

Langley Research Center
Hampton, Virginia
23665

70-1314

Reply to Attn of 429

April 10, 1985

U. S. Nuclear Regulatory Commission
License Management Branch
Division of Fuel Cycle and Material Safety
Washington, DC 20555

Subject: Renewal of License Number SNM-1288

Renewal is requested for License Number SNM-1288 authorizing the possession of Uranium-235 at NASA-Langley Research Center. The only authorized use of the 2 gram maximum amount of licensed material will be for storage only. The licensed material will be stored only at Building 1247D or Building 1254, NASA-Langley Research Center. The expiration date for this license is May 31, 1985.

The Langley Research Center's radiation protection program is set forth in LHB 1710.5 (January 1978 revision). Two copies are enclosed. If additional information relative to this renewal request is desired, please contact our Radiation Safety Officer, Carter B. Ficklen at 804-865-2246 or FTS 928-2246.

V. William Wessel
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Safety Manager, Head,
Safety Engineering Branch,
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Reliability Office

Enclosures

cc (w/o Encl.):
U. S. Nuclear Regulatory Commission
Document Management Branch, US NRC
Division of Fuel Cycle and Material Safety
Washington, DC 20555

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LHB 1710.5
JANUARY 1978



Langley Research Center

IONIZING RADIATION

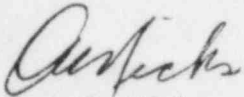
National Aeronautics and Space Administration

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PREFACE

This chapter of the Langley Safety Manual (LHB 1710.5) implements the Nuclear Regulatory Commission (NRC) regulations by assigning responsibilities and authorities at the Langley Research Center. Ionizing radiation sources not covered by NRC regulations are included in this handbook.

The standards and regulations contained herein do not in any way relieve the supervisors of various organizational elements from their responsibility for conduct of safe operations.



Oran W. Nicks
Deputy Director

Distribution:
Safety Manual Holders
Safety Office (250)
Management Analysis Branch - MSD (10)

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I. INTRODUCTION

A. Purpose

This manual describes the policy, organization, procedures, and requirements for the radiological health and safety activity of the Langley Research Center (LaRC).

B. Scope

This manual describes organization, training, and responsibilities for radiological health and safety at LaRC. It defines procedures and requirements for procurement, use, handling, storage, shipment, and disposal of sources of ionizing radiation, as well as personnel monitoring and emergency procedures. It also indicates sources from which more detailed information may be obtained when necessary.

C. LaRC Policy

It is the policy of LaRC to: (1) exercise centralized control over operations involving use of radioactive materials and radiation-producing equipment; (2) assure that exposure of personnel to ionizing radiation from radioactive materials or radiation-producing equipment is kept to a minimum; (3) assure that compliance with Federal, state and local regulations is maintained.

The responsibility for implementation of these safety policies with respect to a particular radiation device is given to the Organizational Facility Safety Head (a member of line management). The Organizational Facility Safety Head will establish normal and emergency operating procedures and insure all personnel operating the device are properly trained. A review system is established to insure that these procedures are in compliance with the protection standards adopted herein.

D. Applicability

The procedures and radiation protection practices as set forth in this manual apply to all organizational elements of LaRC and to all contractors working in facilities under the administrative control of LaRC. It should be noted that regulations quoted are Federal statutes imposed on NASA under terms of its licenses with the Nuclear Regulatory Commission (NRC, formerly Atomic Energy Commission), and applicable regulations promulgated by Occupational Health and Safety Administration (OSHA), 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 LaRC Radiation Safety Officer (RSO) (extension 2246, Health Physicist, Occupational Medical Center, Building 1149).

E. Revision of Manual

Revisions to this manual will be developed by the LaRC Ionizing Radiation Committee (IRC) (see LMI 1700.3, "The Executive Safety Board and Its Committees"). Specific changes will be numbered and transmitted by the Safety Manager and will consist of a change checklist, and the new pages to be inserted into the document.

II. IONIZING RADIATION COMMITTEE (IRC)

A. Authority

This committee is established under the authority of LMI 1700.1, "Safety Program," and LMI 1700.3. Its establishment is necessary in the public interest and to: (1) insure compliance with licensing requirements for radioactive material under the rules and regulations of the U.S. Nuclear Regulatory Commission (NRC), and (2) insure compliance with the U.S. Department of Labor, Occupational Safety and Health Standards, Title 29, Code of Federal Regulations, Part 1910.96 (29 CFR 1910.96).

Any member of this committee is authorized to investigate any questionable radiation source, equipment, system, etc., and is authorized to act in the name of the Director to stop work or to prevent the use of equipment which he considers unsafe and to start action to eliminate the unsafe condition. Such action will be documented within 24 hours by formal memorandum to the Safety Manager with a copy to the Chairman of the IRC. Work can be resumed after the corrective action has been taken. However, if line management is not in agreement with the corrective action recommended by the official who stopped the work, the line manager is to submit his reasons to the Chairman of the Executive Safety Board who will make an appropriate review. In these cases work cannot be resumed without the approval of the Chairman of the Executive Safety Board.

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 Section IV, Part B, "Authorization of Use."

B. Structure and Organization

The IRC functions as a subcommittee of the Executive Safety Board. Its position in the organization for radiation safety is shown in the block diagram of Figure 1.

Committee members (including Chairman and Vice Chairman) are appointed by the Vice Chairman of the Executive Safety Board by virtue

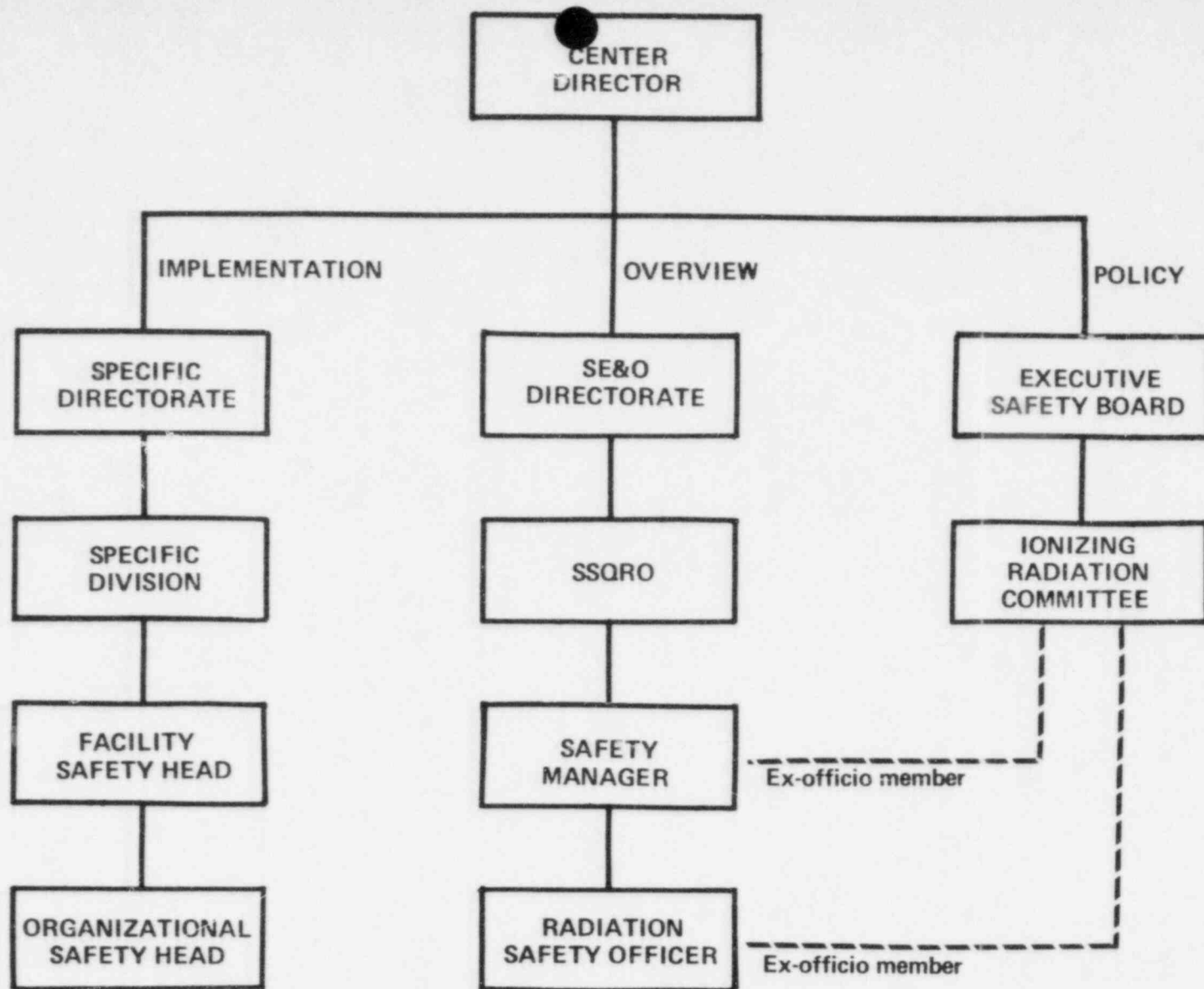


Figure 1.- LaRC Organization for Radiation Safety.

of their technical and/or educational expertise in the field of ionizing radiation. A typical committee will consist of a Chairman, a Vice Chairman, three qualified members and two ex-officio members. Members serve for a two year term with the exception of the Safety Manager and the RSO who are ex-officio committee members and serve as long as the committee continues to function.

During the first meeting of a new calendar year, the committee will elect a committee secretary from its full membership. The committee secretary will be responsible for preparing and distributing committee minutes in addition to his other responsibilities.

C. Duties and Responsibilities

1. General

To assure compliance with federal regulatory statutes, the IRC must 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 (see Section IV).

In addition, the IRC will insure that an audit is made of each facility's possession and use of sources of ionizing radiation no less frequent than annually (see Section V).

The IRC is responsible for developing and coordinating material incorporated in this handbook as the need arises.

