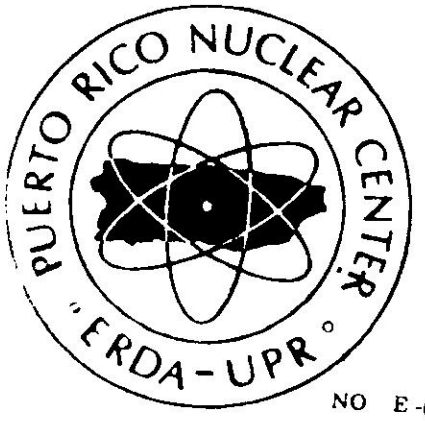
PRNC-199

PUERTO RICO NUCLEAR CENTER

HEALTH AND SAFETY REGULATIONS MANUAL

Health and Safety Division

June 30, 1976



OPERATED BY UNIVERSITY OF PUERTO RICO UNDER CONTRACT
NO E-(40-1)-1833 FOR US ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

PRNC-199

PUERTO RICO NUCLEAR CENTER

HEALTH AND SAFETY REGULATIONS MANUAL

Health and Safety Division

June 30, 1976

Operated by University of Puerto Rico under Contract

No. E (40-1)-1833 for

Energy Research and Development Administration

AUTHORIZATION

THE REVISED HEALTH AND SAFETY REGULATIONS MANUAL (PRNC-199)

FOR THE PUERTO RICO NUCLEAR CENTER

IS HEREBY APPROVED AND MADE OPERATIVE AS OF JUNE 30, 1976.

THIS EDITION SUPERSEDES

RADIATION SAFETY REGULATIONS (PRNC-172) DATED OCTOBER 1973.

ISMAEL ALMODOVAR

Director

TABLE OF CONTENTS

Contents

I. INTRODUCTION

The Puerto Rico Nuclear Center is authorized by the Energy Research and Development Administration to produce, procure, and use radioactive nuclides, and to operate certain sources of high energy radiation. The validity of this authorization is contingent upon the existence of a radiation safety organization and certain advisory groups. This document is designed to establish guidelines for the effective functioning of the various groups concerned with radiation and industrial safety within PRNC. However, it must be remembered that Safety is Everyone's Business at All Times. The existence of any potential hazard is of concern to every PRNC employee who should take appropriate action whether or not he has a directly assigned responsibility in the safety program.

II. RESPONSIBILITIES

A. Director PRNC

1. Has the ultimate responsibility and authority for all activities, including those of health and safety. It is recognized that safety is a line responsibility and that independent review of that responsibility is mandatory, and in this respect, the Director will obtain competent advice. The Director will issue regulations governing the use of radiation and other

hazardous agents within areas controlled by the PRNC. He will supervise the enforcement of these regulations and will personally determine the need and extent of any disciplinary action.

2. Shall establish, implement, and maintain an internal review system for Reactor facilities that complies with the requirements of ERDA IAD-8401-7. This review system shall be implemented by the Technical Committee. The system shall be reviewed by management for adequacy of performance every three years or more often as required.

3. Shall establish, implement, and maintain an initial training and qualification program as well as a retraining and requalification program for Reactor operators and Reactor supervisors, that complies with the requirements of ERDA Appendix 8401 and ERDA IAD-8401-6. The Head, Nuclear Engineering Division has been appointed as examiner. The Director shall be the Certifying Officer.

4. Shall maintain an up-to-date Quality Assurance Program for the operation of the Reactors and shall prepare Quality Assurance Plans for any modifications to, or eventual decommissioning of the Reactors.

5. Shall maintain, through the Head of the Reactor Division, a training program for Reactor maintenance personnel that complies with the requirements of the Nuclear

Reactor Safety contract clause.

6. Shall establish and maintain a plan for the inspection of the physical plant at least annually.

B. Associate Director

1. Represents the Director in all matters concerning Mayaguez operations. He is responsible for general management and assures safe operations at the Mayaguez site.

C. Head, Health and Safety Division

1. Represents the Director in all matters relating to safety. Proposes regulations regarding safety and is responsible for implementing all PRNC safety regulations and applicable ERDA and Commonwealth radiation safety regulations. Is a member of the Safety Advisory Committee, the Technical Committee and the Human Applications Committee.

III. COMMITTEES AND SUBCOMMITTEES

A. Technical Committee

Charter

1. Scope: To assure that Reactor and Accelerator operations (including experiments) are conducted in a safe manner, and to consider any other matter assigned by the Director.

2. Chairman: The Chairman shall be appointed by the Director and shall be an individual who does not

have a line responsibility for Reactor operations. The Chairman shall chair the meetings of the Committee and enter into the discussions, but shall not vote on any issue before the Committee except in the case of a tie vote.

3. Secretary: The Secretary of the Committee is appointed by the Chairman and does not need to be a member of the Committee.

4. Membership: Membership is selected from different disciplines pertinent to reactor safety. The Chairman, with the approval of the Director, chooses the members of the Technical Committee which should include the following:

   a. Ex officio member: The Health and Safety Division Head or representative.

   b. Members:

      1) A physicist

      2) A chemist

      3) A nuclear engineer

      4) A mechanical engineer

      5) An environmental scientist

5. Requirements: Each member shall be competent in his field and shall have a keen interest in the business of the Committee.

