



Langley Research Center

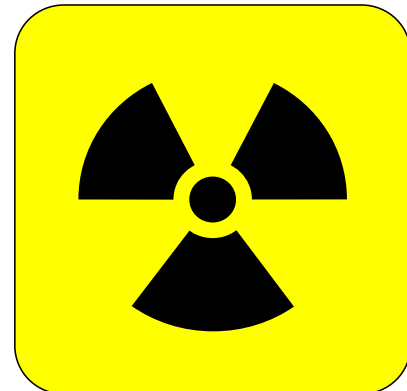
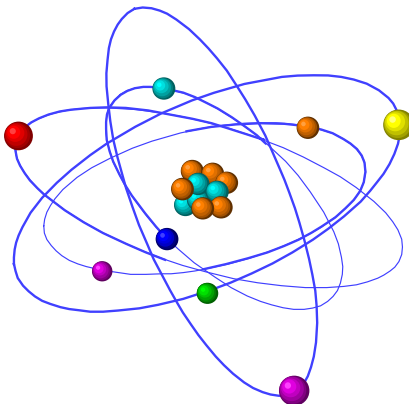
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IONIZING RADIATION



National Aeronautics and Space Administration

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Responsible Office: Safety and Mission Assurance Office

PREFACE

P.1 PURPOSE

- a. This Langley Procedural Requirement (LPR) prescribes the Nuclear Regulatory Commission (NRC) regulations by assigning responsibilities and authorities at Langley Research Center (LaRC). Ionizing radiation sources not covered by NRC regulations (such as x-ray machines) are included in this LPR.
- b. The standards and regulations contained herein do not in any way relieve supervisors, employees, or contractors of their responsibilities for the conduct of safe operations.

P.2 APPLICABILITY

- a. The procedures and radiation protection practices as set forth in this LPR apply to all organizational elements of LaRC and to all contractors working in facilities under the administrative control of LaRC.
- b. It is the responsibility of Contractors to provide and implement their own ionizing radiation program for facilities solely operated by the Contractor. As a minimum, this program shall be in accordance with the LaRC program as described in this LPR.
- c. It should be noted that referenced regulations are Federal statutes imposed on NASA under terms of licenses with the Nuclear Regulatory Commission (NRC), and applicable regulations promulgated by the Occupational Safety and Health Administration (OSHA), the Food and Drug Administration (FDA), and the Department of Transportation (DOT). Questions concerning details of current regulations or the applicability of regulations should be referred to the Radiation Safety Officer (RSO), Safety and Facility Assurance Branch (SFAB), Safety and Mission Assurance Office (SMAO).

P.3 AUTHORITY

- a. Occupational Safety and Health Standards, 29 CFR §1910.1096.
- b. U.S. Nuclear Regulatory Commission (NRC) Regulations, 10 CFR.
- c. NPR 1800.1, NASA Occupational Health Program Procedures
- d. U.S. Nuclear Regulatory Commission Materials License 45-01052-21
- e. U.S. NRC Form 313, Application for Materials License.
- f. LAPD 1700.2, Safety Assignments and Responsibilities.

P.4 APPLICABLE DOCUMENTS AND FORMS

- a. U.S. Nuclear Regulatory Commission (NRC) Regulations, 10 CFR.
- b. Title 49 CFR Parts 100-177
- c. LAPD 1150.2, Councils, Boards, Panels, Committees, Teams, and Groups.
- d. LAPD 1700.1, Safety Program.
- e. LPR 1046.1, Emergency Management Plan (EMP).
- f. LPR 1740.6, Personnel Safety Certification.
- g. LF 38, Safety Permit Request - Radioactive Material.
- h. LF 44A, Radiation Hazard Form.
- i. LF 48, Safety Permit Request - Radiation Machine.
- j. LF 56, Radioactive Material Transfer.
- k. LF 498, Safety Permit.
- l. U.S. NRC Form 3, Notice to Employees.
- m. U.S. NRC Form 313, Application for Materials License.

P.5 MEASUREMENT/VERIFICATION

None

P.6 CANCELLATION

LPR 1710.5, dated March 17, 2014.

Original signed on file

Clayton Turner
Deputy Director

Distribution:

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Chapter 1

1. INTRODUCTION

1.1 PURPOSE

1.1.1 It is LaRC policy to comply with NASA regulations and federal laws (section P.3 and P.4, herein), and to:

- a. Exercise centralized control over operations involving the use of radioactive materials and radiation producing equipment.
- b. Ensure that exposure of personnel to ionizing radiation from radioactive materials or radiation-producing equipment is maintained as low as is reasonably achievable (ALARA).
- c. Ensure that compliance with Federal, State, and Local regulations is maintained.

1.1.2 The responsibility for implementation of these safety policies with respect to a particular radiation device is given to the responsible Facility Safety Head (FSH). FSHs shall establish normal and emergency operating procedures and ensure all personnel operating devices within their facility are trained. LF 498, "Safety Permit," review system is established to ensure that the procedures are in compliance with the protection standards adopted herein.

1.2 SCOPE

1.2.1 This LPR defines the requirement for the procurement, use, handling, storage, shipment, and disposal of sources of ionizing radiation, as well as personnel monitoring and emergency procedures.

1.2.2 The LPR also indicates sources from which more detailed information may be obtained when necessary.

1.3 ISSUANCE AND CONTROL OF PROCEDURAL REQUIREMENTS REVISIONS

1.3.1 SFAB shall issue, distribute, and control this LPR.

1.3.2 Revisions to this LPR shall be developed by the LaRC Ionizing Radiation Committee (IRC) (Ref. LAPD 1150.2, "Councils, Boards, Panels, Committees, Teams, and Groups").

1.4 DEFINITIONS AND TERMINOLOGY

1.4.1 Appendix A contains definitions and terminology used in this LPR.

1.5 RECORDS

1.5.1 Ionizing radiation inventory records include:

- a. Records of trained and safety certified radiation workers
- b. Incident and over-exposure reports
- c. Receipts and shipments of ionizing radiation sources
- d. Records of personnel monitoring
- e. Records of calibration of monitoring instrumentation
- f. Personnel dosimetry reports
- g. Records of all radioactive waste disposals

1.5.2 Minutes of the quarterly Ionizing Radiation Committee meetings

1.5.3 Safety Permits

1.5.4 Radiation Survey Records

1.5.5 Audit Records of:

- a. Trained and safety certified radiation workers
- b. Personnel monitoring
- c. Calibration of monitoring instrumentation

Chapter 2**2. IONIZING RADIATION COMMITTEE (IRC)****2.1 AUTHORITY**

2.1.1 The IRC is established under the authority of LPR 1700.1, "Safety Program," and LPR 1150.2, "Councils, Boards, Panels, Committees, Teams, and Groups." Its establishment is necessary in the public interest and to:

- a. Ensure compliance with licensing requirements for radioactive material under the rules and regulations of the U.S. Nuclear Regulatory Commission in 10 Code of Federal Regulations (CFR) and NASA Langley's NRC Materials License # 45-01052-21.
- b. Ensure compliance with the U.S. Department of Labor, OSHA's "Occupational Safety and Health Standards" (29 CFR 1910.1096).

2.1.2 Any member of the IRC is authorized to investigate any questionable radiation source, equipment, system, etc.; and is authorized to act in the name of the LaRC Director to stop work; to prevent the use of equipment that is considered unsafe; and, to start action to eliminate the unsafe condition.

2.1.2.1 To stop work or eliminate unsafe conditions, actions shall be documented within 24 hours by formal memorandum to the LaRC Safety Manager with a copy to the Chairperson, IRC.

2.1.2.2 With line management agreement, work shall only be resumed after the corrective action has been taken.

2.1.3 If line management is not in agreement with the corrective action recommended by the official who stopped the work, the line manager shall submit the reasons for disagreement to the Chairperson, Executive Safety Council.

2.1.3.1 The Chairperson, Executive Safety Council, shall make an appropriate review.

2.1.3.2 Work shall not resume during review of corrective actions in disagreement without the approval of the Chairperson, Executive Safety Council.

2.1.4 Due to the need for the IRC to maintain an overview of ionizing radiation activities at LaRC, a review system is established for major radiation facilities. This review system is described in Chapter 4, "Routine Procedures and Requirements."

2.2 STRUCTURE AND ORGANIZATION

2.2.1 The IRC functions as a subcommittee of the Executive Safety Council. Its position in the organization for radiation safety is shown in Figure 2.1, LaRC Organization for Radiation Safety.

2.2.2 The IRC consists of voting members including the Chairperson, Vice-Chairperson and Secretary as well as non-voting members such as the LaRC Radiation Safety Officer (RSO) and the LaRC Safety Manager or Safety Manager's representative. Committee members (including Chairperson and Vice Chairperson) are nominated by the IRC Chairperson, or by the outgoing Chairperson, in the case of a new Chairperson, by virtue of their technical and/or educational expertise in the field of ionizing radiation. This nomination must be approved by the immediate supervisor of the new member; the Director, Safety and Mission Assurance Office (SMAO); and the appropriate Organizational Director.