2. Specific

The duties of the committee chairman are to:

- a. Call meetings of the committee with an agenda furnished or approved by him. Meetings shall be called as required but no less frequent than quarterly.
- b. Act as the presiding officer at all committee meetings.
- c. Act as the signature authority for actions approved by the committee (safety permits, etc.).
- d. Be cognizant of all matters pertaining to ionizing radiation at LaRC.

The duties of the committee vice chairman are to:

- a. Assist the chairman whenever feasible.

- b. Serve as the chairman in his absence.

The duties of the committee secretary are to:

- a. Prepare and distribute minutes of committee meetings which shall contain, as a minimum, a record of persons present and a description of matters discussed and conclusions reached, including the opinions of dissenting members, and copies of all reports issued or approved by the committee. Distribution of committee minutes shall include all members, the affected Organizational Facility Safety Heads, the Chairman of the Executive Safety Board, and Head, Systems Safety, Quality and Reliability Office (SSQRO).

- b. Handle official correspondence for the committee as needed.

The duties of the membership are to:

- a. 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.

- b. Serve on ad hoc committees which are appointed by the chairman, as needed.

III. SAFETY AND HEALTH FUNCTIONS

The responsibility for implementing the policies of this handbook is divided among five safety and health functions. The interface requirements of these functions and their duties and responsibilities are given below.

A. Organizational Facility Safety Head (OFSH)

The Principal Facility Safety Head of each facility wherein there exists ionizing radiation operations shall appoint an Organizational Facility Safety Head (OFSH) for each such operation which is functionally or generically distinct. Procedures and forms for appointment are described in LMI 1700.2, "Safety Assignments." The OFSH shall, in each case, be a representative of line management who is thoroughly familiar with the operation and its potential hazards. In some cases the OFSH may also be the prime user of the source(s) of ionizing radiation.

1. Interfaces

The OFSH is the first point of contact for the individual who has a requirement for the procurement, use, or disposal of sources of ionizing radiation. The first point of contact for the OFSH is the RSO.

2. Responsibilities

The general duties and responsibilities of an OFSH are described in LMI 1700.2. In addition to those, the OFSH of an operation involving sources of ionizing radiation shall have the following responsibilities:

a. Supervise and coordinate in a safe manner the procurement, use and disposal of sources of ionizing radiation for his operation.

b. Maintain a running inventory of all radioactive sources and all radiation producing machines used in his operations. The inventory shall include locations of use, type of radiation emitted, and maximum radiation intensities produced by these sources and machines.

c. Maintain an inventory of those radiation monitoring instruments in his operation which are required for the purpose of monitoring personnel exposure to ionizing radiation (see Section V, Part O). The instrument inventory shall include the manufacturer, model number, serial number, and the date of calibration for each instrument so required.

d. Secure film badge service from the RSO for all personnel in his operation who are likely to receive ionizing radiation exposure in excess of 25% of the limits specified in Section V, Part J(1). The RSO will assist the OFSH in the determination of film badge requirements upon request.

e. Maintain a current list of employees in his operation who are required to be certified as radiation workers. See Section V, Part D(1), for requirements of certification.

f. Accompany the RSO during audits of his operation and be present at the meeting of the IRC when the results of his audit is presented to the committee for their review.

B. Radiation Safety Officer (RSO)

The position of the RSO has been designated within a contractor team of full-time professional health physicists. The RSO is located in the Occupational Medical Center, Building 1149.

1. Interfaces

The RSO is responsible to the SSQRO of the Directorate of Systems Engineering and Operations (SE&O) and reports directly to the LaRC Safety Manager. The RSO is an ex-officio member of the IRC. Recommendations to the committee for approval or disapproval of new uses of ionizing radiation are made by the RSO following preoperational surveys and review of safety procedures. The RSO assists the radiation user as primary contact on a day-to-day basis for matters relating to radiation safety other than procurement.

2. Responsibilities

In general, the RSO provides administrative and technical guidance to LaRC personnel in the safe use of ionizing radiation. Specific duties of the RSO include the following:

- a. Assume control and initiate corrective action in radiation emergencies.
- b. Coordinate with NRC on matters concerning licensing and other regulatory functions through the Safety Manager.
- c. Prepare incident and over-exposure reports required by the NRC and other agencies.
- d. Perform preoperational 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. Recommend to the IRC approval or disapproval of such facilities.
- e. Perform annual audits of ionizing radiation activity in each division. (See Appendix A for audit schedule.)
- f. Maintain a program of personnel dosimetry (film badges, pocket chambers, etc.). Interpret reports and maintain permanent dosimetry records.
- g. Perform periodic radiation protection surveys and radiation safety evaluations including leak tests required by NRC license.
- 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 government and LaRC requirements.

j. Operate the Health Physics Laboratory (located in Building 1284) and be custodian of the Radioactive Waste and Storage Facility (Building 1254).

k. Provide training and indoctrination of personnel in radiation safety.

l. Review all purchase requests for ionizing radiation sources for compatibility with approved programs and licensing requirements.

m. Inspect and maintain records of all receipts and shipments of ionizing radiation sources.

n. Periodically inform the IRC of new developments in the field of ionizing radiation as they are applicable to activities at LaRC.

C. Safety Manager

The position of LaRC Safety Manager is within the SSQRO of SE&O.

1. Interfaces

The Safety Manager is responsible for the technical management of contractual health physics services at LaRC. The Safety Manager is an ex-officio member of the IRC. The Safety Manager is the primary contact for LaRC management on matters relating to radiation safety. He serves as the official government interface between the RSO and federal regulatory authorities (NRC, OSHA, etc.).

2. Responsibilities

a. Exercise general surveillance over all uses of ionizing radiation at LaRC, including onsite contractor activities to assure radiation use is in conformity with safe practice, pertinent regulations and with provisions approved by the IRC for specific radiation use authorizations (i.e., safety permits). The Safety Manager may elect to use the RSO to perform this function.

b. Serve as the final reviewing and/or certifying authority on the following documents:

(1) NRC License Applications (NRC Form 313).

(2) Worker Appointment and Certification Form (Langley Form 66).

(3) Radiation Hazard Form (Langley Form 44A).

(4) Safety Permits.

D. Occupational Health Officer (OHO)

The position of the OHO is within the Directorate for Management Operations (DMO).

1. Interfaces

The OHO is the Technical Representative of the Contracting Officer (TRCO) for medical support services at LaRC (specifically, the Occupational Medical Center, Building 1149). He is this center's prime contact for matters relating to occupational illnesses or injuries.

2. Responsibilities

a. Determines adequacy of physical examination requirements for ionizing radiation workers at LaRC. Reviews new developments in the area of medical surveillance for these workers.

b. Serves as a qualifying official on Langley Form 66, "Worker Appointment and Certification."

E. Radiation Workers

The OFSH, having direct involvement with sources of ionizing radiation, shall forward recommendations for appointment of radiation workers as described in Section IV, Part B(1). Radiation workers are the only persons permitted to handle radioactive materials or to approach sources of radiation closely enough to receive a dose in excess of 0.5 rem in a year or a dose rate in excess of 2 mR per hour.

1. Interfaces

The radiation worker is under the direct authority of the OFSH. The radiation worker also has authority over all unauthorized personnel in connection with the safe operation of the device to which he is assigned.

2. Responsibility

a. Be cognizant of and to comply with the LaRC regulations pertaining to ionizing radiation safety.

b. Be fully aware of the limitations given in the Description of Duties section of his appointment form, and to notify his OFSH when:

(1) A change in the definition of the limitations is needed.

(2) His need to work in restricted areas has ended.

c. Insure that persons other than qualified radiation workers are not exposed to radiation levels which produce a dose in excess of 0.5 rem in a year.

IV. ROUTINE PROCEDURES AND REQUIREMENTS

Clearly defined procedures and requirements are a prerequisite for the orderly processing of documents and materials for any type of organizational structure. Most of the routine procedures and requirements for matters related to ionizing radiation at LaRC are given below. Questions concerning these procedures and requirements should be directed to the RSO.

A. Procurement and Receipt

Prior to the procurement and receipt of any source of ionizing radiation, the user or operator of the source shall complete Langley Form 44A, "Radiation Hazard Form," and attach it to Langley Form 125, "Purchase Request/Purchase Order." Where an OFSH has not been appointed, the user submits Langley Form 44A to the Principal Facility Safety Head (PFSH). The PFSH shall then appoint an OFSH (as described in LMI 1700.2) for the organization which is procuring the source of ionizing radiation. A flowchart of approvals required for processing this form is shown in Figure 2. Specific responsibilities of the safety and health functions identified in the flowchart are given below.

1. Organizational Facility Safety Head

a. Reviews and approves Langley Form 44A for system compatibility with research objectives.

b. Forwards the approved Langley Form 44A to the RSO.

2. Radiation Safety Officer

Upon receipt of Langley Form 44A the RSO will schedule a preoperational survey with the OFSH. The purpose of this survey is to provide the OFSH with guidance and assistance in the following areas:

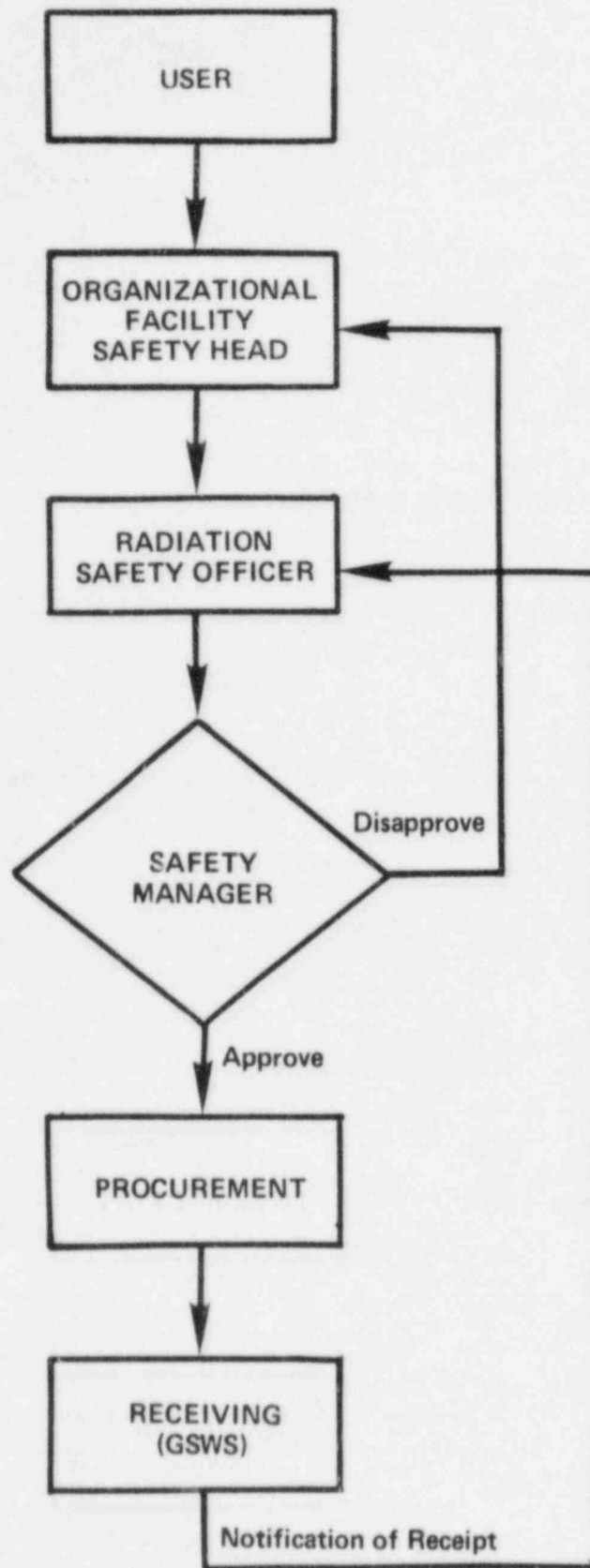


Figure 2.- Authorization of Procurement
(Langley Form 44A, "Radiation Hazard Form").

- a. Applicability of safety permit requirements.
- b. Preparation of NRC license (if applicable).
- c. Preparation of safety procedures.
- d. Preparation of authorizing documents specified in Part B of this section.

Following the survey, the RSO will sign Langley Form 44A and forward to the Safety Manager.

3. Safety Manager

Upon receipt of Langley Form 44A, the Safety Manager will review the RSO's survey and approve or disapprove the purchase of the source of ionizing radiation.

If the Safety Manager disapproves Langley Form 44A, the form is returned to the OFSH with a written explanation of disapproval attached. The OFSH may appeal disapprovals through his division to the Executive Safety Board. If he approves Langley Form 44A, the Safety Manager will sign the form, detach copy II, and notify the OFSH by telephone of its approval. The OFSH may request the Safety Manager to forward the approved Langley Form 44A and Langley Form 125 to the appropriate purchasing officer or he may elect to have these documents mailed back to him.

4. Purchasing

Upon receipt of an approved Langley Form 44A, the purchasing officer will complete the information indicated in the upper right-hand corner of the form. If a contract is let for purchase of the material, the purchasing officer will detach copy III of Langley Form 44A and forward copy IV to the General Supply and Warehousing Section (receiving).

5. Receiving

Upon receipt of any incoming source of ionizing radiation authorized by a Langley Form 44A, the General Supply and Warehousing Section will immediately notify the RSO of its arrival at LaRC. The material will not be released until the RSO has surveyed the package to document radiation intensities and/or contamination.

B. Authorization of Use (Safety Permit)

Some sources of ionizing radiation require the completion of a Safety Permit Request and subsequent approval and issuance of a Safety

Permit before the source can be used or operated at any LaRC facility. The RSO is responsible for the determination of Safety Permit requirements during the processing of Langley Form 44A (see Part A, above).

The Safety Permit is a written designation that the particular research experiment, rig, or operation has been reviewed by technically qualified members of the LaRC staff and that all reasonable safety precautions and environmental requirements have been considered and subsequently implemented. The Safety Permit Request Form for radiation machines or for radioactive materials shall be used as appropriate (see Appendix B, Sample Forms). The Safety Permit Request should describe the maximum potentially hazardous operating parameters (i.e., maximum source strength, kilovoltage, amperage, etc.) expected during the life of the experiment or operation. Changes in the operational configuration which do not exceed the authorized maximum parameters or change the authorized safety features will not require the processing of a modified Safety Permit. Other changes require additional review and approval by the IRC. Safety Permits are valid for a period of one year from date of issuance.

A flowchart of approvals required for processing these documents is shown in Figure 3. Specific responsibilities of the safety and health functions identified in the flowchart are given below.

1. Organizational Facility Safety Head

a. Prepares a Safety Permit Request and attaches pertinent drawings, sketches and supporting information. If safety procedures and precautions cannot be adequately described on line item 2 of the form, an attachment may be used instead of completing this line item.

b. Prepares and attaches to the Safety Permit Request Langley Form 66 (NASA employees) or its equivalent (for contractor employees) for each radiation worker. Samples of Langley Form 66 and its contractor equivalent can be found in Appendix B.

c. Forwards the Safety Permit Request and attachments to the RSO.

d. Posts the approved Safety Permit (along with an attached copy of the Safety Permit Request) in a conspicuous place at the specified site, or if more practical, in the applicable control center for the site.

e. Submits a memorandum to the Safety Manager requesting renewal of a Safety Permit at least 30 days prior to the expiration date or submits a new Safety Permit Request through channels anytime a change is required in the authorized maximum operating parameters.

2. Radiation Safety Officer

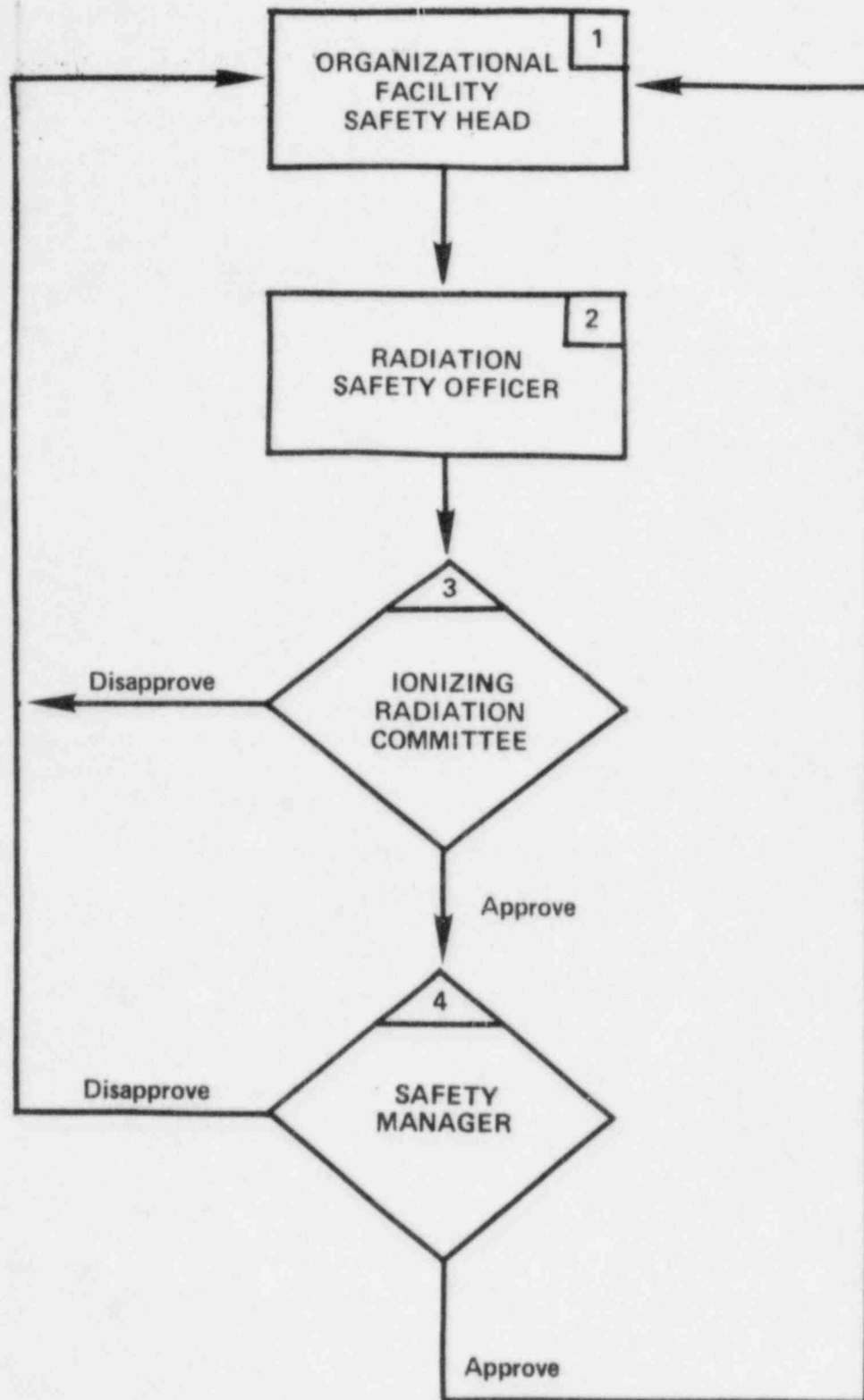


Figure 3.- Authorization of Use (Safety Permit).

a. Upon receipt of the Safety Permit Request and attachments, the RSO will perform a radiation hazard analysis of the proposed operation. During this analysis the RSO will work closely with the OFSH to provide guidance and assistance in the preparation and acquisition of safety procedures, protective equipment, medical surveillance and NRC licensing (if required).

b. The RSO forwards the Safety Permit Request, attachments and his hazard analysis (with appropriate recommendations) to the IRC for their review and approval.

3. Ionizing Radiation Committee

a. Notifies the requester when a committee review meeting will be held.

b. Reviews the Safety Permit Request to determine whether all reasonable precautions have been taken and whether the proposed operations can be carried out with an acceptable level of risk to personnel and equipment. Based on this review the committee:

(1) Recommends issuance of a Safety Permit by the committee chairman if sufficiently satisfied upon completion of review.

