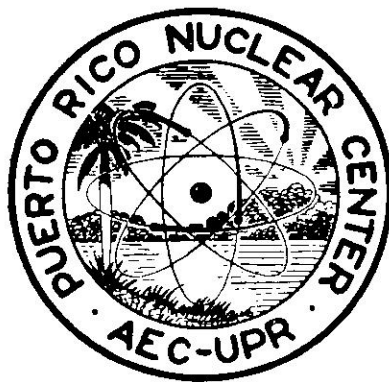


PRNC-4

(Health Physics)

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AREA MONITORING MANUAL



Puerto Rico Nuclear Center
Operated By
University of Puerto Rico
For
U.S. Atomic Energy Commission
Mayagüez, P.R.

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Operated By
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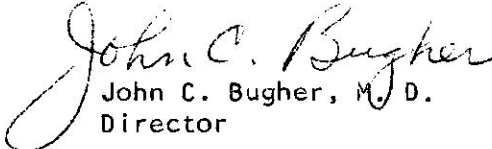
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PUERTO RICO NUCLEAR CENTER
Operated by
UNIVERSITY OF PUERTO RICO
for
U. S. ATOMIC ENERGY COMMISSION

AUTHORIZATION

This Area Monitoring Manual has been revised and approved by the Safety Committee. It is hereby approved and made operative as of January 7, 1963.


John C. Bugher, M. D.
Director

AREA MONITORING AND SURVEY

I. General Survey

It is important that background count for each room (preferably from 2 locations) be known previous to start of operations.

1A. Non-radiation areas.

For routine survey report of non-radiation areas use form No. 611.

This survey shall be made once every six months unless circumstances require otherwise. Survey shall be made using a portable instrument.

1B. Radiation Areas

For routine survey report of radiation areas use form No. 611. This survey shall be made once a month using an appropriate portable survey meter unless circumstances require otherwise.

In areas where contamination is likely to occur, smears will be taken if deemed necessary. (See Section 3) Appropriate measures will be taken whenever necessary.

Under remarks indicate if alpha survey, beta survey etc. If contamination is positive indicate under remarks c/m above B. G. Smear (s) shall follow.

If contamination or intensities beyond recommended levels are encountered, the HPD will send a report (memo) to the appropriate person with recommendations on action to be taken.

AIR MONITORING - AREA MONITORS

Continuous monitoring of particular areas (hot cells, reactor building, radiochemistry laboratories, etc.) for radiation intensity and air activity is part of the environmental and area monitoring and survey programs.

- 2.1 Continuous Air Monitors (CAM) - operate around the clock. The CAM are provided with a chart recorder and an aural alarm. This chart is to be inspected daily at least once in the morning. Write in an appropriate place in the chart the date, time of inspection and initials. Calibration checks are performed once a month.
- 2.2 Portable Samplers-portable Hi-Vol collectors are used to take air samples. The sampling period is normally 24 hours. Some of these samples are taken routinely as part of the Environmental Survey Program. Hi-Vol samplers are calibrated once every six months.
- 2.3 Samplers-a varied number of samplers are available for the collection and study of dust particles. These samplers are calibrated every six months.
- 2.4 Filter paper removed from CAM or samplers are placed in an envelope with the following information; location, date on, date off, sampling time; cfm (or other flow rate) and signature of collector.

Analysis of air samples are reported in form 632A (Environmental Survey Procedures Manual.) Analysis of Special air samples are to be reported in the same form, but indicate: special sample.

To calculate activity of air samples refer to the Environmental Survey Procedures Manual, Section on Calculations.

- 2.5 Area Monitors-operate around the clock to check the beta-gamma radiation intensities in different areas. Most of these monitors are provided with a chart recorder and aural alarm. The chart is to be inspected daily at least once in the morning. Write in an appropriate space in the chart the date, time of inspection and initials. Calibration checks are performed once a month.
- 2.6 At least once every 6 months the air flow at the face in all hoods will be checked with an appropriate calibrated instrument to assure that the off gas system is working properly. Likewise the negative pressure system in the hot cells will be checked at the same interval for proper functioning.