2.2.3 Members serve for a 2-year term with the exception of the LaRC Safety Manager, the RSO, and a representative from the Environmental Management Office (EMO), Center Operations Directorate (COD), who serve as long as the committee continues to function.

2.2.4 Members may serve for multiple terms on the IRC.

2.2.5 The committee secretary shall be responsible for preparing and distributing committee minutes in addition to other responsibilities.

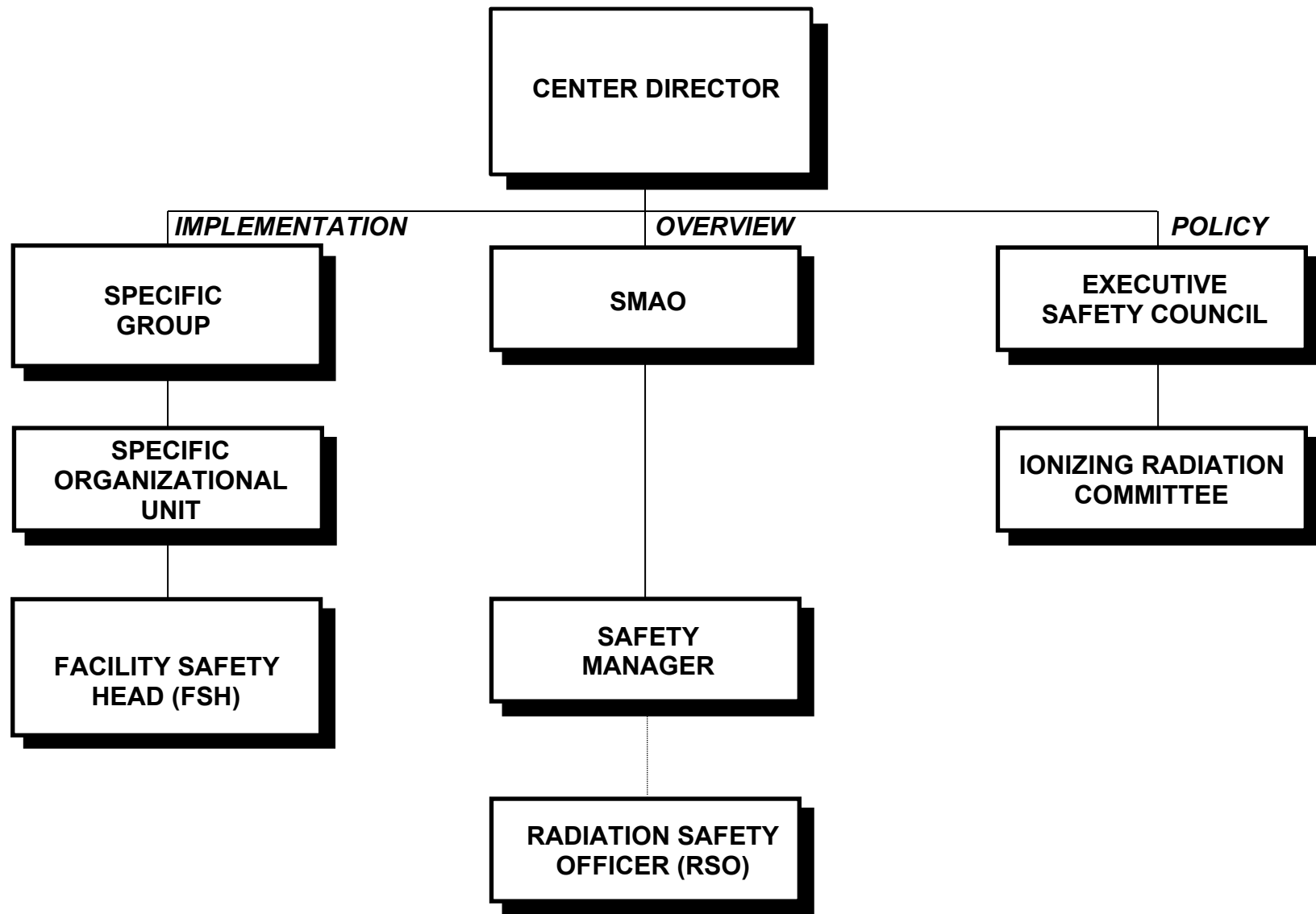


Figure 2.1. LaRC Organization for Ionizing Radiation Safety

2.3 DUTIES AND RESPONSIBILITIES

2.3.1 The IRC shall:

- a. Meet quarterly per year.
- b. Ensure compliance with Federal regulatory statutes.
- c. Exercise a centralized control over sources of ionizing radiation at LaRC. This control is accomplished by a review and approval of all procurement, handling, use, storage, and disposal of radioactive materials and radiation producing machines (Chapter 4).
- d. Ensure that an audit is conducted annually of each facility's possession and use of sources of ionizing radiation (Chapter 6).
- e. Develop and coordinate material incorporated in this LPR as needed.

2.3.2 The specific duties of the officials and members of the IRC are:

a. The Chairperson shall:

- (1) Prepare an agenda and call meetings as required, at least quarterly.
- (2) Act as the presiding officer at committee meetings.
- (3) Act as the signature authority for actions approved by the committee (e.g., safety permits).
- (4) Be cognizant of all matters pertaining to ionizing radiation at LaRC.

b. The Vice-Chairperson shall:

- (1) Assist the Chairperson whenever necessary.
- (2) Serve as the Chairperson when the Chairperson is absent.

c. The Secretary shall:

- (1) Prepare and distribute minutes of committee meetings, which, are to contain, as a minimum, a record of persons present and a description of matters discussed and conclusions reached, including the opinions of dissenting members.

(2) Distribute minutes to all members; the Chairperson, Executive Safety Council; and the Director, SMAO.

(3) Process official correspondence for the committee as needed.

d. Other members of the IRC shall:

(1) Be cognizant of all matters pertaining to radiation safety at LaRC. This is chiefly, but not entirely, achieved by attending the committee meetings and participating in the decisions made by the committee.

(2) Serve on ad-hoc committees appointed by the Chairperson, when necessary.

Chapter 3**3. SAFETY AND HEALTH FUNCTIONS****3.1 GENERAL**

3.1.1 The responsibility for implementing this LPR shall be divided among four safety and health functions.

3.1.2 The interface requirements of these functions and their duties and responsibilities are presented in this chapter.

3.2 FACILITY SAFETY HEAD (FSH)

3.2.1 The FSH may be the first point of contact for the individual who has a requirement for the procurement, use, or disposal of sources of ionizing radiation.

3.2.2.1 The first point of contact for the FSH shall be the RSO.

3.2.2 Responsibilities of the FSH with an operation involving sources of ionizing radiation shall be to:

- a. Supervise and coordinate, in a safe manner, the procurement, use, and disposal of sources of ionizing radiation.
- b. Accompany the RSO during audits of the operation and, when appropriate, attend meetings of the IRC.

3.3 RADIATION SAFETY OFFICER (RSO)

3.3.1 The RSO shall interface by reporting information to SMAO and the LaRC Safety Manager.

3.3.1.1 The RSO shall be a member of the IRC.

3.3.1.2 Recommendations to the committee for approval or disapproval of new uses of ionizing radiation shall be made by the RSO following pre-operational surveys and review of safety procedures.

3.3.1.3 The RSO assists the radiation user as primary contact on a day-to-day basis for matters relating to radiation safety.

3.3.2 The RSO provides administrative and technical guidance to LaRC personnel in the safe use of ionizing radiation.

3.3.2.1 Specific duties of the RSO shall be to:

- a. Assume control and initiate corrective action in radiation emergencies.
- b. Coordinate with NRC on matters concerning licensing and other regulatory functions through the LaRC Safety Manager.
- c. Prepare incident and over-exposure reports required by the NRC and other agencies.
- d. Perform pre-operational surveys and radiation hazard analyses of all proposed uses of facilities for radioactive material and radiation machines to assure conformity with applicable regulations, standards, and good practice.
 - (1) Recommend to the IRC approval or disapproval of these facilities.
- e. Perform annual audits of ionizing radiation activity in each organizational unit.
- f. Maintain a program of personnel dosimetry (film badges, pocket dosimeters, etc.).
 - (1) Interpret reports and maintain permanent dosimetry records.
- g. Perform periodic radiation protection surveys and radiation safety evaluations including leak tests required by Langley's NRC Materials License, 45-01052-21.
- h. Assist line management in implementing radiation safety rules and procedures as promulgated by the IRC and/or Federal regulatory authorities.
- i. Assure that the disposal of radioactive waste is safe and complies with Federal, state, local, and LaRC requirements.
- j. Maintain a continual inventory of all radioactive sources and all radiation-producing machines used in operations.
- k. Provide updates of the ionizing source inventory to the LaRC Fire Chief for incorporation into the Emergency Alarm Response System (EARS).
- l. Maintain an inventory of radiation-monitoring instruments in operation, which are required for the purpose of monitoring personnel exposure to ionizing radiation (Chapter 5, "Special Procedures and Requirements"). The instrument inventory shall include the manufacturer, model number, serial number, and the date of calibration for each instrument required. Calibration certificates must also be kept on file.
- m. Provide training and indoctrination of personnel in radiation safety.