(2) Returns the Safety Permit Request to the requester if problem areas are evident. Rejection of a request by the committee may be appealed by the OFSH through his division to the Executive Safety Board.

c. Committee chairman completes Safety Permit and specifies when appropriate, any special conditions on which approval is based.

d. Forwards Safety Permit Request, attachments and approved safety permit to the Safety Manager.

e. Reviews existing Safety Permits as part of the annual audit to insure that they are valid (either unexpired or have been reviewed before expiration date).

4. Safety Manager

a. Notifies the requester when a review will be completed.

b. Reviews the Safety Permit Request for impact on the environment or creation of safety hazards outside the scope of radiological health. Based on this review the Safety Manager:

(1) Signs the Safety Permit and returns all attached documentation to the requester.

(2) Returns the Safety Permit Request and all attached documentation to the requester if problem areas are evident. Rejection of a safety permit by the Safety Manager may be appealed by the requester through his division to the Executive Safety Board.

V. SPECIAL PROCEDURES AND REQUIREMENTS

A. Special Requirements for Off-Site Radiation Use Authorization

Prior to approving a Safety Permit 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:

1. Written authorization shall be obtained from the administration of the facility. If the facility or institution holds a by-product license from the NRC or an agreement state, then the use of by-product materials should be concurred in by that facility's RSO and/or its IRC.

2. To assure minimal radiation exposure to individuals and confirm no residual radioactive contamination remains in the off-site facilities, an individual shall be named, with adequate training and experience in radiological health activities, to select suitable instrumentation and perform monitoring tasks as determined necessary by the LaRC IRC.

3. 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. 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.

All records of radiation surveys, personnel monitoring and radioactive material transfers shall be maintained by the use supervisor and submitted to the LaRC RSO at the completion of the authorized use. Any incidents involving individuals overexposed, lost sources or contamination problems shall be reported immediately to the RSO.

B. Interim Approvals

When an immediate use of ionizing radiation is determined necessary, the RSO may temporarily modify the following previously approved authorizations with verbal concurrence from the IRC Committee Chairman:

1. Extend an expiration date of a Safety Permit for a period not exceeding 60 days.

2. Add specific users to the Safety Permit provided they have met the standards of training and experience established by the IRC.

3. Add to the sources of ionizing radiation named on an approved authorization provided the sources added will not change the kinds of radiation emissions previously authorized.

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

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 authorization.

C. Audits

The RSO is responsible for conducting an audit of each facility possessing sources of ionizing radiation no less frequent than annually. The annual audit is comprised of four segments in which approximately one-fourth of this Center's activity involving ionizing radiation will be audited each quarter and the results of the audit presented to the IRC during their quarterly meetings.

An approximate audit schedule for those facilities using sources of ionizing radiation can be found in Appendix A. OFSHs will be notified by memorandum one week in advance of the exact day(s) their audit will be conducted. Typical items covered during an audit are:

1. Inventories of:

- a. All radioactive material.
- b. Radiation producing machines.
- c. Monitoring instrumentation.

2. Records of:

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

3. Compliance with terms of Safety Permits.
4. Routine radiation protection surveys by the RSO.

D. Training and certification

1. Requirement

All personnel (including contractors) who operate, manipulate or who have any other type of physical control over the use of radiation producing equipment or material specifically authorized by a Safety Permit are required to be properly trained and safety-certified as radiation workers. Additionally, any person who is likely to receive a radiation dose in excess of 10% of the limits specified in Paragraph J of this section as a result of LaRC operations shall be trained and certified as a radiation worker. Questions concerning this requirement should be directed to the RSO.

2. Responsibility

It is the responsibility of each OFSH to see that his people are properly trained and certified.

3. Qualification

As a minimum, and prior to working with ionizing radiation, individuals must have had either radiation experience and/or training covering the following topics:

- a. General description of radiation and its hazards (provided by RSO).
- b. Basic principles of radiation safety (provided by RSO).
- c. LaRC policies and appropriate federal regulations (contained in this handbook).
- d. Emergency procedures (provided by OFSH).
- e. Radiation safety procedures relevant to duties associated with employment (provided by each OFSH).

4. Authorizing Documents

- a. Langley Form 66, "Worker Appointment and Certification Form."

Langley Form 66 is used for Government personnel to determine and certify that the qualifications for worker training and safety-certification described in paragraph 3 above have been satisfactorily met. Contractor personnel shall use a form which supplies the equivalent information of Langley Form 66 (see sample in Appendix B).

(1) New Safety Permit

Langley Form 66 (or its contractor equivalent), for individuals working on a new operation or experiment involving ionizing radiation, will be processed as attachments to the Safety Permit Request (see IVBla, above). Prior to attaching Langley Form 66 to the Safety Permit Request the requester shall insure that the back of the form (describing previous training and/or experience) and line items 1, 2, and 3, on the front of the form have been properly completed for each individual. If, after committee review, an individual is determined not to be qualified by virtue of past experience or training, his Langley Form 66 will be detached from the Safety Permit Request and given to the RSO who will schedule the individual for an applicable level LaRC course. The RSO will then be responsible for insuring the proper processing of the remainder of the form.

(2) Existing Safety Permit

Langley Form 66 for adding individuals as authorized users to an existing Safety Permit is processed by the RSO as described under Interim Approvals (see Part B, above). Prior to sending Langley Form 66 to the RSO, the OFSH shall insure that the back of the form (describing previous training and/or experience) and line items 1, 2, and 3 on the front of the form have been properly completed for each individual.

b. Radiation Worker's Certification Card

(1) Issuance

Upon completion of Langley Form 66 the RSO will issue the worker a Certification Card (see Appendix B) which is to be worn by him whenever he is performing the function requiring certification. The certification card will be identified with the number(s) of the Safety Permit(s) with which his work is associated.

(2) Revalidation

The certification card will be valid for one year from date of issuance. It is the responsibility of each radiation worker to have his card revalidated by the RSO prior to its expiration.

(3) Termination

Upon termination of employment or termination of a need for certification, the worker shall return the certification card to the RSO.

E. Medical Surveillance

1. Initial Examinations

Personnel requiring safety certification as radiation workers must complete a physical examination at the Occupational Medical Center, Building 1149, prior to being issued a certification card. This examination is normally accomplished through routine processing of Langley Form 66. The RSO is responsible for scheduling the initial examination through the auspices of the LaRC Occupational Health Officer.

2. Routine Examinations

All NASA-LaRC employees are offered an annual physical examination at the Occupational Medical Center during the month of their birthdate. Safety-certified radiation workers shall be required to participate in this annual examination. Medical records of these workers will be specifically identified so that the examining physician can be alerted to symptoms relating to radiation exposure. If the worker's radiation exposure is required to be monitored by film badge (see Part L of this section), he will be asked to review his exposure history for the preceding 12-month period during the annual examination.

3. Termination Examinations

Upon termination of employment or upon completion of a requirement to be safety certified, a radiation worker shall undergo a termination examination at the Occupational Medical Center. Two weeks notification should be given to the RSO so that the termination examination can be properly scheduled. Line supervision is responsible for this notification to the RSO.

F. Receipt

The RSO shall be notified of all arrivals of sources of radiation at LaRC and shall transfer the materials to Building 1254 for documentation, inspection and leak testing if applicable. The General Supply and Warehousing Section (GSWS) will furnish the RSO with a copy of the receiving document at the time of pickup.

G. Storage

All radioactive materials not covered by a current Safety Permit approved by the IRC shall be stored in Building 1254. The key to this building is in the custody of the RSO.

Exceptions shall be only those quantities of radioactive material which are general licensed amounts as specified in Title 10, Code of Federal Regulations, Part 3D (10 CFR 30). All storage areas for radioactive materials shall be so constructed that only authorized users have access to the material.

H. Shipping

All sources of radiation once documented by the RSO and located in a particular facility shall not be transferred to the accountability of another organization, or transferred from one location to another within LaRC without prior notification of the RSO in addition to action required for property control procedures.

Off-site shipments (both commercial and by NASA vehicle) require documentation and completion of a Radioactive Material Transfer Form (available from SSQRO) which shall be included with other relevant shipping documents. Each shipment shall be made in accordance with the applicable Federal, state and local transportation regulations. These regulations are referenced in Appendix C.

All commercial shipments of radioactive material shall be under the auspices of the GSWS when the shipment is sponsored by or shipped in connection with an LaRC sponsored project.

I. Area Designations

The following area designations shall apply for purposes of radiation control at LaRC.

1. Controlled Area

Any area to which access is controlled for purposes of protection of individuals from exposure to radiation and radioactive material. The term "controlled" is meant to be synonymous with the term "restricted" as used in the NRC Regulations.

2. Radiation Area

Any areas, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive any one hour a dose in excess of 2 millirem.

3. High Radiation Area

Any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive, in any one hour, a dose in excess of 100 millirem.

4. Airborne Radioactivity Area

Any room, enclosure, or operating area in which airborne radioactive materials exist in concentrations in excess of the amounts specified in 10 CFR 20, Appendix B, Table I, Column 1, or any room, enclosure, or area in which concentrations, which averaged over the number of hours in any week during which individuals are in the area, exceed 25 percent of the amounts specified in 10 CFR 20, Appendix B, Table I, Column 1.

5. Uncontrolled Area

Any area to which access is not controlled for purposes of protection of individuals from exposure to radiation and radioactive materials. The term "uncontrolled" is meant to be synonymous with the term "unrestricted" as used in the NRC Regulations.

J. Radiation Dose Limits

Radiation dose limits at LaRC are based upon limits specified by the NRC in 10 CFR 20, and by OSHA in 29 CFR 1910.96. 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. A particular effort should be made to keep the radiation exposure of any embryo or fetus to the very lowest practicable level during the entire gestation period as recommended by the National Council on Radiation Protection and Measurements. (Reference: NRC Regulatory Guide 8.13.)

1. Dose Limits for Controlled Areas

Radiation workers shall not be exposed routinely to radiation or radioactive material in such a manner that the following limits are exceeded:

	<u>Rem/Calendar Quarter</u>
Whole body, head and trunk; active blood forming organs; lens of eyes; or gonads	1.25
Hands and forearms; feet and ankles	18.75
Skin of whole body	7.50

In exceptional cases an individual may be permitted to receive a quarterly whole body dose greater than 1.25 rem provided:

a. During any calendar quarter the dose to the whole body shall not exceed 3 rem; and,

b. The dose to the whole body, when added to the accumulated occupational dose to the whole body, shall not exceed $5(N-18)$ rem where N equals the individual's age in years at his last birthday; and,

c. The individual's prior accumulated exposure has been determined.