6. Term:

   a. A new chairman shall be appointed every two years.

   b. Two new members shall be appointed each year replacing the two members with the longest tenure.

c. The Director may extend the term of the chairman or the members at his option.

7. Duties:

a. Review and evaluate all new experiments which will utilize a reactor or accelerator irradiation facility. This review must cover the areas of safety and related technical and operational soundness.

b. Review all previously approved experiments still in progress, at least once a year.

c. Provide technical assistance to the Reactor Division Head whenever requested to do so.

d. Review safety documentation or changes to the documentation including safety analysis reports, technical specifications, operating, administrative and maintenance procedures, quality assurance plans as well as proposed modifications to reactor equipment and instrumentation for reactor, accelerator and radiation facilities with sources above 1,000 curies.

e. Review operating incidents, including any operations beyond the authorized limits as set forth in the Technical Specifications.

f. Carry out a formal PRNC Reactor Audit at least once a year as required by ERDA-IAD-8401-7. This shall be performed by the PRNC Reactor Audit Group appointed by the Technical Committee.

g. Review other safety matters as requested by

the Director.

8. Quorum: A quorum shall consist of more than half of the members of the Committee.

9. Requirements for Holding Meetings: The Committee shall meet no less than once every six months. The Chairman shall call a meeting at his discretion or upon the recommendation of the Director, the Head of the Health and Safety Division or the Head of the Reactor Division. The meetings are restricted to the secretary and members of the Committee. However, when necessary, the Reactor Division Head or other persons designated by the Committee or the Chairman may be invited.

10. Rules: The meetings will be conducted according to the Robert's Rules of Order.

    Note: Formality should not be allowed to overwhelm the meetings and inhibit free and frank discussions. An atmosphere of freedom of speech will be maintained.

11. Reporting: The reviewed written reports, PRNC Reactor Audit Group reports and the minutes of the Committee shall be submitted to the Director.

B. Reactor Audit Group

Charter

1. Scope: The Reactor Audit Group is a subcommittee of the Technical Committee. The members shall be elected by the Technical Committee, with eligibility not

limited to members of the Technical Committee. The Reactor Audit Group shall appraise annually the following items for the TRIGA and the L-77 reactors:

a. Technical specifications

b. Operating Procedures

c. Reactor Operator Training Program

d. Maintenance

e. Monthly Reports of Reactor Operations

f. Prints and Drawings of Facility

g. Housekeeping

h. Security and Visitor Control

i. Incident Reporting

j. General Organization

k. Any other safety related matter deemed appropriate

2. Chairman: The senior member of the Reactor Audit Group shall be the Chairman.

3. Membership:

a. The Audit Group shall consist of three members, with membership limited to three consecutive years. One member shall be replaced each year.

b. Members must have familiarity with nuclear reactors and/or the pertinent regulations.

c. At least one member shall be a nuclear engineer.

d. One member may be elected from outside the Puerto Rico Nuclear Center.

4. Reporting: A written report of the findings shall be submitted to the Technical Committee. The report shall be submitted within a period of one month from

the time of the audit. The Technical Committee shall review the report and forward it, together with comments, to the Director.

C. Safety Advisory Committee

Charter

1. Scope: To advise the Director and to assure that all operations besides those related to the Reactor Division and the Accelerator facility are conducted in a safe manner and to consider any other matter assigned by the Director.

2. Chairman: Mayaguez operations - The Associate Director
Río Piedras operations - The Technical Assistant to the Director

3. Secretary: The Secretary of the Committee is appointed by the Chairman.

4. Membership: The SAC shall be composed of two branches: Mayaguez operations and Río Piedras operations.

   a. Mayaguez operations:

      1) Associate Director - Chairman
      2) Head, Health and Safety Division
      3) Division Heads
      4) Other persons as invited by the Chairman

   b. Río Piedras operations:

      1) Technical Assistant to the Director - Chairman
      2) Associate Director for Medical Programs
      3) Head, Health and Safety Division
      4) Division Heads
      5) Other persons as invited by the Chairman

5. Duties:

   a. Review regulations, procedures and reports in all safety matters, such as, radiation protection, industrial hygiene, industrial safety and fire protection.

   b. Review proposed location of radiation areas.

   c. Receive, examine, discuss, and make appropriate recommendations on accident reports.

   d. Investigate serious accidents or hazardous situations.

6. Quorum: The Chairman shall decide whether there is quorum.

7. Requirements for Holding Meetings: The Committee shall meet as frequently as required but at least once every six months.

8. Rules: The meetings will be conducted according to the Robert's Rules of Order.

9. Reporting: The reports and the minutes of the Committee meetings shall be submitted to the Director.

D. Human Applications Committee

Charter

1. Scope: The Human Applications Committee shall advise the Director and the Associate Director for Medical Programs on all clinical uses of radionuclides in humans.