- n. Review all purchase requests for ionizing radiation sources for compatibility with approved programs and licensing requirements.
- o. Review, sign and forward to the LaRC Safety Manager safety permit requests for the use of radioactive materials (LF 38 "Safety Permit Request- Radioactive Material.") or radiation emitting machines (LF 48 "Safety Permit Request- Radiation Machine").
- p. Inspect and maintain records of all receipts and shipments of ionizing radiation sources.
- q. Periodically inform the IRC of new developments in the field of ionizing radiation, as they are applicable to activities at LaRC.

3.4 ASSISTANT/ALTERNATE RADIATION SAFETY OFFICER (ARSO)

3.4.1 The ARSO is empowered to act in the RSO's absence with the full authority of the RSO's position.

3.4.2 An ARSO must be designated whenever the RSO is away from the Center for extended periods on travel or leave.

3.4.3 The ARSO is a member of the IRC whenever an ARSO is designated.

3.4.4 While the ARSO position is only required when the RSO is away from the Center for extended periods of time, the Center may appoint a safety professional to this position on a permanent basis to ensure the ARSO is current on all aspects of the program.

3.5 LARC SAFETY MANAGER (HEAD, SAFETY AND FACILITY ASSURANCE BRANCH, SMAO)

3.5.1 The LaRC Safety Manager's interfaces shall include:

- a. Serving as a member of the IRC (or assign a designee).
- b. Acting as the primary contact for LaRC management on matters relating to radiation safety.
- c. Representing the government as the liaison between the RSO and federal regulatory authorities (NRC, OSHA, etc.).

3.5.2 The LaRC Safety Manager's responsibilities shall be to:

- a. Exercise general surveillance over all uses of ionizing radiation at LaRC, including on-site contractor activities to assure radiation use is in conformance with safe

practice, pertinent regulations, and with provisions approved by the IRC for specific radiation use authorizations (i.e. radiation safety permits).

- b. Decide whether to have the RSO perform the above function.
- c. Serve as the final reviewing and/or certifying authority on the following documents:
 - (1) NRC Form 313, "Application for Materials License"
 - (2) LF 44A, "Radiation Hazard Form"
 - (3) LF 38 "Safety Permit Request- Radioactive Material"
 - (4) LF 48 "Safety Permit Request- Radiation Machine"
 - (5) LF 498 "Safety Permit"

3.6 RADIATION WORKERS

3.6.1 Radiation workers are the only persons permitted to handle radioactive materials or to approach sources of radiation closely enough to potentially receive a dose in excess of 100 millirem (mrem) in a year or a dose in excess of 2 mrem per any one hour.

3.6.2 Radiation workers' interfaces shall include:

- a. Working under the direct authority of the FSH.
- b. Exercising authority over all personnel in connection with the safe operation of the device to which the radiation worker is assigned.

3.6.3 Radiation workers' responsibilities shall include:

- a. Being cognizant of and complying with the LaRC regulations pertaining to ionizing radiation safety.
- b. Fully understand and comply with all written procedures in the specific use authorization (i.e., safety permit) for which they are authorized to work under.
- c. Notify the FSH when:
 - (1) A change in the definition of the limitations is needed.
 - (2) The need to work in restricted areas or work has ended.

- d. Ensuring that persons who are not qualified radiation workers are not exposed to radiation levels that produce a dose in excess of 100 mrem in a year and 2 mrem in any one hour.

Chapter 4**4. ROUTINE PROCEDURES AND REQUIREMENTS****4.1 GENERAL**

4.1.1 This chapter sets forth procedures and requirements for processing documents and materials related to ionizing radiation.

4.1.2 Questions concerning these procedures and requirements shall be directed to the RSO.

4.2 PROCUREMENT

4.2.1 Prior to the procurement and receipt of any source of ionizing radiation, the user or operator of the source shall complete an LF 44a which is an electronic form available through the Chemical Material Tracking System (CMTS).

4.2.2 After the user submits the LF 44a through CMTS, the electronic form automatically gets routed to the FSH.

4.2.3 The FSH shall:

- a. Review and approve LF 44a for system compatibility with research objectives.
- b. When the FSH electronically approves the LF 44a, it automatically gets routed to the RSO.

4.2.4 The RSO shall:

- a. Schedule a pre-operational review with the user upon receipt of LF 44A. The purpose of this review is to provide the user with guidance and assistance in the following areas:
 - (1) Applicability of NASA Langley radiation safety permit requirements.
 - (2) Preparation of NRC license (if applicable).
 - (3) Preparation of safety procedures.
 - (4) Preparation of authorizing documents specified in this chapter.
- b. Electronically sign the LF 44A after the survey. The form then automatically gets forwarded to the LaRC Safety Manager.

- c. Perform receipt inspections and surveys as necessary of radioactive material that is delivered to the Center.

4.2.5 The LaRC Safety Manager (or assigned designee) shall:

- a. Upon receipt of LF 44A, review and approve or disapprove the purchase of the source of ionizing radiation.
- b. If disapproved, return LF 44A to the FSH with a written explanation of disapproval attached.
- c. The FSH may appeal disapproval(s) through his/her Organizational Director to the Executive Safety Council.

4.3 AUTHORIZATION OF USE (SAFETY PERMIT)

4.3.1 The radiation safety permit is a written set of procedures, rules, and recommendations which authorizes a particular research experiment, or operation to use ionizing radiation after being reviewed by technically qualified members of the LaRC staff. The safety permit ensures that all reasonable safety precautions and requirements have been considered and subsequently implemented.

4.3.1.1 The radiation safety permit is a package that consists of all of the following documents which all together is generally referred to as the safety permit:

- a. An LF38 (Safety Permit Request – Radioactive Material) or an LF48 (Safety Permit Request – Radiation Machine) as applicable.
- b. An LF498 (Safety Permit).
- c. Written SOP's that typically include, but are not limited to, a list of authorized users, the maximum parameters of the ionizing source or machine, the location and intended use, safety controls, the prescription of any necessary personal protective equipment (PPE), the use of dosimetry, etc.

4.3.2 The RSO is responsible for the determination of radiation safety permit requirements during the processing of LF 44A. The pertinent determining factors that require a radiation safety permit include:

- a. Duration of exposure
- b. Source quantity (mass, volume, etc.)
- c. Potential exposure configuration
- d. Commercial certifications.

4.3.3 The IRC reviews the need for radiation safety permits based on these factors during its quarterly meetings for final dispensation rendering.

4.3.4 LF 38 or LF 48 shall describe the maximum potentially hazardous operating parameters (e.g., maximum source strength, kilovoltage, amperage, etc.) expected during the life of the experiment or operation.

- a. Changes in the operational configuration that do not exceed the authorized maximum parameters or change the authorized safety features will not require the processing of a modified safety permit.
- b. Other changes require additional review and approval by the IRC.
- c. Safety permits are valid for a period of one year from date of approval of a modification or initial issuance.
- d. Permits that do not require modification can be renewed for a period of four years.

4.3.5 The FSH shall:

- a. Prepare LF 38 or LF 48 and attach pertinent drawings, sketches, and supporting information, in conjunction with principal person responsible for the activity. If safety procedures and precautions cannot be adequately described in Block 2 of the form, an attachment may be used.
- b. Ensure that all personnel listed as workers on the form are certified radiation workers.
- c. Forward LF 38 or LF 48 and attachments to the RSO.
- d. Post the approved radiation safety permit in a conspicuous place at the specified site, or if more practical, in the applicable control center for the site.
- e. Submit a request to the RSO requesting renewal of the safety permit at least 30 days prior to the expiration date, or submit a new LF 38 or LF 48 to the RSO anytime a change is required in the authorized maximum operating parameters.

4.3.6 The RSO shall:

- a. Perform a radiation hazard analysis of the proposed operation upon receipt of LF 38 or LF 48 and attachments.
- b. Work closely with the radiation worker during this analysis to provide guidance and assistance in the preparation and acquisition of safety procedures, protective equipment, and NRC licensing (if required).

- c. Forward LF 38 or LF 48, attachments, and the hazard analysis (with appropriate recommendations) to the IRC for review and approval.

4.3.7 The IRC shall review LF 38 or LF 48 and attachments to determine that all reasonable precautions have been taken and the proposed operations can be carried out with an acceptable level of risk to personnel and equipment.

4.3.7.1 Based on review results of LFs 38 and 48 and attachments, the IRC shall recommend approval of the radiation safety permit by the committee Chairperson if sufficiently satisfied that radiation hazards have been adequately addressed, or return the request to the requester if problem areas are evident.

4.3.8 The IRC Chairperson shall:

- a. Sign the LF 38 or 48, and LF 498, and specify, when appropriate, any special conditions on which approval is based.
- b. Forward LF 38 or LF 48, LF 498, and attachments to the Safety Manager.