AIR SAMPLE DATA SHEET

Sample no. _____

Date and Time of Coll: _____

Area: _____

Coll. Time: _____

Survey Remarks: _____

Rate of Collection: _____

Instrument: _____

ALPHA

Date	Time	Instrument	Reg.	Lights	Total Counts	Counting Time	c/m	D.G. (c/m)	net c/m

Eff. Factor: _____

For Immediate Alpha Activity

$$(3) \quad \mu\text{c/cc} = \frac{\text{net c/m} \times 5.4 \times 10^{-6}}{RT}$$

For Long-Lived Alpha Activity

$$(5) \quad C_{LL} = \frac{C_2 - C_1 e^{-0.693(t_2 - t_1)}}{1 - e^{-0.693(t_2 - t_1)}}$$

$$(7) \quad \mu\text{c/cc} = \frac{C_{LL} \times 5.4 \times 10^{-6}}{RT}$$

BETA-GAMMA

Date	Time	Instrument	Reg.	Lights	Total Counts	Counting Time	c/m	D.G. (c/m)	net c/m	
									β	γ

Eff. Factor: _____

For Immediate Beta Activity

$$(4) \quad \mu\text{c/cc} = \frac{\text{net c/m} \times 0.9 \times 10^{-6}}{RT}$$

For Long-Lived Beta Activity

$$(5) \quad C_{LL} = \frac{C_2 - C_1 e^{-0.693(t_2 - t_1)}}{1 - e^{-0.693(t_2 - t_1)}}$$

$$(8) \quad \mu\text{c/cc} = \frac{C_{LL} \times 0.9 \times 10^{-6}}{RT}$$

Signature _____

SECTION III

CONTAMINATION

3.1 Smears

In taking smears it is desirable to follow a definite technique, therefore, swipes will be made by wiping approximately one square foot area with 3.2 square inch filter paper (approximately 5 cm in diameter). Cases in which the surface to be wiped is smaller or larger than one square foot are to be handled accordingly.

- 3.2 Smears will be taken at least once a month in all areas such as laboratories, counting rooms, reactor rooms, etc., where the possibility of contamination exists. Other areas will be smeared at least once every six months.