2. Chairman: The Associate Director for Medical Programs shall be the Chairman.

3. Secretary: The Secretary of the Committee shall be appointed by the Chairman.

4. Membership: Human Applications Committee membership guidelines are as follows:

   a. Associate Director for Medical Programs - Chairman

   b. Head, Health and Safety Division - Ex officio member

   c. Nuclear Medicine Specialist

   d. Radiobiologist

   e. Radioecologist

   f. Hematologist

5. Duties:

   a. Review all proposals for the applications of radionuclides to humans, including research and routine clinical proposals, and make appropriate recommendations to the Director.

   b. Review regulations and procedures pertaining to human applications of radionuclides, and make appropriate recommendations to the Director.

   c. Keep records of all Human Applications Committee activities.

6. Quorum: The Chairman will decide whether there is quorum.

7. Requirements for Holding Meetings: The Chairman shall call the meeting as frequently as required.

8. Rules: The meetings will be conducted according to the Robert's Rules of Order.

9. Reporting: The reports and the minutes of the Committee meetings shall be submitted to the Director.

IV. DUTIES

A. Health and Safety Division

1. The Health and Safety Division has operational responsibility for all matters of health and safety except those medical matters directly involving patient treatment. The Head of the Health and Safety Division shall have full authority to stop without consultation any procedure deemed unsafe. The Health and Safety Division is responsible for:

   a. Radiation Protection:

      1) The general surveillance of all activities pertaining to radiation safety including the acquisition, use and disposition of all radioactive materials and radiation sources.

      2) Analyzing the operations involving radioactive materials or radiation sources with a view to minimize the radiation exposures resulting from their use.

      3) Reviewing for approval all requisitions for the purchase of radioactive materials and radiation sources prior to the issuance of a purchase requisition.

      4) Reviewing for approval all requests for the use of Reactor and other irradiation facilities.

      5) Receiving, delivering, shipping, storing, and disposal of all radioactive materials.

6) Furnishing consultation services to personnel at all levels on all aspects of radiation protection.

7) Maintaining and operating a personnel and area monitoring service suitable for the radiations being used or contemplated.

8) Maintaining a calibration facility for all survey instruments and monitoring devices.

9) Maintaining and operating a comprehensive environmental monitoring service for all PRNC-controlled areas, with due consideration to the needs for off-site monitoring.

10) Maintaining an inventory of all radioactive materials under PRNC control except source material.

11) Performing leak tests on all sealed sources under PRNC control.

12) Supervising decontamination procedures in cases of accidents involving radioactive contamination.

13) Notifying individuals and the proper authorities whenever a radiation exposure reaches reportable levels as prescribed by regulations.

14) Organizing indoctrination courses for all new PRNC personnel.

b. Industrial, Fire and Laboratory Safety:

1) Supervising the proper storage and use of all

flammable materials.

2) Checking and maintaining the emergency lamp system.

3) Enforcing the procedure of "Safety Standard for Compressed Gas Cylinders" (PRNC-175).

4) Maintaining general safety procedures in laboratories.

5) Enhancing the continuous practice of good housekeeping as essential to the prevention of accidents.

6) Checking the operability of the safety showers and eye fountains.

7) Checking to make sure the exhaust hood systems are operating properly.

8) Enforcing the use of safety devices such as safety glasses, shoes, etc.

9) Collaborating in the safety training of the investigators and employees who are using biohazardous materials, and correcting work errors and defective conditions which could result in personnel injury and/or property damage.

10) Enforcing all regulations pertaining to the use and handling of biohazard agents.

11) Reviewing all construction plans and inspecting construction work.

12) Performing regular inspections of research field work.

13) Assuring that all electrical equipment is properly grounded and is used in a safe manner.

14) Enforcing all other ERDA applicable occupational safety regulations.

15) Conduct seminars on safety related matters as may be deemed appropriate.

B. Administration and Services Division

1. Administration and Services Division - Río Piedras and Mayaguez, play an important role in the control of radioactive and other hazardous materials entering or leaving PRNC installations. The Administration and Services shall:

a. Withhold processing of all requisitions, or other procurement documents relating to the acquisition by PRNC of any radioactive materials and other hazardous materials, by purchase, loan, transfer, or gift, unless the acquisition is approved by the Health and Safety Division.

b. Notify the Health and Safety Division of the arrival of all radioactive materials that come under administrative cognizance, and deliver these materials to the Health and Safety Division.

c. Notify the Health and Safety Division of pending and actual arrivals for duty of new PRNC personnel, and the interdivision transfer of personnel within PRNC.

d. Notify the Health and Safety Division of

separations from PRNC.

