

C-2. RADIATION PROTECTION PROGRAM

I. INTRODUCTION

The Radiation Safety Office of the Environment, Health and Safety Program (EHS) at the NCI-Frederick administers a comprehensive radiation safety program that satisfies the Nuclear Regulatory Commission (NRC), Agreement State, as well as SAIC Frederick, Inc. operational requirements. Although compliance issues command a great deal of emphasis, the basic philosophy of the NCI-Frederick is to provide a safe working environment for all individuals using radioactive materials and/or radiation producing machines.

To this end the Radiation Safety Office provides Radiation Safety Training to all new radiation workers (prior to work involving radioactive materials) as well as Radiation Refresher Training at a minimum of every two years. In addition, our bioassay program, exposure monitoring program, laboratory survey effort, inventory control procedures, and waste disposal program are all designed and executed to ensure that our commitments to individual safety are being met.

The information that follows details operation methods and responsibilities associated with our program. While the technical services of the Radiation Safety Office are an important element of the NCI-Frederick safety effort, the ultimate success of the safety effort can only be accomplished with cooperation and commitment on the part of everyone involved with the use of ionizing radiation sources and radiation producing machines.

II. SCOPE

The following NCI-Frederick personnel and organizations will comply with the requirements of this procedure, even if this compliance is not mandated by regulation:

1. Those obtaining or possessing radioactive material or radiation producing machines under an approved radiation program; and
2. Those accessing facilities where there is potential for an occupational dose.

III. PURPOSE

- A. It is the policy of NCI-Frederick to ensure that all occupational doses are kept as low as reasonably achievable (ALARA) and that these doses do not exceed applicable limits. Individuals entering a restricted area (an area, access to which is limited by NCI-Frederick for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials) will receive training on the risks of exposure to radiation consistent with their potential level of exposure.
- B. NCI-Frederick policy requires all personnel and organizations to ensure that:
 - 1. Releases of radioactive material are within applicable limits and permit requirements;
 - 2. Exposures to radiation are kept ALARA; and
 - 3. Generation of radioactive waste is minimized.
- C. All NCI-Frederick personnel, organizations, and subcontractors possessing or planning to obtain radioactive material (including NORM and NARM) or radiation producing machines will review applicable license requirements, regulations, ordinances, permit requirements, and any other regulatory documents to ensure that proposed uses of radiological materials are in compliance with these documents.
- D. NCI-Frederick will implement a radiation protection program ensuring, to the extent possible, that actions by NCI-Frederick personnel, organizations, or subcontractors will not result in violating regulatory and/or license requirements.
- E. All NCI-Frederick personnel, organizations, and subcontractors will comply with applicable environmental and emergency response regulations.

IV. DEFINITIONS

Absorbed Dose - The amount of energy imparted to matter by ionizing radiation per unit mass of irradiated material. (See Rad)

Activity - The number of nuclear disintegrations occurring in a given quantity of material per unit of time. (See Curie)

ALARA (acronym for "as low as reasonably achievable") – Making every reasonable effort to maintain exposures to radiation as far below the dose limits in this procedure as is practical, consistent with the license, permit, or registration, considering the state of technology, the economics of improvements in relation to the benefits to the public health and safety, and other societal and socioeconomic considerations.

Alpha Particle - A strongly ionizing particle emitted from the nucleus during radioactive decay having a mass and charge equal in magnitude to a helium nucleus, consisting of 2 protons and 2 neutrons with a double positive charge.

Background Radiation - Ionizing radiation arising from radioactive material other than the one directly under consideration. Background radiation due to cosmic rays and natural radioactivity is always present. There may also be background radiation due to the presence of radioactive substances in other parts of the building, in the building material itself, etc.

Beta Particle - Charged particle emitted from the nucleus of an atom, having a mass and charge equal in magnitude to that of the electron.

Beta Ray - A stream of high-speed electrons or positrons of nuclear origin more penetrating but less ionizing than alpha particles.

Committed Dose Equivalent ($H_{T,50}$) - The dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

Committed Effective Dose Equivalent ($H_{E,50}$) - The sum of the products of the weighing factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues ($H_{E,50} = \sum W_T H_{T,50}$).

Contamination - Deposition of radioactive material in any place where it is not desired or expected and particularly in any place where its presence may be harmful. The harm may be that of invalidating of an experiment or a procedure, or being a source of excessive exposure to personnel.

Controlled Area - An area outside a restricted area but inside the site boundary, access to which can be limited by NCI-Frederick for any reason.

Critical Organ - That organ or tissue, the irradiation of which will result in the greatest hazard to the health of the individual or descendants.

Curie - The quantity of any radioactive material in which the number of disintegrations is 3.7×10^{10} per second. Abbreviated Ci. Millicurie: One-thousandth of a curie (3.7×10^7 disintegrations per second). Abbreviated mCi. Microcurie: One millionth of a curie (3.7×10^4 disintegrations per second). Abbreviated μ Ci.

Declared Pregnant Radiation Worker - A woman who has voluntarily informed the Licensee, in writing, of her pregnancy and the estimated date of conception.

Deep-dose Equivalent (H_d) - That dose equivalent at a tissue depth of 1 cm (1000 mg/cm^2) which applies to external whole-body exposure.

Dose - A general term denoting the quantity of radiation or energy absorbed in a specified mass. For special purposes it must be appropriately qualified (e.g., absorbed dose).