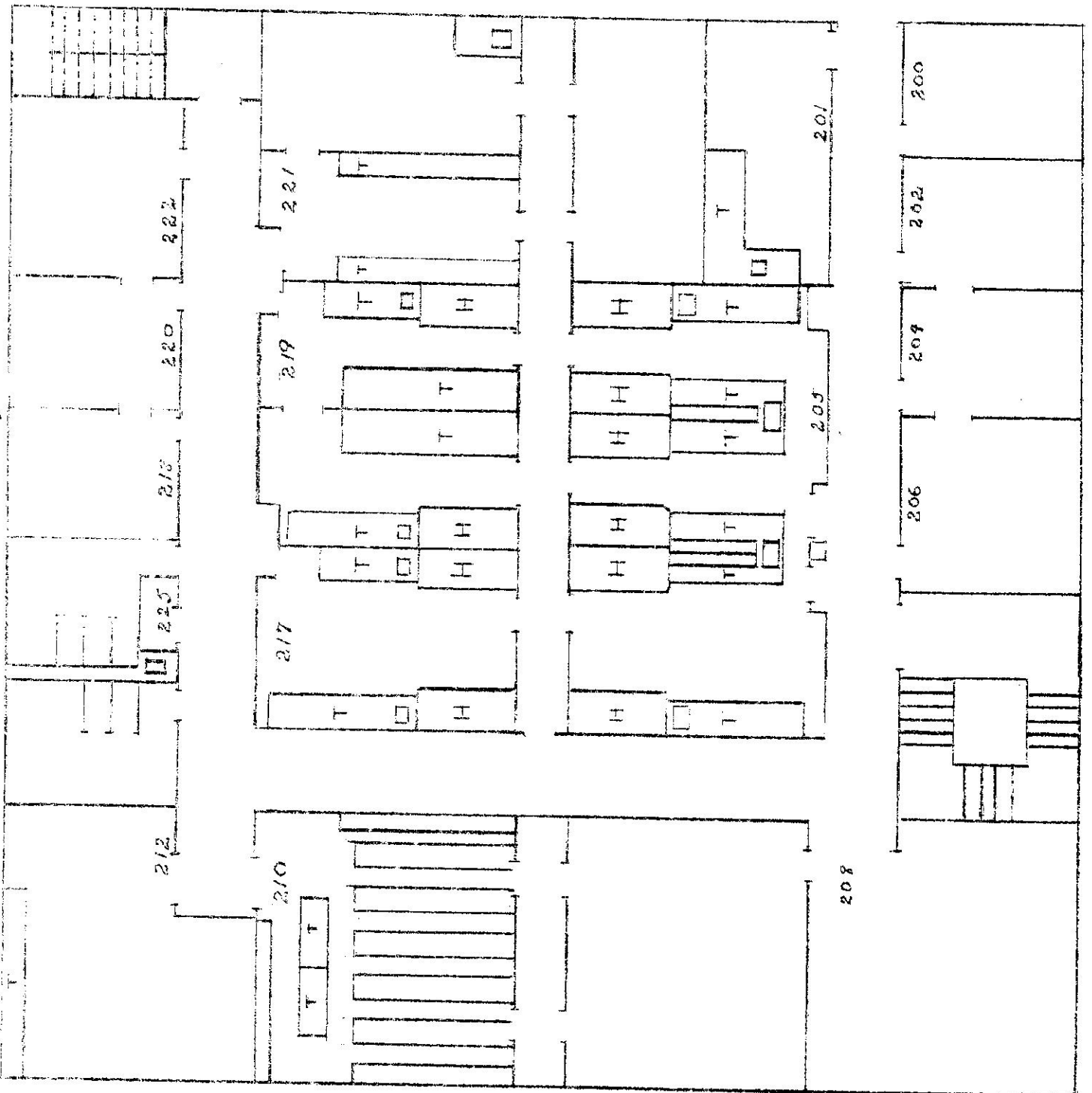
Count smears in an appropriate counter and record results in Form No. 612.

- 3.2 If contamination is found over several areas within a room, indicate contaminated areas in a plan of the room (see accompanying plan specimen) by writing the smear number in the corresponding area.

Example: Room 219 was surveyed and found contaminated from smears results. Ten smears were taken but only No. 1, 3 and 6 indicated contamination.

PRNC LABORATORY BUILDING MAYAGUEZ - P.R.

SECOND FLOOR



SECTION IV

WATER AND SOIL SAMPLING

4.1 Water Samples

Some of the routine water samples taken for the Environmental Survey, can be considered as part of the Area Monitoring Program (samples from stations E 3 and E 7). Other routine samples of the Area Monitoring Program include one monthly sample from the gamma pool and the reactor pool.

Water from the reactor hold up tank and the L-77 reactor water shield tank will be analysed once every 6 months whether water is to be disposed of or not. Analysis is for gross alpha and beta-gamma activity. A memo (see accompanying sample), issued by the HPD upon request will be used for permission to discharge water from any tank, well, reservoir, etc., regardless of its origin which could possibly become contaminated. (See HP Guide and Regulations).

At least once every six months the water from the reactor pool, L-77 reactor and gamma pool will be analysed in a spectrometer for radioisotope contents.

Form 632 (See Environmental Survey Procedures Manual), will be used to report sample analysis. Other than routine analysis shall be marked:

Special.

4.2 Soil Samples

The routine soil samples for the Environmental Survey (around PRNC site and off site) can be considered as part of the Area Monitoring Program.

Revised: January 2, 1963

Date _____

Memorandum

To:

From:

Subject: Water Discharge

Water sample (s) taken from _____

on _____

were analysed for radioactive content. On the basis of the analysis the
water _____ be discharged.

SAMPLE DATA SHEET

TYPE: _____

Sample no. _____

Date and Time of Coll: _____

Area: _____

Sample Volume or Weight: _____

Survey Remarks: _____

Laboratory Remarks: _____

Date Sample Prepared: _____

ALPHA

Aliquot: _____ ml. or gm.