C. Individual Employee

1. Each employee is responsible for:

a. Conducting himself with respect to radiation and other potentially hazardous agents in such a manner as to minimize his chances of undue radiation exposure or injury.

b. Wearing any prescribed monitoring devices such as film badges or pocket dosimeters and leaving them after working hours on rack provided for that purpose.

c. Wearing clothing appropriate to the task being performed.

d. Wearing protective devices such as gloves, coveralls, or respirators when such used is required.

e. Having himself and his clothing surveyed for possible contamination before leaving an area where there is a possibility of contact with radioactive materials.

f. Requesting that Health and Safety monitor areas where radioactive materials are being used.

g. Properly labeling hazardous materials and equipment that have been used with them.

h. Keeping areas where hazardous materials are used neat and clean.

i. Refraining from smoking, drinking, eating or using cosmetics in any room or laboratory where

hazardous materials are used.

j. Making use of those techniques that will prevent a spill or other accident.

k. Never under any circumstance, pipetting any radioactive or potentially dangerous solution by mouth.

l. The custody of the radioactive materials in his possession. These materials shall not be loaned, given, or otherwise transferred without prior approval by the Health and Safety Division.

m. Reporting promptly to the supervisor and the Health and Safety Division any accident.

n. Taking prompt action to prevent the spread of any released or spilled material.

o. Carrying out decontamination procedures under the direction of a competent authority.

p. Never under any circumstances, working with hazardous solutions while having an exposed wound.

q. In the case of female personnel, reporting pregnancy, as soon as it is confirmed, to the supervisor and to the Health and Safety Division.

r. Prior to separation, leaving the working area in a clean, safe and neat condition.

D. Supervisory Personnel

1. Supervisory personnel shall insure that individual responsibilities are carried out by those under their direction and shall further be responsible for:

a. Adequate planning of procedures and supervision to insure safety to personnel and to property. Whenever there may be an appreciable health hazard, the Health and Safety Division shall be consulted before proceeding.

b. Instructing those personnel for whom they are responsible in the techniques necessary to maximize safety.

c. Making all new employees available for any indoctrination course sponsored by the Health and Safety Division.

d. Requesting the issuance of a film badge using Form HPD 602 for all new employees one week before they start work, and notifying the Health and Safety Division within two weeks of any transfer or termination of employment.

e. Procuring, using and disposing of radioactive or other hazardous materials in accordance with these regulations.

f. Guarding against the transfer of hazardous materials to unauthorized individuals.

g. Insuring that the Health and Safety Division has been notified of any accident within his division or project. An immediate oral report shall be made, followed by a written report.

h. Assuring that all persons associated with their division or project, whether a PRNC employee or

not, are familiar with, and are complying with this Health and Safety Regulations Manual.

i. Obtaining clearance from the Health and Safety Division before any equipment that may be contaminated is sent from a working area for cleaning, repair, or modification, to surplus, or to ultimate disposal.

j. Notifying the Health and Safety Division before any service or maintenance work is done on plumbing, ventilation, or other components in any area where hazardous materials have been used.

k. Obtaining approval from Health and Safety Division for the procurement of hazardous materials.

l. Prior to separation, leaving working areas in a clean, safe and neat condition.

V. CONTROL OF RADIATION SOURCES

A. Acquisition of Radiation Sources

The following procedures are to be followed in the acquisition of any radioactive material or other source of ionizing radiation. In developing these procedures every attempt has been made to achieve simplicity while at the same time complying with all applicable regulations and the requirements of general safety.

1. Radiation Producing Devices: The Health and Safety Division shall be notified in advance of the intent to procure any radiation-producing device such as

an X-ray generator, high voltage accelerator, or a sealed radioactive source. Notification shall consist of a memorandum describing the radiation output of the device, its proposed location, plans for operation, safety considerations and any other pertinent details. In some cases a catalog description or a purchase specification will suffice for the technical submission. Health and Safety will advise on the installation and operation at the proposed location. Installations and preliminary operation of any such device shall be carried out in coordination with the Health and Safety Division. The Health and Safety Division will be responsible for determining any hazards that may arise from use of the source, and will assist in developing operating procedures designed to minimize these hazards.

2. Radioactive Materials from Outside PRNC: Only those individuals who have been approved by the Health and Safety Division are permitted to acquire, by whatever means, radioactive materials from outside of PRNC. A request for procurement is initiated by submitting two copies of PRNC Form 660 to the Health and Safety Division. If the application is approved, Health and Safety will return one copy of Form 660 bearing an approval number. This number, valid for the current fiscal year, will authorize the procurement of the listed radionuclides in the amounts and for the use specified. If the proposed acquisition or

use is unacceptable on safety grounds, the Health and Safety Division will consult promptly with the originator to determine the modifications needed to satisfy safety requirements. When an approved user desires to acquire radioactive material as specified on approved Form 660, he will submit to the Health and Safety Division, Form 661 in triplicate together with the standard PRNC purchase requisition form where applicable. When the request is approved Health and Safety will:

a. Return one approved copy of PRNC 661 to the originator.

b. Note approval on the purchase requisition and on one copy of PRNC 661 and forward it to the Administration and Services Division - Procurement Office for processing. The Procurement Office will not initiate procurement without this approval.

All incoming radioactive materials shall be delivered to Health and Safety Division. Upon receipt of a shipment the Health and Safety Division will:

a. Check the shipping data against the amount requested.

b. Monitor the package and any inner containers for surface contamination or breakage.

c. Where possible, make at least a rough check on the activity received.

d. If acceptable, deliver the material promptly to the requisitioner.