Dosimetry - Measurement of radiation with an instrument that is proportional to actual absorbed dose. Film badges/and or optically stimulated luminescence (OSL) are the most commonly used device in the laboratories.

Effective Dose Equivalent (H_e) - The sum of the products of the dose equivalent to the organ or tissue (H_T) and the weighting factors (W_T) applicable to each of the body organs or tissues that are irradiated ($H_E = \sum W_T H_T$).

Exempt Quantity - In the absence of an approval from a regulating authority to possess radioisotopes, certain isotopes and/or quantities may be classified as exempt. At the NCI-Frederick there are **NO** exempt quantities.

Exposure - Being exposed to ionizing radiation or to radioactive material.

Film Badge - A packet of photographic film used for the approximate measurement of radiation exposure for personnel monitoring purposes. The badge may contain two or more films of differing sensitivity, and it may contain filters which shield parts of the film from certain types of radiation.

Gamma Ray - Very penetrating electromagnetic radiation of nuclear origin. Except for origin, identical to x-ray.

Geiger Counter - Highly sensitive gas-filled detector and associated circuitry used for radiation detection and measurement.

Gray (Gy) - The SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule/kilogram (100 rads).

High Radiation Area - An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

Individual Monitoring Devices (individual monitoring equipment) - Devices designed to be worn by a single individual for the assessment of dose equivalent such as film badges, thermoluminescent dosimeters (TLDs), pocket ionization chambers, and personal (lapel) air sampling devices.

Ionizing Radiation - Any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter.

Isotopes - Nuclides having the same number of protons in their nuclei, and hence having the same atomic number, but differing in the number of neutrons, and therefore in the mass number. Almost identical chemical properties exist between isotopes of a particular element.

License - A license issued under the regulations in 10 CFR Parts 30 through 35, 39, 40, 50, 70, or 72 and/or agreement state regulations as outlined in COMAR 26.12.01.01.

Maximum Permissible Dose - Maximum dose of radiation which may be received by persons working with ionizing radiation, which should produce no detectable damage over the normal life span.

Monitoring - Periodic or continuous determination of the amount of ionizing radiation or radioactive contamination present in an occupied region as a safety measure for purposes of health protection and the use of the results of these measurements to evaluate potential exposures and doses.

- Area Monitoring: Routine monitoring of the level of radiation or of radioactive contamination of any particular area, building, room, or equipment.
- Personnel Monitoring: Monitoring any part of an individual, his breath, excretions, or any part of his clothing. (See Radiological Survey).

Occupational Dose - The dose received by an individual in a restricted area or in the course of employment in which the individual's assigned duties involve exposure to radiation and to radioactive material from licensed and unlicensed sources of radiation, whether in the possession of NCI-Frederick or other person(s). Occupational dose does not include dose received from background radiation, as a patient from medical practices, from voluntary participation in medical research programs, or as a member of the general public.

Qualified Health Physicist - An individual with the following qualifications:

- A degree in Health Physics, Radiological Engineering, Radiation Sciences (or equivalent degree) and at least 1 year of practical experience in operational health physics; or
- A degree in Physical or Biological sciences with at least 3 years of practical experience in operational health physics; or
- Current registration with the National Registry of Radiation Protection Technologists (NRRPT); or
- Current American Board of Health Physics certification.

Quality Factor - The modifying factor (listed in Table C-2-1, "Quality Factors and Absorbed Dose Equivalents") that is used to derive dose equivalent from absorbed dose.

Table C-2-1. Quality Factors and Absorbed Dose Equivalencies

Type of Radiation	Quality Factor (Q)	Absorbed Dose Equal to a Unit of Dose Equivalent ^a
X-, gamma, or beta radiation	1	1
Alpha particles, multiple-charged particles, fission fragments, and heavy particles of unknown charge	20	0.05
Neutrons of unknown energy	10	0.1
High-energy protons	10	0.1

^a Absorbed dose in rad equal to 1 rem or the absorbed dose in gray equal to 1 sievert.

Rad - The special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs/gram or 0.01 joule/kilograms (0.01 gray).

Radiation - The emission and propagation of energy through space or through a material medium in the form of waves; for instance, the emission and propagation of electromagnetic waves, or of sound and elastic waves.

Radiation (ionizing) - Alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation as used in this procedure does not include non-ionizing radiation such as radio or microwaves, or visible infrared, or ultraviolet light.

Radiation Area - An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates, or in any five consecutive days a dose equivalent in excess of 0.100 rem.

Radiation Machine - Any device capable of producing radiation when the associated control devices are operated.

Radiological Survey - Evaluation of the radiation hazards incident to the production, use, or existence of radioactive materials or other sources of radiation under a specific set of conditions. Such an evaluation customarily includes a physical survey of the disposition of materials and equipment, measurements or estimates of the levels of radiation that may be involved, and a sufficient knowledge of processes using or affecting these materials to predict hazards resulting from expected or possible changes in materials or equipment.

Radionuclide - A nuclide with an unstable ratio of neutrons to protons placing the nucleus in an unstable state. In an attempt to reorganize to a more stable state, it may undergo various types of rearrangement that involve the release of radiation.

Rem - The special unit of dose equivalent. The dose equivalent in rems is numerically equal to the absorbed dose in rads multiplied by the quality factor, distribution factor, and any other necessary modifying factors. For practical estimates in the lab, 1 rem = 1 rad.

