concerning Risks from Occupational Radiation Exposure," Regulatory Guide 8.29, Revision 1, February 1996.[1] (Electronically available at www.nrc.gov/NRC/RG/index.html)

4. Committee on the Biological Effects of Ionizing Radiations, National Research Council, *Health Effects of Exposure to Low Levels of Ionizing Radiation* (BEIR V), National Academy Press, Washington, DC, 1990.

5. United Nations Scientific Committee on the Effects of Atomic Radiation, *Sources and Effects of Ionizing Radiation*, United Nations, New York, 1993.

6. R. Doll and R. Wakeford, "Risk of Childhood Cancer from Fetal Irradiation," *The British Journal of Radiology*, 70, 130-139, 1997.

7. David Wiedis, Donald E. Jose, and Timm O. Phoebe, "The Rock and the Hard Place: Employer Liability to Fertile or Pregnant Employees and Their Unborn Children—What Can the Employer Do?" *Radiation Protection Management, 11,* 41-49, January/February 1994.

8. National Council on Radiation Protection and Measurements, *Considerations Regarding the Unintended Radiation Exposure of the Embryo, Fetus, or Nursing Child*, NCRP Commentary No. 9, Bethesda, MD, 1994.

9. National Council on Radiation Protection and Measurements, *Risk Estimates for Radiation Protection*, NCRP Report No. 115, Bethesda, MD, 1993.

10. National Radiological Protection Board, *Advice on Exposure to Ionising Radiation During Pregnancy*, National Radiological Protection Board, Chilton, Didcot, UK, 1998.

11. M.L. Thomas and D. Hagemeyer, "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities, 1996," Twenty-Ninth Annual Report, NUREG-0713, Vol. 18, USNRC, 1998.[2]

[1]Single copies of regulatory guides, both active and draft, and draft NUREG documents may be obtained free of charge by writing the Reproduction and Distribution Services Section, OCIO, USNRC, Washington, DC 20555–0001, or by fax to (301)415–2289, or by email to <DISTRIBUTION@NRC.GOV>. Active guides may also be purchased from the National Technical Information Service on a standing order basis. Details on this service may be obtained by writing NTIS, 5285 Port Royal Road, Springfield, VA 22161. Copies of active and draft guides are available for inspection or copying for a fee from the NRC Public Document Room at 2120 L Street NW., Washington, DC; the PDR's mailing address is Mail Stop LL-6, Washington, DC 20555; telephone (202)634–3273; fax (202)634–3343.

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FORM LETTER FOR DECLARING PREGNANCY

This form letter is provided for your convenience. To make your written declaration of pregnancy, you may fill in the blanks in this form letter, you may use a form letter the licensee has provided to you, or you may write your own letter.

DECLARATION OF PREGNANCY

To:_____

In accordance with the NRC's regulations at 10 CFR 20.1208, "Dose to an Embryo/Fetus," I am declaring that I am pregnant. I believe I became pregnant in_____ (only the month and year need be provided).

I understand the radiation dose to my embryo/fetus during my entire pregnancy will not be allowed to exceed 0.5 rem (5 millisievert) (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.

_____

(Your signature)

_____

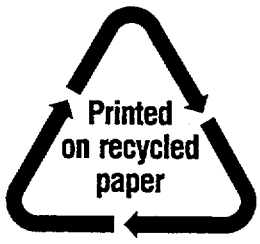
(Your name printed)

_____

(Date)

REGULATORY ANALYSIS

A separate regulatory analysis was not prepared for this regulatory guide. A regulatory analysis prepared for 10 CFR Part 20, "Standards for Protection Against Radiation" (56 FR 23360), provides the regulatory basis for this guide and examines the costs and benefits of the rule as implemented by the guide. A copy of the "Regulatory Analysis for the Revision of 10 CFR Part 20" (PNL-6712, November 1988) is available for inspection and copying for a fee at the NRC Public Document Room, 2120 L Street NW, Washington, DC, as an enclosure to Part 20 (56 FR 23360).



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