3. Radioactive Materials Produced Within PRNC: Only those individuals who have been approved by the Health and Safety Division are permitted to acquire or have produced radioactive materials. A request for production of radioactive materials is initiated by submitting three copies of Form 664 to the Health and Safety Division. If the application is approved, one copy of Form 664 bearing an approval number will be returned to the user and one copy to the Head, Reactor Division. The approval number is valid for the current fiscal year and will authorize the production of the listed radionuclides in the amounts and for the uses specified. If the proposed production or use is unacceptable on safety grounds, Health and Safety will consult promptly with the originator to determine the modifications needed to satisfy safety requirements. When an approved user desires to have produced radioactive material as specified on approved Form 664, the following steps will be taken:

   a. He will submit PRNC Form 665 in triplicate to the Health and Safety Division for approval.
   b. Upon approval, the Form 665 will be forwarded in triplicate to the Head of the Reactor Division.
   c. Reactor Division Head will sign Form 665 and forward one copy to the user with time of irradiation indicated. The original will be returned to the Health and Safety Division.

Unless a specific exception is granted, all production samples shall be monitored by Health and Safety prior to removal from the Reactor building. To facilitate this monitoring, the Head of the Reactor Division shall furnish the Health and Safety Division daily irradiation schedules with the estimated times of sample removals. It will be the responsibility of Health and Safety Division to monitor the removed samples and to determine the times of cooling required before they can be turned over to the requester. Unless there has been a special pre-arrangement, Health and Safety will not release from the Reactor building any sample reading more than 300 mR/hr on contact.

B. Disposition of Radioactive Sources

1. Radioisotope Inventory: With the exception of certain low activity sources which may be specifically exempted, all radioactive materials in PRNC custody will be carried on an inventory list maintained by the Health and Safety Division. The Division will make inventory checks every six months to determine the activities remaining in stock, the amounts used, and the amounts disposed of as waste. It is recognized that a high accuracy cannot be achieved on some inventory items. However, each custodian is expected to make best estimates in cases where exact figures are not available.

2. Radioisotope Transfer: Complex governmental regulations control the physical and custodial transfer of

radioactive isotopes. No physical transfer of radioactive materials involving transport over public highways or in any type of vehicle shall be made without the supervision of the Health and Safety Division. Strict compliance with the following procedures will be needed to avoid violations.

a. Transfer Inside PRNC. No custodian of radioactive material shall transfer custody within PRNC without the approval of the Health and Safety Division. This approval is requested by submitting Form PRNC 662. Approval will be granted only if the recipient is an approved user of that particular material. Upon receiving approval the radioactive material is given to the Health and Safety Division to accomplish the actual transfer. Such transfer will be by means approved by the Head of the Health and Safety Division and in all cases will be in compliance with all ERDA, Commonwealth, and applicable regulations. The above regulations also apply to cases where the user is transferring his own material to locations within PRNC other than that specified in Form 660 (Application for Radioisotope Procurement) or Form 664 (Application for Radioisotope Production).

b. Transfer Outside PRNC

1) The Health and Safety Division shall be notified in writing of any desired transfer of

radioactive materials to an individual outside of PRNC. The license status of the intended recipient will be determined. If he is qualified, the sender will be promptly notified. Health and Safety will supervise the packaging and shipment to insure compliance with all packaging and transportation regulations.

2) When returnable radioisotope containers are ready for shipment back to the supplier, the responsible custodian shall so notify the Health and Safety Division. The Health and Safety Division will ascertain that the containers are free of contamination before releasing them for return through normal channels.

3. Radioactive Waste Disposal. Dangerous chemicals and other toxic materials can be rendered harmless by various treatments, such as incineration or neutralization. This is not the case with radioactivity. Once made, each radioactive nuclide decays at its own characteristic rate and nothing that man can do will change this rate. For this reason strict regulations govern the disposal of radioactive materials. At PRNC, the Health and Safety Division is responsible for the ultimate disposal of all radioactive wastes. The following simplified regulations apply to all users of radioactive nuclides. For more specific instructions on solid waste disposal refer to "Procedure for Solid Waste Disposal".

a. The total amount of radioactive materials released into the municipal sewerage system by PRNC at either Río Piedras or Mayaguez shall not exceed one curie per year. In addition, certain other conditions on quantity and type of material govern any discharge into the sewerage system. To insure compliance with these conditions no person shall discharge any radioactive waste into the municipal sewerage system without the specific approval of the Health and Safety Division.

b. Under no circumstance shall radioactive materials be discharged into waste baskets or other containers which would permit the contamination of the regular trash. Containers for liquid and solid wastes are available from the Health and Safety Division.

c. Animal carcasses containing radioactive nuclides shall not be disposed off by incineration without the prior approval of the Health and Safety Division.

d. Each user must make as good an estimate as possible of the amount of radioactive nuclide deposited in the waste containers. These estimates are essential because all activities that are shipped from PRNC for ultimate disposal must be reported.

e. Wastes will be collected at regular intervals, or upon call.

f. The Health and Safety Division shall be notified

promptly if there has been any accidental violation of any of the provisions of this section.