Chapter 5**5. SPECIAL PROCEDURES AND REQUIREMENTS****5.1 SPECIAL REQUIREMENTS FOR OFF-SITE RADIATION USE AUTHORIZATION**

5.1.1 Prior to approving an LF 38 or LF 48 for an organizational element of LaRC in which LaRC-owned radiation-producing material or equipment will be used at a temporary job site (a facility not under the administrative control of LaRC), the following requirements shall be satisfied:

- a. Written authorization shall be obtained from the administration of the facility. If the facility or institution holds a byproduct license from the NRC or an agreement state (see definition in appendix A), then the use of byproduct materials should be concurred with by that Center's RSO and/or its IRC.
- b. To ensure minimal radiation exposure to individuals and confirm no residual radioactive contamination remains in the off-site facilities, an individual with adequate training and experience in radiological health activities shall be named to select suitable instrumentation and perform monitoring tasks as determined necessary by the LaRC IRC.
- c. Procedures and arrangements for disposal, to handle radioactive waste generated at the temporary job site, shall be formally specified and approved by the LaRC IRC.
 - (1) The preferred waste disposal method shall be by direct transfer to NRC or agreement state licensee authorized to perform collection and/or disposal of radioactive waste.

5.1.2 All records of radiation surveys, personnel monitoring, and radioactive material transfers shall be maintained by the use supervisor and submitted to the RSO at the completion of the authorized use.

5.1.3 Any incidents involving individuals overexposed, lost sources, or contamination problems shall be reported immediately to the RSO.

5.2 INTERIM APPROVALS

5.2.1 Interim approvals for use of ionizing radiation shall be concurred with by the RSO and the IRC Chairperson.

5.2.2 When an immediate use of ionizing radiation is determined necessary, the RSO, with concurrence from the Chairperson, IRC, may temporarily:

- a. Extend an expiration date of a safety permit for a period not to exceed 60 days.

- b. Add to the sources of ionizing radiation named on an approved safety permit provided the sources added will not change the kinds of radiation emissions previously authorized.
- c. Authorize activities under a new radiation safety permit if the activity must start prior to the next IRC meeting.

5.2.3 The IRC shall evaluate these temporary modifications and, if satisfied that the RSO's action was proper, shall ratify the actions at the next committee meeting.

5.2.4 Approvals may be withdrawn at any time if safety violations occur or use of a regulated source is found not to be in compliance with conditions of the approved safety permit.

Chapter 6

6. IONIZING RADIATION PROGRAM REQUIREMENTS

6.1 AUDITS

6.1.1 The RSO shall conduct annually an audit of each facility possessing sources of ionizing radiation.

6.1.1.1 The results of those audits shall be presented to the IRC during their quarterly meetings.

6.1.1.2 Typical items covered during an audit are:

a. Inventories of:

- (1) All radioactive material.
- (2) Radiation producing machines.
- (3) Monitoring instrumentation.

b. Records of:

- (1) Trained and safety certified radiation workers.
- (2) Personnel monitoring.
- (3) Calibration of monitoring instrumentation.

c. Compliance with terms of the radiation safety permit.

d. Conduct of routine radiation protection surveys.

6.1.2 An annual assessment of the radiation safety program shall be performed to evaluate its content and effective implementation.

6.1.3 The annual assessment shall cover topics suitable to meet the annual assessment required by the Nuclear Regulatory Commission in 10 CFR 20.1101(c).

6.2 TRAINING AND CERTIFICATION

6.2.1 All personnel (including contractors) who operate, manipulate, or have any other type of physical control over the use of radiation-producing equipment or material specifically authorized by a radiation safety permit, shall be trained and certified as radiation workers.

6.2.2 All radiation workers performing work under an approved radiation safety permit shall be certified radiation workers and listed on the permit.

NOTE: Certified personnel may be added to or removed from a permit by the RSO without modifying the permit.

6.2.3 Radiation worker training will provide employees with an understanding of the risks associated with radiation exposure and the training should follow the guidance provided in NRC Regulatory Guide 8.29, Instruction Concerning Risks from Occupational Radiation Exposure. The training will cover at least these topics:

- a. General description of the applicable radiation type and the associated biological effects.
- b. An explanation of the different types of biological effects, i.e. somatic, genetic, acute, chronic, etc.
- c. Basic principles of radiation protection with an emphasis on ALARA.
- d. Dose limits.
- e. Instruction on how to “declare pregnancy” as a radiation worker.
- f. Emergency procedures.
- g. LaRC policies and procedures for ionizing radiation.

6.2.4 A declared pregnant employee shall be provided with the information contained in the NRC, Regulatory Guide 8.13, Instruction Concerning Prenatal Radiation Exposure. Once an employee declares pregnancy, the information should also be provided to any employee or supervisor who may be affected by a declaration of pregnancy or who may have to take action in response to such a declaration.

6.2.5 Ionizing Radiation workers shall be recertified every 2 years. Recertification involves attending refresher training. Refresher training can be scheduled by contacting the RSO.

6.3 INSTRUCTION TO WORKERS (10 CFR 19.12)

6.3.1 All individuals who in the course of employment are likely to receive in a year an occupational dose in excess of 100 mrem (1 mSv) shall be:

- a. Kept informed of the storage, transfer, or use of radiation and/or radioactive material in their work area.

- b. Instructed 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.
- c. Instructed in, and required to observe, to the extent within the workers control, the applicable provisions of Commission regulations and licenses for the protection of personnel from exposure to radiation and/or radioactive material.
- d. Instructed of their responsibility to report promptly to the licensee any condition which may lead to or cause a violation of Commission regulations and licenses or unnecessary exposure to radiation and/or radioactive material.
- e. Instructed in the appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation and/or radioactive material.
- f. Advised as to the radiation exposure reports which workers may request.
- g. The extent of these instructions must be commensurate with potential radiological health protection problems present in the workplace.

6.4 MEDICAL SURVEILLANCE

6.4.1 Medical examination/testing is not part of any ongoing or routine surveillance requirements for employees working with radioactive materials or other sources of ionizing radiation. However, it may be necessary if there are accidents/incidents that result in high radiation exposures or significant intakes of radioactive material.

6.5 SHIPPING RADIOACTIVE MATERIAL

6.5.1 Without prior notification, sources of radiation, once documented by the RSO and located in a particular facility, shall not be:

- a. Transferred to the accountability of another organization,
- b. Transferred from one location to another within LaRC, or
- c. Removed from the Center, without prior notification of the RSO.

NOTE: The RSO notification is in addition to action required for property control procedures.

6.5.2 Off-site shipments (both commercial and by NASA vehicle) require documentation and completion of a LF 56, "Radioactive Material Transfer," which is to be included with other relevant shipping documents.

- a. Each shipment shall be made in accordance with the applicable Federal, State, and local transportation regulations. There are three sources of regulations pertaining to the shipment of radioactive material:

- (1) DOT: Title 49, Parts 171–185, Hazardous Materials Regulations
- (2) NRC: Title 10, Part 71, Packaging and Transportation of Radioactive Material
- (3) IATA: Dangerous Goods Regulations, Section 10—Radioactive Material

NOTE: While the rules are somewhat similar, determining the appropriate regulations to follow depends upon factors such as the type and form of radioactive material, the amount of activity, the shipping container, and mode of shipment. The DOT would serve most commonly as the regulatory authority for radioactive shipments at LaRC. For instances where the DOT regulations might not apply to a licensed radioactive material shipment, the requirements of the NRC’s 10 CFR 71 would need to be satisfied. For air or international shipments of RAM, requirements specified by IATA’s “*Dangerous Goods Regulations, Section 10—Radioactive Material*” would also need to be satisfied.

- b. All commercial shipments of radioactive material shall be under the cognizance of the Logistics Management Office (LMO) when the shipment is sponsored by or shipped in connection with a LaRC sponsored project.
- c. All shipments of radioactive material to or from the Center shall be coordinated through the RSO.
- d. Personnel who perform any of the shipping responsibilities shall complete a certified DOT training course for shipping radioactive material. This training certification must be renewed every three years if shipping in accordance with DOT or NRC regulations, and every two years if shipping via IATA regulations.

6.5.3 Labeled Packages Versus Non-Labeled Packages (e.g., DOT “excepted” packages)

- a. Under Department of Transportation (DOT) hazardous material regulations, radioactive material above minimal specified radioactivity levels is classified as “Class 7” material. Within DOT Class 7, radioactive material packages will either be “Labeled” or non-labeled. The term “labeled” refers to the transportation categories of White I, Yellow II, and Yellow III for radioactive material (see examples of labels below). A “labeled” package will bear the word “radioactive” and show a three-bladed radiation trefoil symbol. The radioactivity content in such packages exceeds the levels found in non-labeled packages. A non-labeled package is referred to as a “Radioactive material—excepted package...,” which is typically for small (i.e., “limited”) quantities of radioactive material or instruments/articles containing smaller radioactive sources. Non-labeled packages will not bear the word

“radioactive” or show a radiation symbol. They will be marked with a UN identifier such as UN2910 or UN2911.



6.6 RECEIPT OF RADIOACTIVE MATERIAL

6.6.1 Prior to purchasing or receiving any radioactive material or devices containing such materials, individuals shall contact the RSO to discuss relevant requirements associated with possessing and using the radioactive material.