2. Dose Limits for Minors

An individual under the age of 18 years shall not be permitted to enter or be employed in controlled areas such that he will receive doses of radiation in amounts exceeding 10 percent of the limits in paragraph 1, above. Exposures shall be averaged over periods not to exceed one calendar quarter.

3. Dose Limits in Uncontrolled Areas

Radiation dose limits in uncontrolled areas shall be such that an individual will not receive a dose to the whole body in excess of 0.5 rem in any calendar year. Furthermore, radiation levels shall be such that if an individual was continuously present in the area, he would not receive a dose in excess of 100 millirem in any seven days.

K. Airborne Concentration Limits

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

1. Controlled Areas

With no allowance made for protective clothing or equipment, no personnel shall be exposed to airborne radioactive material in average concentrations in excess of the limits specified in 10 CFR 20, Appendix B, Table I. These limits are based upon an exposure to these concentrations for 40 hours in any period of seven consecutive days. For exposure times, other than 40 hours, the airborne concentration limits may be increased or decreased proportionately.

2. Minors

An individual under the age of 18 years shall not be exposed to airborne radioactive material in an average concentration in excess of the limits specified in 10 CFR 20, Appendix B, Table 2. Concentrations may be averaged over periods not greater than one week.

3. Uncontrolled Areas

No personnel in uncontrolled areas shall be exposed to airborne radioactive material in concentration in excess of the limits specified in 10 CFR 20, Appendix B, Table 2. Concentrations may be averaged over a period not greater than one year.

L. Personnel Monitoring

1. Personnel monitoring is required in any area where there is a probability that an individual may receive a radiation dose in excess of 25 percent of the limits specified in Part J1, above.

2. The details of the monitoring procedure shall be determined in each case by the RSO in consultation with the OFSH and with consideration of the LaRC dose limits.

3. Personnel monitoring procedures shall include, as a minimum, the wearing of film badges and/or pocket dosimeters. Film badges shall be changed for processing on or about the fifth working day of each month. Personnel monitoring devices shall be available from the RSO. When needed, the appropriate radioassay service shall be furnished.

4. The RSO shall maintain a permanent record of all personnel dosimetry reports. If a report indicates an overexposure, an investigation shall be initiated to determine cause and to suggest remedial action. The overexposure shall be reported to the NRC in compliance with 10 CFR 19.

5. Individuals determined to require radiation monitoring shall be advised annually of the worker's exposure to radiation or radioactive material during the required annual physical examination.

M. Posting and Labeling

The posting and labeling requirements for LaRC are based on the regulations in 10 CFR 19, 10 CFR 20, and 29 CFR 1910.96. The radiation symbols prescribed by this section shall be the conventional magenta or purple three-bladed design on a yellow background. Any additional information that may minimize exposure to radiation or to radioactive material shall be on or near signs and labels. Posting and labeling requirements are as follows:

1. Radiation Area

Each radiation area shall be conspicuously posted with a sign or signs bearing the radiation symbol and the words:

CAUTION RADIATION AREA

2. 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

All high radiation areas established for a period of 31 days or more, shall be equipped with a control device which shall 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 shall energize a conspicuous, visible or audible alarm signal in such a manner that the individual entering and the supervisor of the operation are made aware of the entry.

3. 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

4. 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, Appendix C, or which contains natural uranium or thorium in an amount exceeding 100 times the quantity specified in 10 CFR 20, Appendix C, shall be conspicuously posted with a sign or signs bearing the radiation symbol and the words:

CAUTION RADIOACTIVE MATERIAL(S)

5. Operating Procedures and General Information

Areas in which individuals are employed in activities covered by this handbook shall be posted with the following in such a manner to be readily observable to 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 1910.96.
- d. A copy of the NRC license and document references therein.
- e. A copy of LHB 1710.5, "Ionizing Radiation."
- f. Notice of cited violations of appropriate Federal regulations and the resulting LaRC actions.

In addition to the above, NRC Form No. 3, "Notice to Employees," must be posted in such a manner to be readily observable in areas utilizing radioactive materials.

6. Containers

a. Each container of radioactive material shall bear a durable, clearly visible label identifying the radioactive contents as to radionuclide, quantity, and date of assay.

b. The label shall bear the radiation symbol and the words:

CAUTION RADIOACTIVE MATERIAL(S)

7. 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 the words:

CAUTION

THIS MACHINE PRODUCES X-RADIATION WHEN ENERGIZED

8. Exemptions to Posting and Labeling Requirements

Exemptions to posting and labeling requirements at LaRC shall be approved by the RSO and shall be 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 five (5) millirem 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, Appendix C.

d. Containers containing only natural uranium or thorium in quantities no greater than 10 times amounts specified in 10 CFR 20, Appendix C.

e. Containers that do not contain licensed materials in concentrations greater than amounts specified in 10 CFR 20, Appendix B, Table 1, Column 2.

f. Containers when they are attended by an individual who shall take precautions necessary to prevent the radiation exposure to any individual in excess of the LaRC limits.

g. Containers when they are in transport and packaged and labeled in accordance with applicable transportation regulations.

N. Leak Tests

1. Each sealed source containing byproduct material, other than Hydrogen-3, 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 6 months. In the absence of a certificate from a transferor indicating that a test has been made within 6 months prior to the transfer, the sealed source shall not be put into use until tested.

2. Notwithstanding the periodic leak test required by the preceding 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 or less of beta and/or gamma emitting material or 10 microcuries or less of alpha emitting material.

3. The periodic leak test required by this condition does not apply to sealed sources that are stored in the radioactive storage area (Building 1254) and not being used. The sources excepted from this test shall be tested for leakage prior to any use or transfer to another person unless they have been leak tested within 6 months prior to the date of use or transfer.

4. The test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. 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. Records of leak test results shall be kept in units of microcuries and maintained for inspection by the US Nuclear Regulatory Commission.

5. If the test reveals the presence of 0.005 microcurie or more of removable contamination, the RSO shall immediately withdraw the sealed source from use and shall cause it to be decontaminated and repaired or to be disposed of in accordance with NRC regulations. A report shall be filed within 5 days of the test with the office that is charged with Byproduct Material Licensing, US Nuclear Regulatory Commission, Washington, DC 20545, describing the equipment involved, the test results, and the corrective action taken. The report shall also be sent to the Director, Region II, Office of Inspection and Enforcement, NRC, 230 Peachtree Street, N.W., Suite 818, Atlanta, Georgia 30303.

6. Tests for leakage and/or contamination shall be performed by the health physics staff as authorized by the NRC to perform such services.

O. Area Monitoring Instrumentation

1. Requirement

Source(s) of ionizing radiation requiring an approved Safety Permit for its authorized use or operation shall have assigned to the requester of that Safety Permit a working and calibrated radiation survey meter. The survey meter shall be appropriate for measuring the specific type of radiation emanating from the source (i.e., alpha, beta, gamma, neutron, x-ray, etc.).

2. Responsibilities

a. Issuance

The RSO, in consultation with the requester of the Safety Permit, shall designate the appropriate type of survey meter for each application and shall make arrangements for its issuance.

b. Maintenance

The OFSH is responsible for seeing that survey meters are kept in good working order and calibrated every 6 months while in use, and/or after any repair. For each survey meter needing repair and/or calibration the requester shall complete Langley Form 165, "Work Order and Shipping Memorandum," and submit it with the instrument to the

Instrument Research Division (IRD) in Building 1230, Room 124. When necessary, IRD will issue a suitable replacement survey meter to the requester while awaiting repair or calibration of the original instrument.

c. Calibration

Radiation instrument calibration by IRD shall require exposure to known radiation fields with at least two points in each range checked. Generally, the calibration checks will be made in the regions of 10-30 percent and 70-90 percent of full scale. In the event it is not possible to obtain a calibration check for a particular range, the instrument will be considered uncalibrated for that range and will be so marked. Should all calibration check readings fall within ± 10 percent, no change will be made in instrument settings. When the calibration check shows the instrument response to exceed the above tolerance, a calibration adjustment will be made according to the manufacturer's specific procedures. If the instrument's response exceeds ± 20 percent either because of rate or energy dependence and cannot be corrected by adjustment, suitable correction factor graphs or charts will be prepared and attached to the instrument.

P. Radioactive Waste Disposal

Special waste receptacles shall be provided by the SSQRO for the disposal of low level solid and liquid radioactive wastes. These receptacles shall be conspicuously marked with the radiation symbol and the words:

CONTAMINATED WASTES CAUTION RADIOACTIVE MATERIALS

Separate receptacles shall be provided for low-level solid and liquid wastes, and these wastes shall be strictly segregated. Concentrated stock solutions of radioactive materials, sealed sources and other high-level materials shall not be disposed of in low-level waste containers. The health physics staff, upon request by the OFSH, shall be responsible for disposal or removal and storage of such high-level material.

The contents of the radioactive waste receptacles shall be collected by the health physics staff periodically. The arrangements for ultimate disposal of all radioactive waste resulting from LaRC operations shall be the responsibility of the SSQRO in conjunction with property control personnel. Disposal of high-level material is limited to an appropriate licensee of the NRC or one of its agreement states who will conduct final disposal operations.

Records of all radioactive waste disposals shall be maintained by the RSO.

Q. Contract Radiography

Several Divisions within the LaRC Directorate for Systems Engineering and Operations (specifically, the Plant Engineering and Fabrication Divisions) often require the use of contract radiography operations for the nondestructive testing of welds, castings, new construction, etc. While the sporadic and uncertain nature of these operations prohibits the effective use of the Safety Permit system, the following procedural and safety criteria shall be observed for all contract radiography performed at LaRC:

1. At least four hours prior to initiating contract radiography operations the responsible NASA Inspector shall notify the following people by phone of the location, starting time and expected duration of the operation:

- a. The Radiation Safety Officer.
- b. The NASA guard force.
- c. The duty officer at the heating plant.
- d. The Facility Coordinator for the facility where the operation is to be performed.
- e. The NASA fire department.