Restricted Area - An area, access to which is limited by NCI-Frederick for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

Roentgen (R) - The quantity of X radiation or gamma radiation such that the associated corpuscular emission per 0.001293 grams of dry air produces, in air, ions carrying one electrostatic unit of quantity of electricity of either sign. The roentgen is the special unit of exposure.

Shallow-dose Equivalent (H_s), which applies to the external exposure of the skin or an extremity - Is taken as the dose equivalent at a tissue depth of 0.007 centimeters (7 mg/cm^2) averaged over an area of 1 square centimeter.

Shielding Material - Appropriate material used to absorb (or attenuate) radiation and thus effectively reduce the intensity of radiation, and in some cases eliminate it. Lead, concrete, aluminum, water, and plastic are examples of commonly used shielding material.

Sievert - The SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor ($1 \text{ SV} = 100 \text{ rems}$).

Survey - An evaluation of the radiological conditions and potential hazard incident to the production, use, transfer, release, disposal, or presence of radioactive material, or other sources of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

Total Effective Dose Equivalent (TEDE) - The sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Very High Radiation Area - Area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in 1 hour at 1 meter from a radiation source or from any surface the radiation penetrates. (Note: At very high doses received at high dose rates, units of absorbed dose (e.g., rads and grays) are appropriate, rather than units of dose equivalent (e.g., rems and sieverts).

X-rays - penetrating electromagnetic radiations having wavelengths shorter than those of visible light. They are usually produced by bombarding a metallic target with fast electrons in a high vacuum. In nuclear reactions it is customary to refer to photons originating in the nucleus as gamma rays, and those originating in the extranuclear part of the atom as x-rays. These rays are sometimes called roentgen rays.

V. **RESPONSIBILITIES**

A. Principal Investigator, SAIC-Frederick, Inc.

1. Designated by the licensing authority as the individual responsible for ensuring that all sources of ionizing radiation at SAIC-Frederick, Inc., are used safely and in a manner that complies with all license and regulatory requirements.
2. Appoints the members of the Radiation Safety Committee to act in his behalf on policy matters involving the use of by-product radioactive material.

B. Radiation Safety Committee

1. Act for the Principal Investigator, SAIC-Frederick, Inc., as the authoritative body on radiological safety.
2. Review and approve or disapprove proposed uses of ionizing radiation sources at the NCI-Frederick.
3. Establish policy regarding the safe use of ionizing radiation sources.
4. Assure that applicable regulations and NCI-Frederick policies are being met by users of radiation sources.
5. Ensure that all investigators who use ionizing radiation sources are qualified by experience and/or training to use such sources.
6. Provide technical supervision of the Radiation Safety Office.
7. Reviews and approves radiological protection plans and acts as the

clearinghouse for all related reports (e.g., dose summaries, accident reports, overexposures, etc.).

8. Review all instances of alleged infractions of regulations or policies and recommend appropriate corrective action.
9. Suspend any project or procedure that it finds to be a threat to health or property.
10. Meet in formal session at least twice per year, maintaining complete records of its activities.
11. In the process of reviewing proposed users of ionizing radiation, the Committee makes no judgement as to the scientific merit of such use. The Committee is concerned only with health, safety, and regulatory compliance.
12. Provide reports to the Principal Investigator, SAIC-Frederick, Inc. concerning any action that would impact license continuity.

C. Radiation Protection Officer

1. Functions under the technical supervision of the Radiation Safety Committee and acts as the operational agent of the Committee.
2. Implements a radiation protection program consistent with applicable regulations, permits, regulatory and license requirements, industry practices, and this procedure.
3. Obtains copies of governing regulations.
4. Develops and implements NCI-Frederick written procedures specific to the location/operation following the format and content of this procedure.
5. Annually reviews the NCI-Frederick written Radiation Protection Program and implementation with updates and improvements as necessary. Briefs the Radiation Safety Committee on the results of the annual review.
6. Reviews compliance with occupational dose limits.

7. Ensures documentation of employee radiation safety training.
8. Provides for or ensures the monitoring of exposures to radiation and radioactive materials to demonstrate compliance with occupational dose limits and provide reports to monitored individuals on an annual basis.
9. Posts documents required by applicable license, permit, or registration.
10. Performs or causes to be performed surveys of radiological materials and radiation producing machines at intervals specified in applicable license, permits or registration, and if no periodicity is specified then the surveys are to be conducted at least annually.
11. Assures that radioactive materials and their containers are properly labeled, in accordance with applicable regulations.
12. Assures that appropriate radiation signs and labeling to address the existing radiation hazards are consistent with applicable regulations, requirements, and guidance.
13. Establishes, maintains, and retains appropriate procedures for the handling, shipping, and receiving of radioactive materials including inspection and opening of packages in accordance with current regulations governing such action.
14. Investigates overexposures, accidents, spills, losses, thefts, unauthorized receipts, uses, transfers, disposals, and other deviations from approved radiation safety practice. Distributes reports to the Radiation Safety Committee for implementation of corrective actions as necessary.
15. Sends reports, as necessary, of lost, stolen, or missing radioactive material in compliance with license, permit, or registration requirements.
16. Provides notification of incidents such as overexposures, release of radioactive materials, property damage, or loss of operations in compliance with license, permit, or registration requirements to receive or possess radiological material. Notification is to be provided to the Radiation Safety Committee.