VI. PERSONNEL MONITORING

A. Film Badges*

1. Each PRNC employee will be assigned a film badge dosimeter. Badges will have a photograph of the employee and will also serve as an identification badge. Visitors who are not required to wear film badge will be issued a pocket dosimeter.
2. The Division Heads and Project Leaders shall request a film badge for any new employee prior to the date of employment.
3. Request for film badges shall be made by filling out PRNC Form 602.
4. No person shall start working in controlled areas without a film badge. A pocket dosimeter can be used for a few days until a badge is issued.
5. There are two types of film badges:
   a. A red badge entitles the wearer to enter any area controlled by PRNC.
   b. A green badge entitles the wearer to enter any area controlled by PRNC with the exception of the Reactor control room (Mayaguez), the beam tube floor of the Reactor building (Mayaguez), and any

*These badges are expensive and are the property of PRNC. The badge shall be treated like any other sensitive instrument. Any attempt made to open the badge may destroy it.

other designated exclusion areas. Entry into exclusion areas is permitted when accompanied by a red badge holder.

6. A red badge will be issued on request if the applicant's work assignment requires access to an exclusion area, if he has an acceptable knowledge of radiation hazards, and if he appreciates the philosophy and practices of radiation protection. Film badge requested will be issued within a week after request.
7. Film badges shall be worn at all times, while at PRNC. They shall not be left in or on desks, laboratories, coats or benches. Routinely, each employee shall leave his badge in the rack provided whenever he leaves the building and shall pick it up from the rack on his return to work.
8. The badge shall be worn, face outward, outside of all clothing on that part of the body where the greatest radiation exposure is anticipated. This will usually be at about chest level.
9. Any changes (termination, transfer from division or extension of appointment) should be reported in writing to the Health and Safety Division within two weeks after the change is made. (Use the Exposure Record Receiving Report, that is attached to each monthly Exposure Report.)
10. No names will be removed from the Health and Safety Division records unless reported by Division Heads.

11. A person who loses his film badge shall make a request for a new badge, to the Health and Safety Division through his Division Head or Project Leader. After the application is received by the Health and Safety Division, a new film badge will be issued.

12. Film badges will be changed monthly or quarterly as assigned.

13. Personnel exposures to ionizing radiation are submitted by the Health and Safety Division to the Division Heads. Information can be made available to any individual through their division head or the Health and Safety Division upon request.

14. In special cases the regular badge will be supplemented with wrist badges, finger ring badges, or with other types of personnel dosimeters.

15. PRNC employees from Río Piedras visiting Mayagüez, or vice versa, shall not take their film badges with them. Regular visitors will be assigned a badge at each installation.

16. PRNC personnel whose official duties take them into a potential radiation exposure area not controlled by PRNC should consult the Health and Safety Division regarding the desirability of wearing their regular badge while in the area.

17. The receptionist will provide each individual visitor with a pocket ionization chamber or other personnel monitoring device.

18. Personnel monitoring devices will be issued to representative members or visiting groups who will remain together during a guided tour of PRNC facilities.

19. The Health and Safety Division will determine the type of personnel monitoring devices to be issued to service or contractor personnel making repeated visits to PRNC-controlled areas. Service company employees (telephone, typewriter repair, etc.) on occasional visits are considered as visitors.

B. Permissible Radiation Exposure Guidelines

There is no particular radiation dose at which injury suddenly occurs and which could, therefore, be defined as "maximum permissible". Radiation sources have been used in medicine and industry for more than 60 years and this experience has been supplemented in the past 20 years by extensive studies on the damaging effects of radiation. As a result of this experience and research, responsible organizations such as the National Council on Radiation Protection and Measurements (NCRP) and the Federal Radiation Council (FRC) have been able to set a series of Guides or recommended limits of radiation exposure considered to be acceptable in connection with an occupation. Any radiation received for medical reasons is not to be counted as an occupational exposure. It is the responsibility of the Health and Safety Division, PRNC, to be familiar with all the Guides, which are too complex to be presented in detail here. The Puerto Rico Nuclear Center operates

under the dosage schedules given by the ERDA 0524 and the United States Code of Federal Regulations, Title 10, Part 20. The basic regulations governing penetrating radiation such as would be measured by a film badge are given in units of rems per calendar quarter.

1. Guide for PRNC employees:
   a. Whole body, head and trunck, gonads, lens of the eye, red bone marrow, active blood forming organs shall not exceed a maximum dose or dose commitment of 5 rems per year or 3 rems per calendar quarter. A beta exposure below an average energy of 700 Kev will not penetrate the lens of the eye; therefore, the applicable limit for these energies would be that for the skin (15 rem/year).
   b. Unlimited areas of the skin (except hands and forearms). Other organs, tissues, and organ systems (except bone) shall not exceed a maximum dose or dose commitment of 15 rems per year or 5 rems per calendar quarter.
   c. Bone shall not exceed a maximum dose or dose commitment of 30 rems per year or 10 rems per calendar quarter.
   d. Forearms shall not exceed a maximum dose or dose commitment of 30 rems per year or 10 rems per calendar quarter.
   e. Hands and feet shall not exceed a maximum dose or dose commitment of 75 rems per year or 25 rems per calendar quarter.