The NASA Inspector shall notify the following people when contract radiography operations have been completed:

- a. The NASA guard force.
- b. The duty officer at the heating plant.
- c. The NASA fire department.

2. A NASA Inspector shall be present for the entire duration of the radiographic operation. The NASA Inspector shall be trained as a "radiation monitor" and shall be responsible for insuring that the contractor:

- a. Establishes a "controlled area" as defined in paragraph 11, of this section. This includes the use of ropes, barriers, clearly visible signs and/or audible alarms to prevent the unauthorized entry of area personnel into the controlled area.

b. Complies with Paragraph J (Radiation Dose Limits) and Paragraph M (Posting and Labeling Requirements) of this section.

c. Attempts to further minimize exposure by the use of shielding devices and beam collimators when available.

3. Within 24 hours following the completion of the operation, and for information purposes only, the NASA Inspector will complete a Safety Permit Request and forward it to the RSO.

4. Due to the difficulty encountered in the control of personnel, contract radiography will not normally be allowed to commence until 5:00 p.m. or after on weekdays. Exceptions must have the prior written approval of the Chairman of the IRC.

R. In-House Mobile Radiography (NASA)

When performing mobile radiography operations outside of an approved x-ray laboratory facility, the OFSH shall follow the procedures in Part Q, above. The OFSH will not be required to submit a Safety Permit Request for his mobile operation if the equipment and personnel involved have been authorized by an approved Safety Permit for a permanent x-ray laboratory facility.

VI. EMERGENCY PROCEDURES

A. General

Contamination is easily spread during an emergency situation such as a fire, explosion, accidental breakage of a container, or spilling. Radioactive materials can be spread very rapidly and easily by the air currents set up by a fire. They may also find their way into an air-conditioning system, or, if spilled on the floor, they may be tracked around by personnel. This contamination is undetectable except by the use of special radiation-detecting devices, such as the Geiger counter. Since it is extremely difficult to set up adequate detection controls in an emergency, preplanned emergency procedures are included in this manual. Personnel whose work involves the use of radioactive materials shall familiarize themselves with these procedures.

B. Procedures After Spillage of Radioactive Material

1. General Responsibilities

Immediately after the occurrence of a spill, the involved person must vacate all affected personnel to a safe area. He will then notify by telephone, or by the most rapid method of communication, the RSO, and follow his instructions or those of his authorized representative.

2. Specific Precautions

Unless he has received different instructions from the RSO, the person involved in the spillage shall proceed to:

- a. Prevent all nonemergency personnel from approaching the contaminated area, or from attempting to deal with the spillage.
- b. Close all windows and other openings such as ventilating grills.
- c. Close and lock all doors.
- d. If the spillage involves powdered or gaseous radioactive material, seal all doors and other openings after closing. Suitable sealing materials usually handy are the wide masking tape, adhesive tape, or heavy wrapping paper, clipped or pasted to the frames.

3. Rules Affecting Conduct of all Personnel

- a. No person shall enter the 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 his authorized qualified delegate.
- d. Personnel shall be instructed to keep their movements in the contaminated area to a minimum to avoid spreading the contaminant by tracking.

C. Fires in Radiation Areas

In case of fire in areas where radioactive materials are in use, every practical effort should be made by the user to replace the material in its shielded container. If this is not possible, it is the responsibility of the user to promptly notify the Fire Department and RSO or his alternate.

Fire Department personnel should be knowledgeable of radiation hazards, and the Fire Department is encouraged to contact the health physics staff for periodic instruction. The RSO shall periodically notify the Fire Department in writing of all locations of radioactive materials in amounts that may prove hazardous to Fire Department

personnel either externally or internally or that may present a serious contamination problem. Upon call to one of these locations, the Fire Chief, in consultation with the RSO, shall be responsible to see that proper procedures are implemented to minimize radiation exposure to personnel and spread of contamination.

D. Lost or Mislabeled Sources of Radiation

Lost or misplaced sources of radiation should be reported immediately to the RSO.

The RSO shall immediately prepare all reports required by NRC after a theft or loss of licensed material for transmission by the Safety Manager.

E. Notification of Accidents

1. A user or operator will report to the RSO immediately any incident or accident involving radiation sources or malfunction of radiation producing equipment. The RSO will promptly investigate any such report and advise NASA management of his findings. The OFSH and Chairman, IRC, will be periodically informed of the progress of the investigation.

2. The RSO will assure that the NRC is notified immediately following an accident as described in 10 CFR 20, Paragraph 20.403.

3. The RSO shall submit a written report for transmission to NRC within 30 days following an overexposure to radiation levels and concentrations of radioactive material as described in 10 CFR 20, Paragraph 20.405.

VII. VISITOR CONTROL

Visitors shall be allowed to enter radiation areas at LaRC only with approval of the cognizant OFSH and subsequent notification to the RSO. Visitors shall be required to submit their full name, date of birth, social security number, and a statement of previous exposure history so that they can be issued a film badge prior to entry into a radiation area. Visitors must be accompanied by a certified radiation worker at all times within a radiation area.

APPENDIX A

AUDIT SCHEDULE (Beginning 1978)

Building 1247D	January
Building 1250	February
Building 1230	March
Building 1284A	April
Building 1244	May
Building 1296	June
Building 1205	July
Building 1148	August
Building 1232A	September
Building 1202	October
Building 1283	November

APPENDIX B
SAMPLE FORMS

WORKER APPOINTMENT AND CERTIFICATION FORM

Last Name,	First Name	Middle Name	Date of Birth	Social Security Number
Position Title		Organization -- Division, Branch, Section		Mail Stop
Extension				
WORKER CATEGORY (Check appropriate box)				
<div style="display: flex; justify-content: space-between;"> <div> <input type="checkbox"/> Radiation </div> <div> <input type="checkbox"/> Laser </div> <div> <input type="checkbox"/> Special Equipment </div> </div>				
<div style="display: flex; justify-content: space-between;"> <div> <input type="checkbox"/> Chemical </div> <div> <input type="checkbox"/> Pyrotechnic </div> <div> <input type="checkbox"/> High Worker </div> </div>				
<div style="display: flex; justify-content: space-between;"> <div> <input type="checkbox"/> Other _____ </div> </div>				
DESCRIPTION OF DUTIES (be specific)				
TO BE COMPLETED BY APPOINTEE				
<input type="checkbox"/> I have read and understand the regulations of Langley Research Center: for _____ safety described in LHB _____.				
<input type="checkbox"/> I completed the applicable LaRC safety course on _____ (Date).				
<input type="checkbox"/> I have had equivalent prior training and experience (see reverse side).				
APPOINTEE'S SIGNATURE				DATE
DIVISION APPROVALS (as applicable)				
Organizational Facility Safety Head		SIGNATURE		DATE
Division Training Coordinator		SIGNATURE		DATE
Appointee's Division Chief		SIGNATURE		DATE
RADIATION SAFETY OFFICER'S CONCURRENCE		SIGNATURE		DATE
CERTIFICATION BY OCCUPATIONAL HEALTH OFFICER				
This appointee was examined and found to be physically qualified for the described duties on _____ (Date).				
Periodic re-examination and/or a termination exam may be required (check the appropriate LHB).				
HEALTH OFFICER'S SIGNATURE				DATE
SAFETY MANAGER'S APPROVAL		SIGNATURE		DATE

PRIOR TRAINING AND EXPERIENCE

TRAINING (Use supplemental sheets if necessary)

	Formal	Informal	Location	Duration
1. Basic principles and practices	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No		
2. Measurements standardization and monitoring techniques.	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Other (Specify)				

EXPERIENCE (Use supplemental sheets if necessary)

Type of X-ray/Accelerator, Nuclide or Laser	Maximum Energy, Power and/or Curies	Purpose in Use	Location	Duration

* Radiation and Laser entries shown for illustration; modify for other worker categories

PRIVACY ACT STATEMENT FOR NASA LANGLEY FORM 66 WORKER APPOINTMENT AND CERTIFICATION FORM

- The information to be provided on this form (No. 66) is authorized to be collected by NASA by 42 U.S.C. 2473; 44 U.S.C. 3101, OMB Circular A-72; Public Law 92-255; Public Law 79-658; Public Law 91-66. Providing this information is mandatory under the law.

Information Regarding Disclosure of Your Social Security Number Under Public Law 93-579 Section 7 (b)

Disclosure by you of your social security number (SSN) is mandatory to obtain the services, benefits or processes that you are seeking. Solicitation of the SSN by the United States Civil Service Commission is authorized under provisions of Executive Order 9397, dated November 22, 1943. The SSN is used as an identifier throughout your Federal career from the time of application through retirement. It will be used primarily to identify your records that you file with the Civil Service Commission or agencies. The SSN also will be used by the Civil Service Commission and other agencies in connection with lawful requests for information about you from your former employers, educational institutions, and financial or other organizations. The information gathered through the use of the number will be used only as necessary in personnel administration processes carried out in accordance with established regulations and published notices of systems of records. The SSN also will be used for the selection of persons to be included in statistical studies of personnel management matters. The use of the SSN is made necessary because of the large number of present and former Federal employees and applicants who have identical names and birth dates, and whose identities can only be distinguished by the SSN.

- The principal purposes for which the information is intended to be used are: 1) Review by physicians in consideration of fitness for duty; 2) Exposure data for radiation/toxic exposure units, compliance and examinations and evaluation of employees for specialized or hazardous duties.
- This information will be incorporated in the system of medical records. The routine uses of this information outside of NASA will be the standard uses of all NASA forms, such as law enforcement, court proceedings, obtaining security clearances or licenses, and for certain employment situations.
- Refusal to provide all or any part of the information requested may result in appropriate disciplinary action.