6.6.2 The RSO shall determine if there are licensing issues associated with the new source. For example, does LaRC’s current radioactive materials license allow for possession AND intended use of the “new” source or would the license need to be first amended? If the RAM is contained within a generally licensed or license-exempt device, what are the restrictions or conditions of use associated with the general license or license exemption?

Note: Amendment requests for the Center’s NRC materials license can take 2 or more weeks to prepare and submit, assuming all necessary information is available. The NRC could take 90 days (or longer) to review and approve the proposed amendment or reply with questions. Receipt of the RAM would not be legally authorized until the RSO has received notice from the NRC. Similarly, the source supplier would not be legally authorized to transfer a non-exempt, licensable source to LaRC unless they had a copy of LaRC’s license demonstrating the possession was authorized.

6.6.3 The LMO shall, upon receipt of any incoming package of non-labeled (e.g. UN2910) radioactive material, notify the RSO of its arrival at LaRC within one business day after its arrival. Upon receipt of any labeled radioactive packages (e.g., White I, White II and Yellow III), the LMO shall notify the RSO immediately and the package shall be received by the RSO within 3 hours during normal working hours, or if the radioactive package is delivered while the facility is closed, it should be received within 3 hours of the next business day. While not anticipated, if the Center is expected to

receive a package containing quantities of radioactive material in excess of a “Type A” quantity, then the RSO would coordinate this receipt activity with the LMO as needed to satisfy NRC rules for receipt in 10 CFR 20.1906.

6.6.4 The LMO shall inspect any package known to contain radioactive material for signs of shipping damage such as crushed or punctured boxes, or dampness. Any obvious damage shall be reported to the RSO immediately (If needed, the Emergency Dispatcher can be called and asked to make contact with the RSO). Workers shall be kept away from the location of the damaged package and the parcel shall not be moved or touched. In addition, the person delivering the damaged package shall be asked to remain at the dock area until that individual and their vehicle can be appropriately monitored. Efforts shall be made to limit the potential spread of contamination from the suspected leaking package.

6.6.5 The RSO will perform radiation surveys, contamination surveys, and leak testing of the received radioactive material package, as applicable.

6.6.6 The LMO shall furnish the RSO with a copy of the receiving document.

6.6.7 All radioactive material shall be delivered by the RSO to the custodian.

6.7 RADIATION GENERATING DEVICES (RGD)

6.7.1 Electronic equipment with high voltage potentials greater than 10 kV under vacuum have the potential of generating x-rays, either intentionally or as a byproduct of their operation.

- a. Owners of equipment meeting these criteria shall contact the RSO to have the equipment evaluated.
- b. The equipment shall be categorized by the RSO based upon equipment design and the results of a radiation survey.

6.7.2 Class 1 RGD—A device may be classified as a Class 1 RGD if its design is such that there is little potential for workers to be exposed to radiation in excess of the dose limits for members of the general public.

6.7.2.1 The Class 1 RGD category includes equipment such as electron microscopes, certified cabinet x-ray devices, or x-ray package scanners.

6.7.2.2 Operators of Class 1 RGDs do not require certification as Radiation Workers, but safety guidelines shall be posted near the device.

6.7.2.3 Class 1 RGDs may be monitored using work area dosimetry to verify that workers are not exposed to radiation levels that would require individual monitoring.

6.7.3 Class 2 RGD—Devices that have the potential to cause personnel exposure to

radiation above the limits for members of the general public shall be categorized as Class 2.

6.7.3.1 The Class 2 RGD category includes devices such as x-ray machines for non-destructive testing, high energy electron beam devices, and any x-ray device that has an accessible x-ray beam, such as unshielded x-ray fluorescence devices.

6.7.3.2 Operators of Class 2 RGDs shall have certification as Radiation Workers, and Class 2 RGDs require approved Radiation Safety Permits for their operation.

6.7.4 Regardless of the classification of x-ray devices, operators of RGDs shall not move, alter the physical structure, or increase the emission characteristics of an RGD without prior approval from the RSO.

6.7.4.1 The RSO shall make periodic inspections of RGDs to ensure that the classification is still accurate.

6.7.4.2 The RSO shall label RGDs with their classification and serial number.

6.7.4.3 Certified cabinet x-ray systems will be surveyed at intervals not to exceed 12 months to ensure conformance with Federal performance standards.

6.8 AREA DESIGNATIONS

NOTE: Several area designations apply to radiation control at LaRC.

6.8.1 Controlled Area—any area to which access is controlled for purposes of protection of individuals from exposure to radiation and radioactive material.

6.8.1.1 The term “controlled” is meant to be synonymous with the term “restricted” as used in the NRC Regulations.

6.8.2 Radiation Area—any area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of .005 rem (0.05 msv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

6.8.3 High Radiation Area—any 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.

6.8.4 Very High Radiation Area—any 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 one hour at one meter from a radiation source or from any surface that the radiation penetrates.

6.8.5 Airborne Radioactivity Area—an airborne radioactive area is a room, enclosure, or area in which airborne radioactive materials composed wholly or partly of licensed material exist in concentrations:

- a. In excess of the derived air concentrations (DAC's) specified in Appendix B of 10 CFR 20, or
- b. To such a degree that an individual present in the area without respiratory protective equipment could exceed, in one week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

6.8.6 Uncontrolled Area—any area to which access is not controlled for purposes of protection of individuals from exposure to radiation and radioactive materials.

6.8.6.1 The term “uncontrolled” is meant to be synonymous with the term “unrestricted” as used in the NRC Regulations.

6.8.6.2 The dose rate in uncontrolled areas shall not exceed 0.002 rem in 1 hour.

6.9 RADIATION DOSE LIMITS

NOTE: Radiation dose limits at LaRC are based upon limits specified by the NRC in 10 CFR 20, and by OSHA in 29 CFR 1910.1096. It should be recognized that the LaRC limits are established as maximum values and, in all cases, personnel exposure should be maintained as far below the limits specified in this part as practical.

6.9.1 Occupational Dose Limits for Adults—Radiation workers shall not be exposed routinely to radiation or radioactive material in a manner that exceeds the following limits:

Exposed Body Area	Rem/Year
a. Whole body (head, trunk, active blood forming organs, and internal organs)	5 rems total effective dose equivalent or 50 rems total dose to any single organ or tissue, whichever is the more limiting (effective dose equivalent being the sum of the deep dose equivalent (external dose) and the committed effective dose equivalent (internal dose))
b. Skin or extremities (hands, forearms, leg below the knee, feet and ankles)	50 rem
c. Lens of the eye	15 rem
d. Embryo/fetus (declared pregnancy and estimated time of conception)	0.5 rem during entire gestation period

NOTE: In exceptional cases, an individual may be permitted a planned special exposure separate from, and in addition to, the annual dose limits.

6.9.2 Local Exposure Control Level – The local exposure control level for radiation workers at LaRC is 500 mrem in a year. Workers shall receive approval from the RSO with concurrence from the IRC chairperson to receive radiation exposure in excess of this level up to 2 rem in a year. Additional approval from the SFAB Safety Manager is required to receive exposure in excess of 2 rem in a year not to exceed the limits in section 6.9.1. The RSO shall perform an assessment to determine the necessity for additional controls or removal from radiation work, to ensure personnel do not exceed federal dose limits.

6.9.3 Occupational Dose Limits for Minors—An individual under the age of 18 years shall not be permitted to enter or be employed in controlled areas if the individual will receive doses of radiation in amounts exceeding 10 percent of the specified dose limits for adult radiation workers (i.e., 0.5 rem for whole body).

6.9.4 Dose Limits to Members of the Public—Annual dose to members of the public shall not exceed 100 mrem, excluding medical and background radiation and other exposures not related to working in the environment of radiation. In addition, the dose in any unrestricted area from external sources shall not exceed 2 mrem in any one hour.

NOTE: Center employees who are not radiation workers are considered to be members of the public.

6.9.5 Dose Limits for Pregnant Workers—Radiation workers who are pregnant or believe that they may be pregnant are urged to contact the RSO for counseling and further details about declaring pregnancy.

NOTE: Federal regulations provide for a reduced radiation dose limit for declared pregnant radiation workers of 500 mrem for the duration of the gestational period. In order for this dose limit to be implemented, the worker must formally declare herself to be pregnant to the RSO.

6.9.5.1 The RSO shall perform an evaluation of the work area to determine if any work restrictions or alterations will be necessary to minimize exposure.

6.9.5.2 The worker shall be provided protection of seniority, time in grade and promotion potential.

6.9.5.3 The declaration shall be voluntary and may be withdrawn at any time with no stated reason.

6.9.5.4 All discussions and pregnancy declarations shall be kept confidential if requested by the employee.

6.10 CONTAMINATION LIMITS AND CONTAMINATION CONTROL GUIDELINES

NOTE: The information in this section shall be considered basic guidance. Task-specific contamination control procedures, protocols, or work instructions will be developed and implemented for activities involving the use or handling of radioactive materials.