17. Conducts radiological oversight to ensure compliance with all NCI-Frederick, NRC, Department of Transportation (DOT), Occupational Safety and Health Administration (OSHA), Agreement State, and the requirements established in any applicable license, permit or registration.
18. Reports overexposures, major incidents, accidents, theft or loss of radioactive material to the Radiation Safety Committee.
19. Provides for approval or disapproval of the procurement, shipment, and distribution of all radioactive materials to or from the NCI-Frederick.
20. Provides periodic reports to the Radiation Safety Committee on the status of the Radiation Protection Program and the surveillance activities.
21. Provides for the receipt and inspection of all shipments of radiological materials being delivered to the NCI-Frederick.
22. Approves and signs or disapproves all correspondence to the NRC.
23. Provides a disposal service in coordination with an approved hazardous waste broker(s) through the EHS Waste Management Office.

D. Management

1. Enforces procedures regarding radiation protection that are consistent with this procedure and the requirements established in any license, permit, or registration.
2. Ensures that all individuals working in or frequenting any portion of a restricted area receive instruction, consistent with their potential level of exposure, on radiation protection and the hazards and risks associated.
3. Establishes and maintains involvement and accountability to ensure the proper implementation of radiation protection procedures. Ensures corrective actions identified during investigation of overexposures, accidents, spills, losses, thefts, unauthorized receipts, uses, transfers, disposals, and other deviations from

approved radiation safety practices are implemented as necessary and appropriate.

4. Ensures the performance and accuracy of all radiological measurements and analyses, individual monitoring results, and public exposure estimates.
5. Ensures that radiation exposures and releases from radiological operations are in accordance with the ALARA standard.
6. Conducts oversight operations to ensure compliance with all NCI-Frederick, NRC, DOT, Agreement State, and the requirements established in any applicable license, permit, or registration.

VI. PROCEDURES

A. Radiation Protection Program

1. SAIC-Frederick, Inc. by virtue of its present contractual agreement with the NCI has obtained the necessary material licenses that authorize the possession and use of by-product radioactive material for research and development. A radiation protection program, including written procedures, commensurate with the scope and extent of activities authorized by the license has been developed, documented, and implemented to ensure sufficient compliance with the provisions of the license and NCI-Frederick operational procedures.
2. NCI-Frederick will implement the portion of the Radiation Protection Program that addresses tracking and control of radiation exposure for the following:
 - a. Those personnel who may receive greater than 0.250 rem/yr total effective dose equivalent above ambient background (5% of NRC allowable limits);
 - b. Those that are issued a radiation dosimeter or radiation bioassay or on whom in-vivo counting is performed;
 - c. Those where local management determines it is prudent.

3. NCI-Frederick will use to the extent practicable, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as reasonably achievable (ALARA).
4. NCI-Frederick will periodically (at a minimum annually) review the Radiation Protection Program content and implementation.
5. The NCI-Frederick Radiation Protection Program covered by this procedure is to be periodically reviewed and audited by a qualified health physicist.
6. The written Radiation Protection Program is to contain procedures for controlling the dose to an embryo/fetus of a Declared Pregnant Radiation Worker during the entire gestation.
 - a. The Radiation Protection Program and instruction to workers is to include the regulatory exposure limit for a declared pregnant radiation worker . The exposure limit may not exceed 0.5 rem during the entire gestation period. To ensure the dose to an embryo/fetus during gestation is in compliance with these exposure limits and ALARA, the worker is to be requested to inform the NCI-Frederick Occupational Health Services (OHS) in writing, of her pregnancy and the estimated date of conception. The worker is also to be informed that the decision to declare the pregnancy is the right of the worker.
 - b. This information is to be treated confidentially and will only be used for radiation protection purposes.
 - c. A woman has the right to undeclare (in writing). An undeclared pregnant radiation worker will be protected under the same exposure limits as a radiation worker.

B. Dose Limits

1. NCI-Frederick will ensure that the occupational exposure of its employees and subcontractors, as well as doses to the public, are as low as reasonably achievable (ALARA).

2. NCI-Frederick will attempt to obtain the previous radiation history of its employees who are likely to receive in a year an occupational dose requiring monitoring prior to any potential exposure.
3. NCI-Frederick will track exposures of individuals requiring monitoring to ensure that they do not exceed the applicable limits specified in any license, permit, or registration. The Radiation Protection Officer will report any exposure in excess of authorized limits to the Radiation Safety Committee. Exposures over regulatory limits will be reported in accordance with applicable federal, state, and local regulations.
4. NCI-Frederick is to control the occupational dose limit to individual adult radiation workers (18 or more years of age) to the applicable dose limits as specified in 10 CFR 20.1201.
5. NCI-Frederick is to control the occupational dose limits for minors (individuals less than 18 years of age) to 10% of the limits for adult radiation workers.
6. NCI-Frederick is to control the dose for individual members of the public to the limit specified in 10 CFR 20.1301. If NCI-Frederick permits members of the public to have access to controlled areas, the limit of 0.25 millirem per hour is the maximum allowable exposure rate.
7. The NCI-Frederick Radiation Protection Program will establish controls to ensure documented compliance with applicable dose limits. Typical methods to be employed may include:
 - a. Monitoring programs (individual and area);
 - b. Access control and postings;
 - c. Radiation protection training;
 - d. Radiation and contamination surveys with follow-up;
 - e. Area monitoring programs;
 - f. Radioactive material control programs;
 - g. Exposure tracking system;
 - h. Analysis of actual and potential exposure;
 - i. Implementation of an ALARA program;
 - j. Engineering design, and;
 - k. Use of Personal Protective Equipment.