NASA Langley Form 66 (PA) Dec. 1975)

RADIATION HAZARD FORM (Attach to Purchase Request) Use for radioactive material, X-ray equipment, lasers, microwave and ultraviolet radiation.					FOR PROCUREMENT ONLY Order or Contract No.:	
Item Ordered:			Ordered By:		For Use in Bldg. No.:	
Manufacturer:			Max. Power or Energy Output:		Max. Isotope Quantity:	
APPROVALS	SIGNATURE	DATE	PHONE	INCOMING MATERIALS ONLY (To be completed by Org. Facility Safety Head)		
Org. Facility Safety Head				Shipped From:		
Radiation Safety Officer				Serial No.	Model No.	Inventory No.
Safety Manager						
Special Contact Instructions:				Date Received	Conditions:	
Special Handling Instructions:				Applicable Shipping Document: NOTE: Send copy to Radiation Safety Officer		
				Serial No.		

IMPORTANT TO RECEIVING: Telephone Radiation Safety Officer immediately upon receipt of this item. This call must be made so that action can be initiated.

NOTE: COPY OF SAFETY PERMIT REQUEST MUST BE POSTED WITH THIS PERMIT

SAFETY PERMIT

PERMIT NO.

DATE ISSUED

EXPIRATION DATE

LOCATION (Room, building, cell, etc.)

DRAWING AND
PROCEDURE NOS.

(Affix color coded sticker here. |)

ACTIVITY (Describe research operation, facility equipment, etc., requiring safety approval.)

EMERGENCY CONTACT

HOME
PHONE

(Knowledgeable person)

(Custodian)

(Alternate)

ACTIVITY APPROVED FOR SAFETY SUBJECT TO THE FOLLOWING CONDITIONS:

PERSONS AUTHORIZED TO RECEIVE, WITHDRAW AND/OR UTILIZE PYRO

REVIEWING AUTHORITY ACTION*

REVIEWED BY

CONCURRENCE - CHAIRMAN OF
REVIEWING AUTHORITY

APPROVAL - SAFETY MANAGER

ACTIVITY COMPLETED

DATE

SIGNATURE

INSTRUCTIONS

*REVIEW AUTHORITY (Selection by Discipline or Recommendation
of Safety Manager)

1. Systems Operation Committee
2. Potentially Hazardous Materials Committee
3. Ionizing Radiation Committee
4. Non Ionizing Radiation Committee
5. Pressure Systems Committee
6. Electrical Committee
7. Occupational Health Services

After Approval of the Safety Permit Request Complete this Permit and Send
one Copy to Each of the Following:

Project (Responsible) Engineer
Reviewing Authority
Safety Manager

PROJECT ENGINEER (Responsible Engineer)

1. Post a copy of this permit, together with a copy of
the Safety Permit Request, in a conspicuous place
at the location described.
2. Submit a new Safety Permit Request at least 30
days prior to the expiration date if:
 - a. the activity will not be completed by the
expiration date;
 - b. any change is made in conditions as described
in this permit.
3. When the activity is completed, remove this permit,
indicate the completion date and send it via the
cognizant Reviewing Authority, Chairman to the
Safety Office.

SAFETY PERMIT REQUEST – RADIOACTIVE MATERIAL

(Prepare in original and one copy)

ORGANIZATION—DIVISION, BRANCH, SECTION	<input type="checkbox"/> NEW REQUEST <input type="checkbox"/> MODIFICATION	DATE PREPARED	REFERENCE NUMBER
1. TITLE OR BRIEF DESCRIPTION OF PROJECT			
2. PROCEDURE, INCLUDING SPECIAL TECHNIQUES & SAFETY PRECAUTIONS (ATTACH DETAILS ON A SEPARATE SHEET OF PAPER)			3. Estimated Completion Date
4. RADIOACTIVITY REQUIREMENTS			
A. ELEMENT(S) AND ISOTOPE(S)		B. PHYSICAL FORM	
C. TOTAL QUANTITY REQUIRED		D. ESTIMATED ACTIVITY PER EXPERIMENT	
5. LOCATION OF USE			
<input type="checkbox"/> LARC <input type="checkbox"/> TEMPORARY JOB SITE (Specify)		BUILDING NO.	ROOM NO.
6. USERS/OPERATOR (Submit Langley Form 66 for each radiation worker)			
APPROVALS	SIGNATURE	DATE	
7. ORG. FACILITY SAFETY HEAD			
8. RADIATION SAFETY OFFICER			
9. CHAIRMAN—IONIZING RADIATION COMMITTEE		DATE	Expiration Date
IONIZING RADIATION COMMITTEE (LMI 1700.3) <input type="checkbox"/> DISAPPROVED <input type="checkbox"/> APPROVED, SUBJECT TO CONDITIONS NOTED IN ITEM 11.			
10. SAFETY MANAGER	SIGNATURE	DATE	
11. CONDITIONS			
<p>An approved Safety Permit for the use of radioactive materials shall be subject to all applicable policies of the LaRC Ionizing Radiation Committee now or hereafter in effect and any conditions specified below:</p> <p>A. <u>Standard Conditions</u></p> <ol style="list-style-type: none"> 1. The Organizational Facility Safety Head shall insure compliance with LHB 1710.5, Ionizing Radiation Manual and statements and procedures contained in this request. 2. The Organizational Facility Safety Head shall provide routine and emergency safety procedures to each radiation worker. <p>B. <u>Special Conditions</u> (to be completed by Ionizing Radiation Committee).</p>			

SAFETY PERMIT REQUEST – RADIATION MACHINE

(Prepare in original and one copy)

ORGANIZATION – DIVISION, BRANCH, SECTION		<input type="checkbox"/> NEW REQUEST	DATE PREPARED	REFERENCE NUMBER
		<input type="checkbox"/> MODIFICATION		
1. TITLE OR BRIEF DESCRIPTION OF PROJECT				
2. PROCEDURE, INCLUDING SPECIAL TECHNIQUES & SAFETY PRECAUTIONS <i>(ATTACH DETAILS ON A SEPARATE SHEET OF PAPER)</i>			3. ESTIMATED COMPLETION DATE	
4. MACHINE CHARACTERISTICS				
A. MANUFACTURER		B. SERIAL NUMBER		
C. MODEL		D. MAXIMUM SETTING		
5. LOCATION OF USE				
<input type="checkbox"/> LARC <input type="checkbox"/> TEMPORARY JOB SITE <i>(Specify)</i>		BUILDING NO.	ROOM NO.	
6. USERS/OPERATOR <i>(Submit Form 66 for each radiation worker)</i>				
APPROVALS		SIGNATURE		DATE
7. ORG. FACILITY SAFETY HEAD				
8. RADIATION SAFETY OFFICER				
9. CHAIRMAN–IONIZING RADIATION COMMITTEE				DATE Expiration Date
IONIZING RADIATION COMMITTEE (LMI 1700.3) <input type="checkbox"/> DISAPPROVED <input type="checkbox"/> APPROVED SUBJECT TO CONDITIONS NOTE IN ITEM 11.				
10. SAFETY MANAGER		SIGNATURE		DATE
11. CONDITIONS				
<p>An approved Safety Permit for the use of radiation machines shall be subject to all applicable policies of the LaRC Ionizing Radiation Committee now or hereafter in effect and any conditions specified below:</p> <p>A. <u>Standard Conditions</u></p> <ol style="list-style-type: none"> 1. The Organizational Facility Safety Head shall insure compliance with LHB 1710.5, Ionizing Radiation Manual and statements and procedures contained in this request. 2. The Organizational Facility Safety Head shall provide routine and emergency safety procedures to each radiation worker. <p>B. <u>Special Conditions</u> <i>(to be completed by Ionizing Radiation Committee)</i></p>				

FRONT

RADIATION WORKER'S CERTIFICATION CARD	
Certified Worker's Name:	
Safety Permit Nos. (List applicable numbers denoting duties to be performed)	
Safety Manager's Signature (Certification in compliance with applicable safety regulations)	Date
NASA Langley (Sept. 1977) SEO-SSQRO Prescribing Documents LHB 1710.5 & 1710.8	

BACK

This certification is void one year from date on opposite face unless revalidated as indicated below. This card must be returned to Radiation Safety Officer upon termination of duties.		
REVALIDATION		
DIV. CHIEF (Signature)	Radiation Safety Officer (Signature)	EXP. DATE

RADIOACTIVE MATERIAL TRANSFER*(See instructions on reverse side of Receiving File Copy)***SECTION I - ORIGATION INFORMATION (Originator complete this section)****A. ITEM DATA**

(1) NAME OF ITEM

(2) SERIAL NUMBER

(3) ISOTOPE

(4) ACTIVITY (MILLICURIES)

(5) PHYSICAL AND CHEMICAL FORM OF RADIOACTIVE MATERIAL

(6) DOSE RATE AT SURFACE OF PACKAGE
(MREM/HR _____)(7) ACTIVITY DETERMINED BY *(Check one)*☐ RECORD INFORMATION☐ CALCULATION☐ MEASURED BY: _____

DATE DETERMINED

(8) PURPOSE OF ITEM

(9) LEAK TEST CERTIFICATE PROVIDED WITH THIS TRANSFER?

☐ YES☐ NO☐ EXEMPT**B. ACCOUNTABILITY DATA**

(1) TRANSFERRED FROM (LICENSEE'S NAME)

LICENSE NUMBER

(Check one)☐ NRC☐ STATE OF _____

(2) TRANSFERRED TO (LICENSEE'S NAME)

LICENSE NUMBER

(Check one)☐ NRC☐ STATE OF _____**C. RESPONSIBLE INDIVIDUAL (Shipper's Radiological Control Officer or equivalent)**

(1) SIGNATURE

TITLE

DATE

TELEPHONE No.

(2) ORIGINATING ORGANIZATION *(Complete address - Include Zip Code)***D. SHIPPING DATA**

(1) DATE SHIPPED

(2) ADDRESSED TO *(Include Zip Code)*(3) MODE OF SHIPMENT *(Specify)*

(4) NAME OF CARRIER

(5) TRANSPORTATION DOCUMENTATION *(Give name & number of shipping document)***SECTION II - DESTINATION INFORMATION (Receiver complete this section)****A. RECEIPT INFORMATION**

(1) DATE ITEM RECEIVED

(2) CONDITION

(3) INFORMATION IN BLOCK _____ SHOULD BE CORRECTED TO:

B. RESPONSIBLE INDIVIDUAL (Receiver's Radiological Control Officer or equivalent)

SIGNATURE

TITLE

DATE

TELEPHONE NO.