6.10.1 Personal Contamination and Personal Protective Equipment (PPE)

- a. At a minimum, individuals shall wear impermeable gloves (i.e., latex, nitrile, etc.) while working with radioactive materials. Other glove types may be specified depending upon other materials or chemicals being handled. Also, additional clothing may be specified to cover other body parts. Gloves/clothing are to be removed when work is completed. Gloves/clothing that are suspected of being contaminated should be isolated, and the Radiation Safety Officer (RSO) should be contacted.
- b. The user shall immediately contact the RSO or their designee if personnel contamination is suspected.
- c. Open wounds shall be dressed and covered by impermeable PPE when working with RAM of any form.

6.10.2 Personnel Decontamination

- a. Decontamination methods shall be prescribed by and performed by or under the supervision of the RSO.
- b. Attempts shall be made to decontaminate personnel to non-detectable levels (externally), and personnel shall not be released until localized skin contamination is reduced to background levels.
- c. Decontamination agents and methods may become increasingly abrasive depending on the type and level of contamination present. Decontamination is an iterative process where contamination is removed followed by re-monitoring the affected area until acceptable levels are achieved.
- d. Decontamination methods shall be performed in a manner to minimize the possibility of cross contamination of other areas or personnel and to prevent resuspension of surface contaminants.
- e. All decontamination materials shall be collected for proper disposal.
- f. Special methods shall be employed if an individual is believed to have sustained internal contamination such as the use of chelating agents under direct medical supervision.

6.10.3 Area Contamination

- a. Removable contamination shall not be tolerated on exposed surfaces, such as bench tops and floors and shall be removed as soon as possible, or the area shall be isolated.
- b. The RSO shall assure the surveys of contamination levels are scheduled and that these levels do not exceed the limits established in this program.
- c. Any operations involving gaseous, finely divided, or particulate radioactive material shall be carried out in an appropriately designed laboratory hood, glove box, or similar equipment approved by the RSO.
- d. The user shall immediately contact the RSO or their designee whenever contamination is suspected.

6.10.4 Contamination Limits (Unrestricted Use)

In accordance with the program's policy for ALARA exposures, contamination found in unrestricted areas shall be immediately decontaminated to background levels, if practical. When such levels are not reasonably feasible, the surface contamination levels observed should at least be less than the limits specified in the table below. The release limits in this table apply to all surfaces, including structures (walls, floors, doors, etc.), furnishings (bench tops, file cabinets, sinks, etc.) and articles (equipment, tools, etc.) and are based upon guidance from Regulatory Guide 1.86. The process of assessing potential surface contamination for an area or an item will involve using as much available information about the subject surface, conservative assumptions, as needed, and some pragmatic decision-making. As needed, the RSO may, on a case-by-case basis, authorize alternate contamination assessment plans based upon case-specific information or data.

TABLE: MAXIMUM PERMISSIBLE CONTAMINATION LEVELS FOR UNRESTRICTED USE

NUCLIDE ^a	TOTAL		REMOVABLE ^{b e} (dpm/100 cm ²)
	AVERAGE ^{b c} (dpm/100 cm ²)	MAXIMUM ^{b d} (dpm/100 cm ²)	
U-natural, U-235, U-238, and associated decay products	5,000 α (alpha)	15,000 α	1,000 α
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100	300	20
Th-natural, Th-232, Sr- 90, Ra-223, Ra-224, U-232,	1,000	3,000	200

I-126, I-131, I-133			
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 dpm β - γ (beta-gamma)	15,000 dpm β - γ	1,000 dpm β - γ

^a Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should be applied independently.

^b As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector by background, efficiency, and geometric factors associated with the instrumentation.

^c Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such objects.

^d The maximum contamination level applies to an area of not more than 100 cm².

^e The amount of removable radioactive material per 100 cm² of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally, and the entire surface should be wiped.

6.11 AIRBORNE CONCENTRATION LIMITS

6.11.1 Airborne concentrations of radioactive materials to which personnel at LaRC may be exposed are specified by the NRC in appendix B of 10 CFR 20. Again, the LaRC limits are established as maximum values, and in all cases airborne concentrations shall be maintained at the lowest practical level.

6.11.2 Working in areas of airborne radioactivity requires extensive engineering and administrative controls. Every effort shall be made to prevent the generation of airborne radioactivity. The RSO should be contacted well in advance of any activity that has the potential to generate airborne radioactivity (e.g., grinding, machining, or wire brushing on radioactive materials) to ensure that a detailed analysis and work plan are done.

6.12 PERSONNEL MONITORING

6.12.1 Personnel monitoring requirements shall include:

- a. Personnel monitoring shall be required in any area where there is a probability that an individual may receive in a year an occupational dose in excess of 100 mrem (1 mSv).

- b. The details of the monitoring procedure shall be determined in each case by the RSO in consultation with the radiation worker and with consideration of the dose limits.
- c. Personnel monitoring procedures shall include, as a minimum, the wearing of radiation dosimeters. In addition, an audible warning device shall be worn by all operators and monitoring personnel engaged in the work of radiography. Personnel monitoring devices are available from the RSO with the exception of audible warning devices that are to be procured from the Center Operations Directorate.
- d. The RSO shall maintain a permanent record of all personnel dosimetry reports.
 - (1) If a report indicates an overexposure, an investigation shall be initiated to determine the cause and to suggest remedial action.
 - (2) The overexposure shall be reported to the NRC in compliance with 10 CFR 19. The NASA Senior Environmental Health Officer (SEHO) shall also be informed.
- e. Individuals determined to require radiation monitoring shall be advised annually of their measured dose if:
 - (1) The individual's occupational dose exceeds 1 mSv (100 mrem) TEDE or 1 mSv (100 mrem) to any individual organ or tissue; or
 - (2) The individual requests their annual dose report.

6.13 POSTING AND LABELING

NOTE: The posting and labeling requirements for LaRC are based on the regulations in 10 CFR 19, 10 CFR 20, and 29 CFR 1910.1096.

6.13.1 The radiation symbols prescribed by this Chapter shall be the conventional magenta or purple three-bladed design on a yellow background.

6.13.2 Any additional information that may minimize exposure to radiation or to radioactive material shall be on or near signs and labels.

6.13.3 Operating Procedures and General Information—Areas in which individuals are employed that utilize radioactive materials in activities covered by these procedural requirements shall be posted with the following to ensure that they are seen by individuals on their way to or from their place of employment, or kept in a suitable place so that they are available for examination upon request:

- a. A current copy of 10 CFR 19.
- b. A current copy of 10 CFR 20.

- c. A current copy of 29 CFR 1910.1096.
- d. A copy of the NRC license and its reference documents.
- e. A copy of these procedural requirements (LPR 1710.5).
- f. A notice of cited violations of appropriate Federal regulations and the resulting LaRC actions.
- g. In lieu of posting these documents, a notice can be posted that identifies where said documents can be examined
- h. NRC Form 3, "Notice to Employees."

6.13.4 Posting and labeling requirements specific to areas, equipment, or containers are:

- b. Radiation Area—Each radiation area shall be conspicuously posted with a sign or signs bearing the radiation symbol and the words "CAUTION RADIATION AREA."
- c. High Radiation Area—Each high radiation area shall be conspicuously posted with a sign or signs bearing the radiation symbol and the words "CAUTION HIGH RADIATION AREA" or "DANGER HIGH RADIATION AREA."
 - (1) All high radiation areas established for a period of 31 days or more, shall be equipped with a control device which will cause the level of radiation to be reduced below that at which an individual might receive a dose of 100 millirem in one hour upon entry into the area or will energize a conspicuous, visible, or audible alarm signal to ensure that the individual entering and the supervisor of the operation are made aware of the entry.
- d. Airborne Radioactivity Area—Each airborne radioactivity area shall be conspicuously posted with a sign or signs bearing the radiation symbol and the words "CAUTION AIRBORNE RADIOACTIVITY AREA."
- e. Storage Area—In addition to the above, each area in which radioactive material is used or stored and which contains any radioactive material, other than natural uranium or thorium, in an amount exceeding 10 times the quantity of such material specified in 10 CFR 20, or which contains natural uranium or thorium in an amount exceeding 100 times the quantity specified in 10 CFR 20, shall be conspicuously posted with a sign or signs bearing the radiation symbol and the words "CAUTION RADIOACTIVE MATERIAL(S)."
- f. Containers—Each container of radioactive material shall bear a durable, clearly

visible label identifying the radioactive contents as to radionuclide, quantity, and date of assay.

(1) Container labels shall bear the radiation symbol and the words “CAUTION RADIOACTIVE MATERIAL(S).”

- g. Radiation-Producing Machines or Equipment—All x-ray machines, x-ray diffraction units, electron microscopes, and other similar equipment shall bear a durable, clearly visible label bearing the radiation caution symbol and these or similar words “CAUTION THIS MACHINE PRODUCES X RADIATION WHEN ENERGIZED.”