8. NCI-Frederick is to reduce the dose an individual may be allowed to receive in the current year by the amount of occupational dose received by the individual while employed by any other agency, including exposures resulting from internal depositions of radioactive material present in the body that have not already been included in the worker's total effective dose equivalent.

C. Instruction to Workers

1. Individuals working in or frequenting any portion of a restricted area:
 - a. Radiation workers are to receive training commensurate with their level of involvement with licensed material. Previous training and experience of radiation workers will be evaluated by the Radiation Safety Committee relative to the isotopes and possession limits requested. The Radiation Safety Office provides training in radiation safety and informal instruction dealing with safety techniques, procedures, and requirements at the NCI-Frederick;
 - b. Radiation workers are to receive protocol-specific instruction, which is the responsibility of the Principal Investigator of an approved Radiological Program and shall be presented to each new radiation worker, regardless of prior background. The Radiation Safety Office is available to assist in the development of this training;
 - c. Radiation workers are to be informed of the storage, transfer, or use of radioactive materials or radiation in such portions of the restricted area;
 - d. Radiation workers are to be instructed in the health protection problems associated with the exposure to such radioactive materials or radiation, in precautions or procedures used to minimize exposure, and in the purpose and function of protective devices employed;
 - e. Radiation workers are to be instructed in and instructed to observe, to the extent within the worker's control, the applicable requirements of the federal, state, and local regulations, including the requirements of the NRC license or

equivalent documentation for the protection of personnel from exposure to radiation and radioactive materials occurring in such areas;

- f. Radiation workers are to be instructed of their responsibility to report promptly to NCI-Frederick Radiation Safety Office any condition that may lead to or cause a violation of radiological health or unnecessary exposure to radiation or to radioactive materials;
 - g. Radiation workers are to be instructed in the appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation or radioactive materials;
 - h. Radiation workers are to be informed that radiation exposure reports may be requested.
- 2. The Principal Investigator, SAIC-Frederick, Inc., in concurrence with the other NCI-Frederick officials will ensure that training is provided for all workers commensurate with the potential radiation protection problems they may encounter in the performance of their work scope.
 - 3. Instruction is to be documented in writing.
 - 4. An individual may be exempted from some instruction due to previous training and/or experience; however, the basis for the exemption is to be documented and approved by the Chairman of the Radiation Safety Committee.

D. Notification and Reports to Individuals

- 1. NCI-Frederick will maintain records (NRC Form 5 or equivalent) of doses received by all individuals for whom monitoring is required, and include the following data:
 - a. Name of the organization or the name/title specified in the license, permit, registration, or equivalent documentation;
 - b. Name of individual;
 - c. Individual's social security number;

d. Individual's exposure information.

2. NCI-Frederick will inform each individual, for whom monitoring is performed, of his or her dose, at least annually. The report will include the following statement: "This report is furnished to you under the provisions of the Nuclear Regulatory Commission Regulation 10 CFR 19. You should preserve this report for further reference."

This notification may be revised as needed consistent with the requirements of any applicable license, permit, registration, or equivalent documentation.

3. For radiation workers who are terminating employment, a report of exposure to radiation and radioactive materials is to be provided within 90 days if requested at the time of termination. If final reports are not available, include an estimate and indicate that the doses are estimates.

E. Posting of Notices

NCI-Frederick is to ensure that all notices required under applicable regulations and any license, permit, registration, or equivalent documentation are conspicuously posted.

F. Surveys

1. NCI-Frederick is to perform surveys necessary to document compliance with the requirements established in any applicable license, permit, registration, or equivalent documentation.
2. The radiation monitoring instruments and equipment used for quantitative measurements are to be calibrated in accordance with the appropriate standards for the intended application.
3. A qualified individual will review the selection of instrumentation to ensure that the equipment has the appropriate detection capability; sensitivity, accuracy, and reliability.
4. All monitoring and survey equipment will be used, controlled, maintained, and calibrated under an applicable quality assurance programs. All radiation sources used during calibration procedures

will be traceable to the National Institute of Standards and Technology (NIST) or an equivalent organization's standard unless no such standard exists; then the basis for the calibration will be clearly documented in the Radiation Safety Program. All in-house calibration will be performed in accordance with approved procedures.

5. The NCI-Frederick Radiation Safety Officer will ensure that the survey and monitoring mandated under the Radiation Protection Program are implemented. This mandated program will induce semi-annual leak tests for sealed radiation sources that require leak testing in the possession of the organization unless otherwise specifically addressed in the applicable license, permit, registration, or equivalent documentation. Radiation producing machines are to be surveyed at least annually unless they are being stored and then the radiation producing machines are to be surveyed prior to use.