In special cases with the approval of the Director, a worker may exceed 5 rem/year provided that the total accumulated dose for any of the organ systems listed does not exceed 5(N-18) rems where N is the individual's age at his last birthday. It is evident from this that individuals below the age of 18 must be excluded from occupations involving a radiation exposure. To meet the above dose commitment standards, operations must be conducted in such a manner that it would be unlikely that an individual would assimilate in a critical organ, by inhalation, ingestion, or absorption, a quantity of a radionuclide(s) that would commit the individual to an organ dose which exceeds the limits specified above. All reasonable effort shall be made to keep exposures of forearms and hands to the general limit for the skin. The Health and Safety Division, PRNC, attempts to control operations so that no individual receives a radiation dose approaching the guide values given above, but without imposing undue restrictions on the activities for which PRNC was established. In the case of occupational exposure, arrangements should be made so that, when an employee's pregnancy is confirmed, the average dose to her fetus during the entire pregnancy period does not exceed 0.5 rem. As soon as pregnancy is known, the supervisor and the Health and Safety Division must be notified and arrangements must be made for a new job assignment if a potential to exceed this limit exists.

2. Guide for Students: Students form a special group because tney are not employees covered by the usual provisions of workmen's compensation, but may nevertheless be subjected to radiation exposures by assignment. The recommendations in Report No. 32 of the NCRP will be used as exposure guides for those students for whom PRNC has accepted responsibility. The pertinent provisions are:

   a. Students of any age shall not receive an exposure exceeding 0.5 rem per year in addition to natural background and medical exposures. If a teacher age 18 or higher is routinely exposed to work involving radiation, he becomes an occupational worker and the corresponding exposure limits apply.

   b. Persons under 18 years of age shall not be occupationally exposed to radiation. They should not be employed or trained in an X-ray department, radioisotope laboratory, or industrial radiation facility.

   c. Students under 18 years of age should not receive more than 0.1 rem per year from educational activities. It is recommended that each experiment be so planned that no student receives more than 0.01 rem while carrying it out.

The Health and Safety Division will keep current and cumulative exposure records on all PRNC personnel. Any employee may discuss his record with the Safety

Officer at any time. Upon a change of employment the exposure record will be made available to the new employer upon the written request of the individual concerned.

3. Guide for Visitors: All visitors to PRNC will be issued an appropriate monitoring device, and are required to wear it. The Health and Safety Division will maintain such service and keep a permanent record of all exposures received by visitors. The following provisions apply:

   a. If the visitor receives an exposure of 50 mrem or greater, an exposure report will be furnished to the visitor's employer within 30 days following its determination. Upon written request, however, all exposure information (zero and up) will be provided to the visitor's employer.

   b. Any radiation exposure in excess of the permissible levels established by Section VI.B.1 (Guide for PRNC employees) shall be reported immediately to the visitor's employer by telephone or teletype.

   c. Visitors below 18 years of age shall not enter any area wherein they are liable to receive an exposure greater than 1/10 that of the occupationally exposed personnel. Furthermore, they shall not receive at any one time an exposure exceeding 10 mrem. This exposure is not to be repeated within one calendar quarter.

VII. HANDLING RADIOACTIVE MATERIALS

No exposure guide or permissible dose should be considered as an allowable outer limit which can be approached with complete safety. Every practical effort must be made to keep exposures as far below the guides as is consistent with program efficiency and economy. The Health and Safety Division will assist in determining the laboratory areas in which certain operations can be carried out and will assist in planning procedures that will minimize personnel exposures. A continuous monitor on procedures will be provided where this seems indicated.

A. Designation of Areas

The regulations of ERDA carefully define certain areas with respect to radiation sources.

1. An unrestricted area is an area into which access is not controlled for the purpose of protecting individuals from radiation exposure.
2. A restricted area is an area into which access is controlled for the purpose of protecting individuals from radiation exposure. All buildings and grounds controlled by PRNC, except for a few excepted areas, are restricted areas.
3. A radiation area is any area where an individual could receive to a major portion of his body a dose greater than 5 mrems in one hour or 100 mrems in five consecutive days. Each radiation area shall be conspicuously posted with a sign or signs in English and/or Spanish

bearing the words:

CAUTION RADIATION AREA or DANGER RADIATION AREA

4. A high radiation area is any area where an individual could receive, to a major portion of his body, a dose greater than 100 mrems in one hour. Each high radiation area shall be conspicuously posted with a sign or signs in English or Spanish bearing the words:

CAUTION HIGH RADIATION AREA or DANGER HIGH RADIATION AREA

5. An airborne radioactivity area is any area or enclosure in which radioactive gases or other radioactive materials creating airborne hazards are present. Each airborne radioactivity area shall be conspicuously posted with a sign or signs in English and/or Spanish bearing the words:

CAUTION
AIRBORNE RADIOACTIVITY AREA

or

DANGER
AIRBORNE RADIOACTIVITY AREA

B. Laboratory Practice

It is not possible to present here in detail all of the techniques and procedures applicable to the proper use of radioactive materials and other sources. Some of the more important requirements are given below; the Health and Safety Division will supply detailed information on request:

1. Each entrance into an area where radioactive materials

are used or stored in such a manner as to make that area a Radiation Area, or a High Radiation Area, or an Airborne Radioactivity Area shall be conspicuously marked with a sign identifying the area in accordance with the definitions given above. The signs shall remain in place as long as the area conforms with the definitions. Signs will be removed by the Health and Safety Division only after appropriate radiation surveys.