6.13.5 Exemptions to posting and labeling requirements at LaRC shall be approved by the RSO and limited to the following:

- a. An area is not required to be posted with a sign because of the presence of a sealed source provided the radiation level 12 inches from the surface of the source container or housing does not exceed 5 mrem per hour.
- b. Areas are not required to be posted with signs because of the presence of radioactive materials packaged and labeled in accordance with applicable transportation regulations.
- c. Containers that do not contain materials in quantities greater than amounts specified in 10 CFR 20.
- d. Containers of only natural uranium or thorium in quantities no greater than ten times amounts specified in 10 CFR 20.
- e. Containers that do not contain licensed materials in concentrations greater than amounts specified in 10 CFR 20.
- f. Containers that are attended by an individual who will take precautions necessary to prevent the radiation exposure to any individual in excess of the LaRC limits.
- g. Containers that are in transport and packaged and labeled in accordance with applicable transportation regulations.

6.14 LEAK TESTS AND INVENTORY OF RADIOACTIVE SOURCES

6.14.1 Tests for leakage and/or contamination shall be performed by the health physics staff as authorized by the NRC to perform such services. Leak tests requirements include the following:

- a. Each sealed source containing byproduct material, other than Hydrogen 3 and Kr-85, with a half-life greater than 30 days and in any form other than gas shall be tested for leakage and/or contamination at intervals not to exceed six months.

- (1) In the absence of a certificate from a transferor indicating that a test has been made within six months prior to the transfer, the sealed source shall not be put into use until tested.
- b. All alpha sources greater than 10 microcuries shall be wipe-tested at intervals not to exceed three months.
- c. Notwithstanding the periodic leak test required by the above paragraph, any licensed sealed source containing byproduct material is exempted from periodic leak tests provided the quantity of byproduct material contained in the source does not exceed 100 microcuries of beta and/or gamma emitting material or 10 microcuries of alpha emitting material.
- d. All other sealed sources in storage are exempt from this test. However, all sources shall be tested for leakage prior to any use or transfer to another person unless they have been leak tested within six months notwithstanding the three months for alpha emitting sources prior to the date of use or transfer. No sealed source shall be stored for a period of more than 10 years without being tested for leakage and/or contamination.
- e. The test shall be capable of detecting the presence of 0.005 microcurie (185 Becquerels) of radioactive material on the test sample.
 - (1) The test sample shall be taken from the sealed source or from the surfaces of the device in which the sealed source is permanently mounted or stored on which one might expect contamination to accumulate.
 - (2) Records of leak test results shall be kept and maintained for inspection by the NRC.
- f. If the test reveals the presence of 0.005 microcurie (185 Becquerels) or more of removable contamination, the RSO shall immediately withdraw the sealed source from use.
 - (1) The RSO shall have the sealed source decontaminated and repaired or disposed of in accordance with NRC regulations.
 - (2) A report shall be filed within five days of the test with the office that is charged with Byproduct Material Licensing, Nuclear Regulatory Commission, Washington, DC 20555, describing the equipment involved, the test results, and the corrective action taken.
 - (3) The report shall also be sent to the Regional Administrator, Region II, Office of Inspection and Enforcement, NRC.

6.14.2 Sealed sources shall be inventoried on a semi-annual basis. Lost sources must be reported to the NRC in accordance with Section 20.2201 of 10 CFR 20.

6.14.3 Radiation survey meters used for quantitative measurements shall be calibrated annually.

6.14.3.1 Uncalibrated instruments shall be removed from service or labeled to indicate that they are not for quantitative measurements.

6.15 RADIOACTIVE WASTE DISPOSAL

6.15.1 Special waste receptacles shall be provided by the EMO for the disposal of low-level radioactive waste.

6.15.1.1 These receptacles shall be conspicuously marked with the radiation symbol and the words "CONTAMINATED WASTE CAUTION RADIOACTIVE MATERIALS."

6.15.2 Disposal of radioactive wastes requires the following:

- a. Separate receptacles shall be provided for low-level waste, and these wastes shall be strictly segregated.
 - (1) Concentrated stock solutions of radioactive materials, sealed sources, and other high-level materials shall not be disposed of in low-level waste containers.
 - (2) The health physics staff, upon request by the FSH, shall be responsible for disposal or removal and storage of such high-level material.
- b. The contents of the radioactive waste receptacles shall be collected by the health physics staff periodically.
 - (1) The arrangements for ultimate disposal of all radioactive waste resulting from LaRC operations shall be the responsibility of EMO in conjunction with LMO.
 - (2) Radioactive waste shall be handled as hazardous waste.
 - (3) Disposal of high-level material is limited to an appropriate licensee of the NRC or one of its agreement states who shall conduct final disposal operations.
- c. Records of all radioactive waste disposals shall be maintained by the RSO.

6.16 CONTRACT RADIOGRAPHY

6.16.1 The Center Operations Directorate often requires the use of contract radiography operations for the nondestructive testing of welds, castings, new

construction, etc..

6.16.2 The sporadic and uncertain nature of these operations prohibits the effective use of the NASA Langley radiation safety permit system. The following procedural and safety criteria shall be observed for all contract radiography performed at LaRC.

6.16.3 NASA Inspectors shall attend specialized training conducted by the LaRC RSO prior to being certified by their employer as Radiography Monitors.

6.16.3.1 The NASA LaRC Radiography Monitor shall:

- a. At least 4 hours prior to initiating contract radiography operations, notify the personnel listed below, by telephone, of the location, starting time, and expected duration of the operation:
 - (1) The RSO.
 - (2) NASA LaRC Dispatcher.
 - (3) The Duty Officer at the West Heating Plant, 14 West Taylor Street (Facility 1215).
 - (4) The Facility Coordinator for the facility where the operation is to be performed.
- b. Be present for the entire duration of the radiographic operation.
- c. As a trained Radiography Monitor, ensure that the contractor:
 - (1) Establishes a “controlled area” as defined in this Chapter. This shall include the use of physical barriers, as defined in these procedural requirements, and clearly visible signs to prevent unauthorized entry into the controlled radiation area.
 - (2) Complies with this chapter.
 - (3) Attempts to further minimize exposure by the use of shielding devices and beam collimators when available.
- d. Notify the personnel listed below when contract radiography operations have been completed:
 - (1) NASA LaRC Security.
 - (2) The Duty Officer at the West Heating Plant, 14 West Taylor Street (Facility 1215).
 - (3) The NASA LaRC Fire Department.

6.16.3.2 The LaRC RSO has prepared a checklist for the Radiography Monitors to use to ensure that the radiographer is operating safely. The checklist shall be completed to

the extent possible and forwarded to the RSO after completion of the operation.

6.16.4 Scheduling of Operations—Due to the difficulty encountered in the control of personnel, contract radiography shall not normally be allowed to start until 5:00 p.m. or later on weekdays.

6.16.4.1 Exceptions shall have the prior written approval of the Chairperson, IRC.

6.16.5 Incidents During Radiography—If any of the following situations occur during the conduct of radiography, employees shall immediately notify the Duty Officer, the Emergency Dispatcher, and the LaRC RSO:

- a. The radiography source becomes separated from the control cable or otherwise cannot be retracted into the camera.
- b. There is a suspected overexposure of personnel.
- c. Activity is being performed that is unsafe, in the opinion of the radiography monitor.

6.16.6 Conduct of Radiography on Joint Base Langley-Eustis (JBLE)—As a tenant of JBLE, LaRC shall comply with all radiation control procedures established by the JBLE RSO in addition to these procedures.

6.17 STORAGE OF RADIOACTIVE MATERIAL

6.17.1 Radioactive materials shall be stored in approved locations only.

6.17.2 Radioactive materials shall not be stored alongside other items that may cause unintentional releases, such as corrosive chemicals.

6.17.3 Radioactive materials shall be kept locked up when they are not in use or in the continuous presence of authorized users.

- a. This requirement may be satisfied by either locking the material up in a cabinet or locker or by locking up the work area. In either case, only authorized users may be allowed to have a key to access the material.

Chapter 7**7. EMERGENCY PROCEDURES****7.1 GENERAL**

NOTE: Contamination is easily spread during an emergency situation such as a fire, explosion, accidental breakage of a container, or spill. The air currents set up by a fire can spread radioactive materials very rapidly and easily. They may also find their way into an air conditioning system, or, if spilled on the floor, personnel may track them around. This contamination is undetectable except by the use of special radiation detecting devices, such as the Geiger counter. Because it is extremely difficult to set up adequate detection controls in an emergency, preplanned emergency procedures are included in these procedural requirements.

7.1.1 Personnel whose work involves the use of radioactive materials shall familiarize themselves with these procedures.

7.1.2 Should there be a catastrophic radioactive release, response procedures shall be in accordance with LPR 1046.1, "Emergency Management Plan."

7.2 PROCEDURES AFTER RELEASE OF RADIOACTIVE MATERIAL

7.2.1 Immediately after the occurrence of a release or spill, the involved person shall:

- a. Vacate all affected personnel to a safe area and segregate them from other personnel.
- b. Notify the RSO by telephone or the most rapid method of communication.
- c. Follow the instructions given by the RSO or an authorized representative.