G. Monitoring

1. Each NCI-Frederick location is to monitor exposures to radiation and radioactive materials to demonstrate doses are as low as reasonably achievable (ALARA).
2. NCI-Frederick is to monitor occupational exposure to radiation and is to supply and require the use of individual monitoring devices by:
 - a. Adult radiation workers, minors, and declared pregnant radiation workers likely to receive, in one year from sources external to the body, a dose in excess of 0.250 rem per year; and
 - b. Individuals entering a high or very high radiation area.
3. All personnel dosimeters (except direct and indirect reading pocket ionization chambers and those dosimeters used to measure the dose to the extremities) that require processing to determine the radiation dose are to be processed and evaluated by a dosimetry processor with the following accreditations:
 - a. Holding a current personnel dosimetry accreditation from the National Voluntary Laboratory Accreditation Program

(NVLAP) of the NIST or DOELAP; and

- b. Approved in this accreditation process for the type of radiation or radiations included in the NVLAP or DOELAP program that most closely approximates the type of radiation for which the individual wearing the dosimeters is monitored.
4. In any area where the potential airborne radioactive concentration exceeds or may exceed 10% of the values in Table 1 of Appendix B of 10 CFR 20.1001, sampling and/or monitoring of the radioactive airborne concentrations is required, consistent with the facility design, radiation sources, and the associated radiological risks.
5. In any area where the airborne radioactive concentration averaged over 1 week exceeds or may exceed the values in Table 2 of Appendix B of 10 CFR 20.1001, sampling and/or monitoring of the radioactive airborne effluent concentrations is required, consistent with the facility design, radiation sources, and the associated radiological risks. In addition, the SAIC Corporate EC&HS Manager will assist the NCI-Frederick Radiation Safety Officer in determining the appropriate action relative to reporting under the Clean Air Act.

H. Storage and Control of Radioactive Material

1. All radioactive materials (except those identified in Section 10 CFR 30.15 and 10 CFR 40.13(c) and smoke detectors containing radioactive material) are to be stored in a secure location consistent with applicable federal, state, and local regulations and prudent health physics practices.
2. Radioactive materials (except those identified in Section 10 CFR 30.15 and 10 CFR 40.13(c) and smoke detectors containing radioactive material) are to be inventoried according to NCI-Frederick operational protocols, once every six months.
3. Source location and status (including smear test results) are to be reported to the Principal Investigator, SAIC-Frederick, Inc..

I. Precautionary Signs and Labels

1. The standard radiation symbol is the conventional three-bladed design of either magenta, purple, or black on a yellow background.
 2. All radioactive material will be marked with appropriate signs and labeled consistent with applicable federal, state, and local regulations, requirements established in any applicable license, and prudent health physics practices.
 3. All NCI-Frederick personnel will use the radioactive posting and symbols in a manner consistent with the applicable regulations and requirements established in any applicable license, permit, registration, or equivalent document, and good industry practices.
 4. Radioactive material, when it is in transport and packaged and labeled in accordance with DOT requirements for such material, is exempt from the labeling and posting requirements of Section I.
 5. Prior to disposal of an empty, uncontaminated container to unrestricted areas, the radioactive material label will be removed or defaced or will be otherwise clearly indicated that the container no longer contains radioactive material.
- J. Procedures for Shipping
1. All personnel who package, handle, or ship hazardous material, including radioactive material, are to be trained in compliance with 49 CFR 172, Subpart H, "Training".
 2. NCI-Frederick, in relation to the receipt of radioactive materials, shall establish, maintain, and retain written procedures for safely opening packages in which radioactive material is received or shipped.
 3. Any transportation accident resulting in the release of a Reportable Quantity ("RQ"), 49 CFR 172.101, Table 1, of an applicable radioactive material is to be immediately reported to the National Response Center or equivalent foreign and local SAIC management officials.
 4. NCI-Frederick is to ensure that the procedures are followed and that due consideration is given to special instructions for the type of

package being opened.

5. NCI-Frederick is to monitor the external surfaces of a package known to contain radioactive materials for radioactive contamination and radiation levels if the package:
 - a. Is labeled as containing radioactive material; or
 - b. Has evidence of potential contamination, such as packages that are crushed, wet, or damaged.
6. NCI-Frederick is to perform the monitoring required in paragraph J.5 of this section as soon as practicable after receipt of the package, but not later than 3 hours after the package is received at NCI-Frederick, if it is received during normal NCI-Frederick working hours, or not later than 3 hours from the beginning of the next working day, if it is received after working hours.
7. NCI-Frederick is to immediately notify the final delivery carrier and, by telephone and telegram, mailgram, or facsimile, the administrator of the applicable NRC regional office and the local SAIC management when:
 - a. Removable contamination exceeds the limits of Table C-2-2, "Removable External Contamination Wipe Limits";
 - b. External radiation levels exceed:
 1. 0.2 rem/hr on accessible external surface of the package;
 2. 0.01 rem/hr at any point two meters from the outer edges of the vehicle (excluding the top and underside of the vehicle);
 3. 0.002 rem/hr in any normally occupied position of the vehicle. This provision does not apply to private carriers (i.e., SAIC transporting SAIC-owned radioactive material) with personnel supervised, monitored, and trained in accordance with Section 19.5 C.

Table C-2-2. Removable External Contamination Wipe Limits

Contamination	micro Ci/cm ²	dpm/cm ²
Beta-gamma emitting radionuclides; all radionuclides with half-lives less than ten days; natural uranium, natural thorium, or compounds containing other NORM material	10 ⁻⁵	22
All other alpha emitting radionuclides	10 ⁻⁶	2.2

K. Radioactive Waste

NCI-Frederick will dispose of radioactive waste in accordance with applicable federal, state, and local regulations. All low-level radioactive waste will be either held for decay in storage or disposed of through approved waste broker(s).