C. DISPOSITION OF ITEM

(1) NAME OF CUSTODIAN

TELEPHONE NO.

(2) DISPOSITION AND LOCATION

INSTRUCTIONS FOR PREPARATION

PURPOSE OF FORM: The information requested is required to maintain Radiological Control records in compliance with internal and Nuclear Regulatory Commission procedures and regulations. Completion of form is required for each transfer of a radioactive item by any organization when such action involves transfer of accountability to or from any license held by the Langley Research Center for possession and use of such material. The form is also required to document relocation of radioactive material from one geographical location to another while accountable under a LaRC license. **NOTE: THIS FORM DOES NOT CONVEY AUTHORIZATION TO SHIP.** Authorization to ship must be obtained from the LaRC Radiation Safety Officer by written or telephone message.

COMPLETING FORM:

Section I - ORIGINATION INFORMATION - Originating (shipping) organization shall complete this section.

- A. ITEM DATA - Complete all information in block (1) through (9). If any blocks are not applicable, indicate as N/A.
- B. ACCOUNTABILITY DATA - Show name and license number of organization relinquishing accountability of radioactive material and name and license number of organization assuming accountability. BE ACCURATE

NOTE: For change in location only, enter applicable LaRC license number in both blocks.

- C. RESPONSIBLE INDIVIDUAL - Person authorized by originating organization to control radioactive material.
- D. SHIPPING DATA - Under block (3), Mode of Shipment, specify type of transport
EXAMPLE: Truck freight, air freight, military aircraft, NASA aircraft, etc. Under Transportation Documentation, give name and number of specific documents.

Distribution - Originator will retain Copy 1, include Copies 2 and 3 with shipment.

Section II - DESTINATION INFORMATION - Receiving organization shall complete this section.

A & B - Self explanatory

- C. DISPOSITION OF ITEM - Explain initial disposition of item received.

Distribution - Receiver will retain Copy 3 for his records, return Copy 2 to Originator.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Langley Research Center, Hampton, Va. 23665

WORK ORDER AND SHIPPING MEMORANDUM (USE BALL POINT PEN - FIRMLY)

JOB No. **50454**

READ CAREFULLY:

REQUESTOR: Fill in all information down to next heavy black line and retain USER copy for your files. Furnish manual, if available. Call 3291, for information regarding status of this instrument. Above job number must be given to check status.

NOTE: WORK ORDER NOT PROPERLY COMPLETED WILL RESULT IN WORK ORDER AND INSTRUMENT BEING RETURNED TO USER UNPROCESSED. ALL INDIVIDUAL INSTRUMENTS SUCH AS PLUG-INS, PRE-AMPS, ETC., INVENTORIED OR NOT SHALL HAVE SEPARATE WORK ORDERS. LIKE INSTRUMENTS SUCH AS PRE-AMPS, PRESSURE TRANSDUCERS, ETC. MAY BE ENTERED ON SUPPLEMENTAL SHEET.

INSTRUMENT	MFG.	MODEL	SERIAL	INV. NO.

ACCESSORIES (cables, plugs, manuals, etc.)

USER'S PAYROLL NAME _____ DIVISION _____ PHONE _____ BLDG. _____
M.S. _____ ROOM NO. _____ DATE REQ'D. _____ DATE SENT _____ PROJECT _____
J.O. _____

A REASON(S) SUBMITTED

- 1 CALIBRATION
- 2 VERIFY
- 3 WARRANTY REPAIR
- 4 PREVENTIVE MAINTENANCE
- 5 REPAIR REQUIRE (SPECIFY SYMPTOMS)
- 6 MODIFICATION REQUIRED (SPECIFY)
- 10 ACCEPTANCE TEST TO LRC PROC. SPECS.
- 11 ACCEPTANCE TEST TO MFG. SPECS.
- 13 FACTORY REPAIR AND CALIBRATION
- 15 FAILURE ANALYSIS REPORT REQ'D
- 16 FLIGHT ASSURANCE TEST (FAT)
- 17 FLIGHT QUALIFICATION TEST (FQT)
- 18 SURPLUS EQUIP. TEST TO MFG. SPECS.
- 19 RETURN FROM FACTORY

CODING

B

PROCEDURE TO BE USED

- 1 MFG'S SERVICE PROCEDURE
- 2 MFG'S CALIBRATION PROCEDURE
- 3 LRC CALIBRATION PROCEDURE
- 4 MODIFIED MFG. SERVICE PROCEDURE
- 5 SPECIAL INSTRUCTIONS (ATTACHED)

C

MODIFICATION

- 1 ASSUMED TO BE UNMODIFIED
- 2 CATALOG ITEM, MANUFACTURER MODIFIED
- 3 CATALOG ITEM, LRC MODIFIED
- 4 NON-CATALOG ITEM, MANUFACTURER MODIFIED
- 5 NON-CATALOG ITEM, LRC MODIFIED

REASON(S) SUBMITTED (A) ☐ ☐ ☐ PROCEDURE TO BE USED (B) ☐ ☐ MODIFICATION (C) ☐

Remarks: (symptoms, specifics, reasons, etc.)

REASON(S) SUBMITTED (A) ☐ ☐ ☐ PROCEDURE TO BE USED (B) ☐ ☐ MODIFICATION (C) ☐

Remarks for I.R.C.

Same as above

Acc. as above.

JOB ROUTING

☐ ON BASE CONTRACT ☐ OFF BASE CONTRACT ☐ ON BASE GOV'T ☐ REQ. COMP. DATE _____ APPROVAL _____

ANY ADDITIONAL INFORMATION NEEDED SHALL BE ENTERED ON IRC

FACTORY DISPOSITION

ORDER NO. _____

☐ WARRANTY REPAIR ☐ ACCEPTANCE REJECT ☐ Repair ☐ Calibrate ☐ P. O. REQUIRED ☐ FAILURE ANALYSIS REPORT REQ'D
☐ PAYMENT STOPPED BY PHONE AND MEMO _____ DATE _____ ☐ DATA REQ'D. ☐ PICKED UP AT _____ BY MFG'S REP. _____ (NAME) ☐ SURVEY
☐ RETURN APPROVAL FOR REPAIRS AT NO COST TO GOVERNMENT PER: ☐ TELECON BETWEEN _____ MFG'S REP. _____ AND _____ LRC'S REP. _____ DATE _____ ☐ RECEIPT AND INSPECTION FORM ATTACHED

REMARKS:

COMPLETED _____ TECH MONITOR _____ DATE _____

SHIP TO _____ DATE _____
☐ Wyle, 3200 Magruder Blvd., Hampton, Va.
☐ IRC Only
☐ Other

RE SHIP TO _____ DATE _____
☐ NASA LRC, Bldg. 1230
☐ Other

REC'D BY _____ ORGANIZATION _____
REC'D BY _____ ORGANIZATION _____

APPENDIX C

REFERENCE OF APPLICABLE FEDERAL REGULATORY DOCUMENTS (Available from Radiation Safety Officer)

CODE OF FEDERAL REGULATIONS (CFR)

Title 10 - Atomic Energy

- Part 19 - Notices, Instructions and Reports to Workers;
Inspection
- Part 20 - Standards for Protection Against Radiation
- Part 30 - Licensing of Byproduct Material
- Part 31 - General Licenses for Certain Quantities of Byproduct
Material and Byproduct Material Contained in Certain
Items
- Part 33 - Special Licenses of Broad Scope for Byproduct Material
- Part 35 - Human Uses of Byproduct Material
- Part 36 - Export and Import of Byproduct Material
- Part 40 - Licensing of Source Material
- Part 70 - Special Nuclear Material
- Part 71 - Packaging of Radioactive Material for Transport

Title 29 - Occupational Health and Safety Administration Part 1910.96 - Ionizing Radiation

PROVISIONS OF SPECIFIC NRC LICENSES

Title 14 - US Department of Transportation Part 103 - Federal Aviation Administration

Title 39 - US Postal Regulations Parts 124-125 - Code of Federal Regulations

Title 46 - US Department of Transportation Parts 146-149 - Coast Guard Regulations

Title 49 - US Department of Transportation Parts 171-178 - Rules and Regulations

US POSTAL GUIDE, Part I, Article 37, Chapter IV, Radioactive Materials

APPENDIX D

LMI'S AND LIST OF PERSONNEL ASSIGNED FUNCTIONAL RESPONSIBILITIES FOR IONIZING RADIATION POLICY AND PROCEDURES

Langley Management Instructions

1. LMI 1700.1, "Safety Program."
2. LMI 1700.2, "Safety Assignments."
3. LMI 1700.3, "The Executive Safety Board and Its Committees."

* * *

Listed below are personnel responsible for processing documents and procedures described in this handbook.

Ionizing Radiation Committee Members:

<u>Name</u>	<u>Phone</u>	<u>Mail Stop</u>
John W. Wilson, Chairman	3781	160
Thomas P. Kelly, Vice Chairman	2781	397
Elsie D. Illg	3439	188B
Donald R. McFarland	3781	160
Allen N. Milton	2119	499
 Radiation Safety Officer:		
Carter B. Ficklen	2246	281
 Safety Manager:		
James D. Church	2964	251
 Occupational Health Officer:		
Robert L. McArthur	2605	454

APPENDIX E

GLOSSARY

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.
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 each 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)	The presence of radioactive material anywhere not desired.
curie	The unit of radioactivity; equal 37 billion nuclear decays per second.
decay (radioactive)	Spontaneous disintegration of the nucleus of an unstable atom by the emission of charged particles and/or electromagnetic radiation.
decontamination	The removal of radioactive contaminants.

dose (radiation)	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.
half life (radioactive)	The time in which half the atoms in a radioactive substance decay.
health physics	A profession devoted to the protection of man and his 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 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, e.g., 1 microcurie = 1×10^{-6} curies.

milli-	A prefix meaning one-thousandth, e.g., 1 millicurie = 1×10^{-3} curies.
nuclide	Any species of atom that exists for a measurable length of time.
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	<ol style="list-style-type: none"> 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	That branch of medicine which 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 which are radioactive and, having no further use, are discarded.
x-radiation	Penetrating electromagnetic radiation of non-nuclear origin; usually produced by bombarding a metallic target with high-speed electrons.