7.2.2 Unless instructions given by the RSO are different, the person involved in the spillage shall take the following specific precautions, provided they do not place themselves at additional risk:

- a. Prevent all non-emergency personnel from approaching the contaminated area, or from attempting to deal with the spillage.
- b. Secure sources of ventilation such as HVAC and shut doors and windows as appropriate.
- c. For incidents that have a potential to cause significant exposure, such as with high dose rate sources or airborne radioactivity, ensure that personnel have evacuated to an area of low exposure potential.

7.2.3 Personnel shall conduct themselves by the following rules:

- a. No person shall enter an affected area until the health physics staff has conducted a contamination survey and has pronounced the area safe to resume work.
- b. Unauthorized personnel shall not attempt to make a survey, or to clean up the spillage.
- c. Decontamination procedures shall ALWAYS be conducted under the supervision of the RSO or an authorized qualified representative.
- d. Personnel shall be instructed to keep their movements in the contaminated area to a minimum to avoid spreading the contaminant by tracking.

7.3 FIRES IN RADIATION AREAS

7.3.1 Fires in radiation areas shall be handled as described herein.

- a. In case of fire in areas where radioactive materials are in use, every practical effort shall be made by the user to replace the material in its shielded container. If this is not possible, it shall be the responsibility of the user to promptly notify the NASA LaRC Fire Department and the RSO or alternate.
- b. NASA LaRC Fire Department personnel shall be knowledgeable of radiation hazards and are encouraged to contact the health physics staff for periodic instruction.
- c. The RSO shall periodically notify the NASA LaRC Fire Department in writing of all locations of radioactive materials in amounts that may prove hazardous to NASA LaRC Fire Department personnel either externally or internally or that may present a serious contamination problem.
- d. When responding to one of these locations, the NASA LaRC Fire Chief, in consultation with the RSO, shall ensure that proper procedures are implemented to minimize radiation exposure to personnel and prevent the spread of contamination.

7.4 LOST, MISPLACED, OR STOLEN SOURCES OF RADIATION

7.4.1 Lost, misplaced, or stolen sources of radiation shall be reported immediately to the RSO:

- a. The RSO shall promptly prepare all reports required by the NRC after a theft or loss of licensed material.
- b. These reports shall then be transmitted by the Safety Manager.

7.5 NOTIFICATION OF ACCIDENTS

7.5.1 Accident notification shall be in accordance with the following procedures:

- a. A user or operator shall immediately report to the RSO any incident or accident-involving radiation sources, or malfunction of radiation producing equipment.
- b. The RSO shall promptly investigate any report and advise NASA LaRC management of the findings.
- c. The FSH and Chairperson, IRC, shall be informed periodically of the progress of the investigation.
- d. The RSO shall ensure that the NRC is notified immediately following an accident as described in 10 CFR 20, Paragraph 20.2202. The NASA Senior Environmental Health Officer (SEHO) shall also be notified.
- e. The RSO shall submit a written report, for transmission by the LaRC Safety Manager, to NRC within 30 days following an overexposure to radiation levels and concentrations of radioactive material as described in 10 CFR 20, Paragraph 20.2203. The NASA SEHO shall also be notified.

Chapter 8

8. VISITOR CONTROL

8.1 VISITOR LIMITATIONS

8.1.1 Visitors shall be allowed to enter radiation areas at LaRC only with approval of the cognizant FSH and the RSO.

8.1.2 Visitors shall be required to submit their full name, date of birth, and a statement of previous exposure history so that they can be issued a film badge prior to entry into a radiation area.

8.1.3 Visitors within a radiation area shall be accompanied by a certified radiation worker at all times.

APPENDIX A. DEFINITIONS AND TERMINOLOGY

accelerator	A machine that accelerates electrically charged particles to high velocities. Types of accelerators include the cyclotron, linear accelerator, and Van de Graaff generator.
agreement state	Any state with which the Nuclear Regulatory Commission has entered into an effective agreement to perform specific parts of the Atomic Energy Act of 1954.
ALI	Annual Limitation on Intake
alpha radiation	Positively charged particles, each identical to a helium nucleus and emitted from a nucleus during radioactive decay.
alpha emitter	Any nuclide that emits alpha radiation.
beta radiation	High speed electrons emitted from a nucleus during radioactive decay.
beta emitter	Any nuclide that emits beta radiation.
bremsstrahlung	Electromagnetic radiation emitted by charged particles when they are slowed down by electric fields in passage through matter.
byproduct material	Any radioactive material (excluding source and fissionable material) obtained in the process of producing or using source or fissionable material; includes fission products produced in nuclear reactors.
contamination (radioactive)	Particles of radioactive material in an undesired location.
curie	The unit of radioactivity equal to 37 billion nuclear decays per second.
DAC	Derived Air Concentration
day	Calendar days unless otherwise specified.
Decay (radioactive)	Spontaneous disintegration of the nucleus of an unstable atom by the emission of charged particles and/or electromagnetic radiation.

decontamination dose (radiation)	The removal of radioactive contaminants. The quantity of energy imparted to a mass of material exposed to radiation.
dose rate	The radiation dose delivered per unit time.
dosimeter	Any device that detects and measures radiation dose.
film badge	A packet of photographic film used for measurement of radiation dose for personnel monitoring purposes.
fission	The splitting of a heavy nucleus into roughly equal parts, accompanied by the release of energy and frequently one or more neutrons.
fissionable material	Any material readily fissioned by slow neutrons.
gamma radiation	Highly penetrating electromagnetic radiation of nuclear origin.
gray	Equals 100 rads.
half life (radioactive)	The time in which half the atoms in a radioactive substance decay.
health physics	A profession devoted to the protection of humans and the environment from unwarranted radiation exposure.
ionization chamber	An instrument that detects and measures ionizing radiation by observing the electric current created when radiation ionizes gas in the chamber.
ionizing radiation	Any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter.
isotope	Atoms with the same atomic number but different atomic weights.
licensed material	Any material received, possessed, used, or transferred under a general or special license issued by the Nuclear Regulatory Commission agreement state.
micro	A prefix meaning one millionth, for example, one microcurie equals 1×10^{-6} curies.

milli	A prefix meaning one thousandth, for example, one millicurie equals 1×10^{-3} curies.
msv	Millisievert (equals 0.1 rem).
nuclide	An atomic species defined by the number of protons and neutrons in its nucleus (e.g. Carbon-12)
physical barrier	Any device or devices which would preclude unauthorized entry by causing the physical removal of such before entry can be obtained.
pocket dosimeter	A self-reading, pencil size ionization chamber used for personnel monitoring purposes.
quality factor	A factor used to compare the biological effectiveness of absorbed radiation doses due to different types of ionizing radiation; equivalent to the term, RBE, relative biological effect.
rad	The basic unit of absorbed dose of ionizing radiation; equals the absorption of 100 ergs of energy per gram of matter.
radiation	The emission and propagation of energy through space or through a material in the form of waves. The energy propagated through space or through materials as waves; usually referring to electromagnetic radiation. By extension, particulates such as alpha or beta radiation or rays of mixed type.
radioactivity	The spontaneous decay or disintegration of an unstable atomic nucleus, accompanied by the emission of radiation.
radioassay	The process of analyzing biological material to determine its radioactive content.
radiography	The use of penetrating ionizing radiation to examine solid material.
radioisotope	An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation.
radiology	The branch of medicine that uses ionizing radiation for diagnosis and therapy.

rem	Roentgen equivalent man. A unit of absorbed dose in biological matter; equals the absorbed dose in rads multiplied by the quality factor of the radiation.
roentgen	The amount of gamma or x radiation required to produce ions carrying one electrostatic unit of charge in one cubic centimeter of dry air under standard temperature and pressure conditions.
source material	Any material, except special nuclear material, which contains 0.05 percent or more of uranium, thorium, or any combination of the two.
special nuclear material	Plutonium, uranium 233, uranium containing more than the natural abundance of uranium 235, or any material enriched by any of these substances.
survey	An evaluation of the radiation hazards incidental to the production, use, or presence of radioactive material or other sources of radiation under a specific set of conditions.
temporary job site	Any facility utilized temporarily by a LaRC-sponsored project that is not under the administrative control of LaRC.
waste (radioactive)	Equipment and materials that are radioactive and, having no further use, are discarded.
x radiation	Penetrating electromagnetic radiation of nonnuclear origin; usually produced by bombarding a metallic target with high-speed electrons.
year	365 days

APPENDIX B. ACRONYMS

ALARA	As Low As Is Reasonably Achievable
CFR	Code of Federal Regulations
DOT	Department of Transportation
EMO	Environmental Management Office
FDA	Food and Drug Administration
FSH	Facility Safety Head
IRC	Ionizing Radiation Committee
LAPD	Langley Policy Directive
LaRC	Langley Research Center
LMO	Logistics Management Office
LPR	Langley Procedural Requirements
NASA	National Aeronautics and Space Administration
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
PPE	Personal Protective Equipment
RAM	Radioactive Material
RGD	Radiation Generating Device
RSO	Radiation Safety Officer
SFAB	Safety and Facility Assurance Branch
SMAO	Safety and Mission Assurance Office
TEDE	Total Effective Dose Equivalent