L. Records

1. General Provisions

- a. NCI-Frederick is to use the units curie, rad, rem, including multiples and subdivisions, and is to clearly indicate the units of all quantities on records required by this procedure.
- b. NCI-Frederick is to make a clear distinction among the quantities entered on the records required by this procedure (e.g., total effective dose equivalent, shallow dose equivalent, eye dose equivalent, deep-dose equivalent, committed effective dose equivalent).
- c. Records retention may be extended if required by any applicable federal, state, or local regulation.

2. Records of Radiation Protection Programs

- a. NCI-Frederick is to maintain records of the Radiation Protection Program including:
 1. The provisions of the program; and

2. Audits and other reviews of program content and implementation.
 - b. NCI-Frederick is to retain the records required by paragraph L. 2.a.1 of this section until the requirements established in any applicable license, permit, registration, or equivalent documentation terminate the requirement requiring the record. NCI-Frederick is to retain the records required by paragraph L.2.a.2 of this section for 5 years after the records are made.
3. Records of Surveys
 - a. NCI-Frederick is to maintain records showing the results of surveys and calibrations required by Sections F and G and paragraph J.7. NCI-Frederick is to retain these records for 5 years after the record is made.
 - b. NCI-Frederick is to retain each of the following records for the period of employment plus 30 years:
 1. Records of the results of surveys to determine the dose from external sources and used, in the absence of or in combination with individual monitoring data, in the assessment of individual dose equivalents; and
 2. Records of the results of measurements and calculations used to determine individual intakes of radioactive material and used in the assessment of internal dose.
4. Determination of Prior Occupational Dose
 - a. For each individual who may enter a restricted or controlled area and is likely to receive in a year, an occupational dose requiring monitoring pursuant to paragraph G.2, NCI-Frederick is to:
 1. Determine the occupational radiation dose received during the current year; and
 2. Attempt to obtain the records of lifetime cumulative occupational radiation and committed dose.

- b. In complying with the requirements of paragraph L.4.a. of this section, NCI-Frederick may:
 - 1. Accept, as a record of the occupational dose that the individual received during the current year, a written signed statement from the individual, or from the individual's most recent employer for work involving radiation exposure, that discloses the nature and the amount of any occupational dose that the individual may have received during the current year;
 - 2. Accept, as the record of lifetime cumulative radiation dose, an up-to-date NRC Form 4, or equivalent, signed by the individual and countersigned by an appropriate official of the most recent employer for work involving radiation exposure, or the individual's current employer (if the individual is not employed by NCI-Frederick); and
 - 3. Obtain reports of the individual's dose equivalent(s) from the most recent employer for work involving radiation exposure or the current employer (if the individual is not employed by NCI-Frederick) by telephone, telegram, electronic media, or letter. NCI-Frederick is to request a written verification of the dose data if the authenticity of the transmitted report cannot be established.
- c. NCI-Frederick is to record the exposure history, as required by paragraph L.4.a. of this section, on NRC Form 4, or other clear and legible record, of all the information required on the form. The form or record must show each period in which the individual received occupational exposure to radiation or radioactive material and must be signed by the individual who receives the exposure. For each period for which NCI-Frederick obtains reports, NCI-Frederick is to use the dose shown in the report. In preparing NRC Form 4. For any period in which NCI-Frederick does not obtain a report, NCI-Frederick is to place a notation on NRC Form 4 indicating the periods of time for which data are not available.
- d. If NCI-Frederick is unable to obtain a complete record of an

individual's current and previous accumulated occupational dose, NCI-Frederick is to assume:

1. In establishing administrative controls under paragraph B.7. for the current year, that the allowable dose limit for the individual is reduced by 1.25 rems (12.5 mSv) for each quarter for which records were unavailable.
 2. The individual was engaged in activities that could have resulted in occupational radiation exposure.
- e. NCI-Frederick is to retain the records on NRC Form 4 or equivalent and the records used in preparing NRC Form 4 for the period of employment plus 30 years.
5. Record of Individual Monitoring Results
- a. NCI-Frederick is to maintain records of doses received by all individuals for whom monitoring was required pursuant to paragraph G.2 and records of doses received during accidents and emergency conditions. If these records are maintained by an organization other than NCI-Frederick, NCI-Frederick is to annually audit the other organization's recordkeeping system for completeness and accuracy, and maintain a written record of audit findings. These records must include when applicable:
1. The deep-dose equivalents to the total effective body dose equivalent, eye dose equivalent, shallow-dose equivalent to the extremities;
 2. The estimated intake or body burden of radionuclides;
 3. The committed effective dose equivalent assigned to the intake or body burden of radionuclides;
 4. The specific information used to calculate the committed effective dose equivalent;
 5. The total effective dose equivalent; and
 6. The total of the deep-dose equivalent and the

09/2007

committed effective dose equivalent to the organ receiving the highest total dose.