2. Containers in which radioactive materials are being stored or transported shall be appropriately marked with labels or decals available from the Health and Safety Division. Each label or decal shall identify the nuclide, give the activity within the container, the date of the activity estimate, and the initials of the responsible custodian. This labeling shall not be required for laboratory containers such as beakers and flasks being used in laboratory procedures during the presence of the user.

3. Stock solutions or sources in use may be kept in a laboratory area inside sufficient shielding to reduce the exposure dose-rate at the closest access point outside the shield to 1 mR/hr. The shield should be posted as a "Radiation Area" or a "High Radiation Area", as appropriate, even though a major portion of a body could not be exposed inside the shield.

4. Manipulations involving radioactive materials shall be carried out inside glove boxes or hoods as far as is practicable. Radioactive gases shall be used and stored only in areas approved by the Health and Safety Division.
5. Handling of radioactive gases or other material creating an airborne radioactivity hazard, shall be done within exhaust hoods approved by the Health and Safety Division.
6. As extensive use as possible should be made of protective devices such as trays, glass plates, or absorbent paper in order to prevent contamination of permanent building structures such as bench tops, hoods, and floors. Absorbent paper should be discarded frequently to prevent the dusting off of spills that have dried.
7. Each user of radioactive nuclides shall make periodic surveys of his area to search for contamination.
8. No detectable contamination of any basic building component can be tolerated. Consult the Health and Safety Division upon discovery, or suspicion, of contamination and follow instructions.
9. Equipment used with radioactive nuclides shall not be released to other workers, sent to a shop for repairs or modifications, or to excess, and shall not be discarded until it is demonstrated by the Health and Safety Division to be free of contamination. Repairs or modifications that must be made on contaminated

equipment shall be done under the supervision of the Health and Safety Division.

10. No maintenance work or repair shall be made on any laboratory sink traps or waste lines or on any hood ducts, exhaust systems, or house vacuum lines until the areas involved have been cleared by the Health and Safety Division.
11. Protective gloves of surgical rubber or disposable plastic and lab coats should be worn when working with radioactive materials.
12. Each division shall provide its employees with gloves, lab coats and other protective equipment according to the work area and duties.
13. Protective equipment such as laboratory coats, surgical or disposable gloves, etc., should not be worn outside the laboratories or working area.
14. Mechanical pipette-filling devices shall always be used with radioactive solutions. Never Use the Mouth to Pipette Radioactive Solutions.
15. Smoking, eating, drinking, and use of cosmetics are forbidden in areas where radioactive nuclides are used.
16. Liquid radioactive wastes shall not be put into the regular laboratory sewerage system unless they are known to conform to the requirements specified by the Health and Safety Division (See V.B.3 (Radioactive Waste Disposal).
17. Radiation solid waste should be stored in the containers provided for it.

C. Decontamination Practice

1. Equipment Decontamination

When equipment has been contaminated, a decision must be made as to whether it is most advantageous to discard, set aside for decay, or to decontaminate. If to be discarded such equipment shall be considered as radioactive waste and shall be turned over to the Health and Safety Division for disposal. The Health and Safety Division will also assist in storing equipment during decay to usable levels. It is usually advantageous to start decontamination procedures promptly. Delay frequently fixes the contaminants more firmly onto surfaces. During decontamination procedures protective gloves shall always be worn, supplemented by protective clothing if it is indicated. In general, the user can choose the most effective decontamination procedure from a knowledge of the properties of the contaminant. Health and Safety Division will provide advice, and assistance, and will supervise disposal of the cleaning materials.

2. Personnel Decontamination

When radioactive nuclides come in contact with the skin, the radiation dose-rate at the contaminated area may be very high. In addition, many contaminants are in form that are readily absorbed through the intact skin, and, to a much greater extent, through cuts and abrasions. Any contaminating event must be considered

to create a situation requiring prompt attention. Whenever there has been any personal contamination, Health and Safety should be called at once to assist in the decontamination. When large areas of the body are involved, showering may be required, utilizing either the regular shower facilities at Río Piedras or the special decontamination room at Mayaguez. Without waiting for Health and Safety Division assistance to arrive, start decontamination procedures at once. Personnel handling radioactive nuclides shall become acquainted with proper personnel decontamination procedures. If contamination persists, Health and Safety shall call a physician to direct the use of more drastic cleansing agents. The decontamination of wounds and skin abrasions should also be carried out under the direction of a physician. When the skin is injured, an important barrier to the entry of contaminants is lost and mismanagement of cleansing procedures can do more harm than good. If several vigorous washings do not sharply reduce the decontamination of body hair, it should be cut short, using extreme care not to injure the intact skin. Removal of the hair will permit more effective treatment of the underlying skin.