- b. NCI-Frederick is to make entries of the records specified in paragraph L.5.a. of this section at least annually.
 - c. NCI-Frederick is to maintain the records specified in paragraph L.5.a. of this section on NRC Form 5, in accordance with the instructions for NRC Form 5, or in clear and legible records containing all the information required by NRC Form 5.
 - d. The records required under this section are to be protected from public disclosure because of their personal privacy nature. These records are protected by most state privacy laws and, when transferred to the NRC, are protected by the Privacy Act of 1974, Public Law 93-579, 5 U.S.C. 552a, and the Commission's regulations in 10 CFR 9.
 - e. NCI-Frederick is to maintain the records of dose to an embryo/fetus with the records of dose to the declared pregnant radiation worker. The declaration of pregnancy is also to be kept on file, but may be maintained separately from the dose records.
 - f. NCI-Frederick is to retain each required form or record for the period of employment plus 30 years.
6. Records of Dose to Individual Members of the Public
- a. NCI-Frederick is to maintain records sufficient to demonstrate compliance with the dose limit for individual members of the public pursuant to 10 CFR 20.1301.
 - b. NCI-Frederick is to retain the records required by paragraph L.6.a. for 30 years.
7. Form of Records

Each record required by this procedure must be legible throughout the specified retention period. The record may be the original or a reproduced copy or a microform, provided that the copy or microform is authenticated by authorized personnel and that the microform is capable of producing a clear copy throughout the required retention period. The record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records such as letters, drawings, and specifications, must include all pertinent information, such as stamps, initials, and signatures. NCI-Frederick is to maintain adequate safeguards against tampering with and loss of records.

M. Reports of Theft or Loss of Licensed Material

1. If radioactive material is stolen or control is compromised, notify the appropriate regulatory agencies in accordance with the applicable regulations and requirements established in any applicable license, permit, registration, or equivalent documentation.
2. If radioactive material is stolen or control is compromised, notify the Principal Investigator, SAIC-Frederick, Inc. immediately after the occurrence becomes known to NCI-Frederick.

N. Notification of Incidents

In the event of an incident exceeding 10 CFR 20 for exposure of the workers or the general public or release of effluents, notify the appropriate regulatory agencies in accordance with the applicable regulations and requirements established in any applicable license, permit, registration, or equivalent documentation as well as the local SAIC management.

O. Radiography Employing Radiation Machines

1. Each radiation machine that is capable of producing, in any area accessible to individuals, a dose rate in excess of 0.1 rems per hour is to be provided with a conspicuous visible or audible alarm signal such that any individual at or approaching the tube head or radiation port is made aware that the machine is producing radiation. Such an alarm signal is to be activated automatically only when radiation is being produced.
2. NCI-Frederick is to maintain and keep current written operating

procedures for the kinds of radiation machines and the kinds of radiographic procedures employed. Such procedures are to include detailed instructions in at least the following:

- a. Means to be employed to control and limit exposure to individuals;
 - b. Methods and occasions for conducting radiation surveys and for controlling access to radiography areas;
 - c. The use of radiation survey instruments and personnel monitoring devices.
3. NCI-Frederick is to furnish either a film badge, thermoluminescent dosimeter ("TLD"), and/or OSL dosimetry device and require their use at all times during radiographic operations by every individual who conducts radiography procedures or who otherwise frequents the area during such operations.
 4. Dosimetry device is to be assigned to and worn by only one individual. The dosimetry reports received from the dosimetry processor are to be maintained and kept available for inspection.
 5. During each radiographic operation, the operator is to maintain direct surveillance of the operation to protect unauthorized entry into a high radiation area unless entry into such area is positively controlled by other suitable means.
 6. NCI-Frederick is to maintain current utilization logs that are to be kept available for inspection, containing the following information for each radiation machine:
 - a. The identity of the machine (name, make, and model number);
 - b. The location, date, and identity of the individual operator for each use; and
 - c. The voltage, current, and exposure time for each use.
 7. Definitions, for purposes of this section, and special requirements for various categories of radiography employing radiation machines are as follows:

- a. Cabinet radiography is that which is conducted in an enclosed, interlocked cabinet, such that the radiation machines will not operate unless all openings are securely closed, and the interior of which is so shielded that every location on the exterior meets conditions for "Public Access Areas" as specified in 10 CFR 20.1301. Cabinet radiography is subject to the following conditions:

NCI-Frederick is to prohibit any individual from operating a cabinet radiography unit until such individual has received a copy of the instructions, and demonstrated both understanding of operating procedures for the unit and competence in its use.

- b. Shielded room radiography is that which is conducted in an enclosed room, the interior of which is not occupied during radiographic operation, which is so shielded that every location on the exterior meets conditions for an uncontrolled area as described in 10 CFR 20.1301. The only access is through openings which are interlocked so that the radiation machine will not operate unless all openings are securely closed. Shielded room radiography is subject to the following special conditions:
 - 1. NCI-Frederick is to prohibit any individual from operating a shielded room radiography unit until such individual has received a copy of and instruction in, and demonstrated both an understanding of operating procedures for the unit and competence in its use.
 - 2. NCI-Frederick will supply appropriate personnel monitoring equipment to, and will require the use of such equipment by, every individual who operates, or who performs maintenance on a shielded room radiography unit.

P. High-Risk Activities

- 1. Any activity that involves the potential exposure of workers in excess of 100 rem or the public in excess of 25 rem requires

09/2007

a review of the Radiation Protection Program and its implementation by a certified health physicist prior to/during initiation of the activity. In addition, biennial audits of the facility operations will be performed by a qualified health physicist (preferably a certified health physicist).

2. Any activity that involves a potential for the release of a Reportable Quantity, "RQ", of radioactive material requires a review of the Radiation Protection Program and its implementation by a certified health physicist prior to/during initiation of the activity. In addition, biennial audits of the facility operations will be performed by a qualified health physicist.