Date	Time	Instrument	Reg.	Lights	Total Counts	Counting Time	c/m	D.C. (c/m)	net c/m

Eff. Factor: _____

$$\frac{\text{net c/m}}{F \times A \times 2.22 \times 10^6} = \text{_____ } \mu\text{c/ml. or gm.}$$

BETA-GAMMA

Aliquot: _____ ml. or gm.

Date	Time	Instrument	Reg.	Lights	Total Counts	Counting Time	c/m	D.C. (c/m)	net c/m

Eff. Factor: _____

$$\frac{\text{net c/m}}{F \times A \times 2.22 \times 10^6} = \text{_____ } \mu\text{c/ml. or gm.}$$

Special Analyses: _____

Signature _____

Additional samples (for example around the hot waste storage tanks) will be taken whenever circumstances indicate this would be desirable.

SECTION V

RADIOACTIVE WASTE

5.1 Waste Storage Areas

These will be surveyed at least once every month with a portable survey meter. Air samples of the area will be taken at least every two weeks for detection of possible radioactive particulate release in the atmosphere.

The dry waste storage area shall have an area monitoring system with preset alarm.

SECTION VI

RADIATION SOURCES

6.1 Source Location and Area Survey

In accordance with Section V of the Health Physics Guide and Regulations, receipt, transfer and storage of radioactive material is to be notified to the HPD in order for the division to keep a running inventory of this material.

The division will fill for each person (custodian) in charge of one or more radioisotope or source the Current Location of Radioactive Materials and Source form, (Form 612a). The information given there shall be kept in a current basis.

Once every six months the HPD will carry out an area survey of the locations indicated in this form. A log book will be used to keep records of these surveys.

The HPD will carry a running inventory of all radiation sources (excluding activation analysis samples and their containers) for immediate reference using Form PRNC-HPD (AM) 612b. The initial information in this form may be obtained from Form 661 Notice of Incoming or Outgoing Radioactive Material.

ISOTOPE:	AMOUNT	DATE	T	SOURCE No.	
CUSTODIAN:				LOCATION	
REMARKS:				BLDG.	ROOM

PRNC-HPD (AM) 612 B RADIOACTIVE SOURCE RECORD (OVER)

DESCRIPTION:

DATE STORED:					
RADIATION INTENSITY					
MR/HR		Dist. (Shielded)		MR/HR	
				Dist. (Unshielded)	
CONTAMINATION (SMEARS)					
c/m A	c/m H-G	Date	c/m A	c/m B-G	Date

PRNC-HPD (AM) 612 B RADIOACTIVE SOURCE RECORD (Over)

SECTION VII

VII-01

LEAK TESTS

7.1 Leak Test of Sealed Sources

The AEC requires that sealed sources be tested for leakage at intervals of not more than 6 months and not less than 7 days.

(See attached AEC Procedures)

A sealed source is defined as radioactive material that is encased in, and is to be used in, a container in a manner intended to prevent leakage of the radioactive material.

7.1A Alpha emitting sealed sources (neutron sealed sources are included here).

7.1A1 Smear test-moisten a filter paper (Whatman No. 50 not larger than 5.5 cm in diameter) with a few drops of dilute Versene solution. Wipe the source surface thoroughly, dry the paper completely under an infrared lamp and count. Check against Table 3 Health Physics Guide and Regulations. If necessary c/m may be converted to microcurie activity units. Any source giving more than .005 μc shall be removed from use until the seal is repaired.

7.1B Beta emitting sealed sources

7.1B1 Smear test - same as for alpha sources. If a calibration is desirable place a small amount of the radioisotope in question (about .05 μc) on a surface similar to the source container and proceed with the smear test.

7.1B2 Other tests

- a. See National Bureau of Standards Handbook 66, page 10, 14 and section 12.3
- b. USEPHS Radiation Protection Course Manual, Section VIII, 1958

7.1C Gamma emitting sealed sources

7.1C1 Smear test - same as for alpha

7.1C2 Other tests - see reference listed for betas.

Caution For alpha-neutron sources precautions must be taken to handle the source remotely as they emit gammas and neutrons. For gamma emitting sources the same precautions are to be observed. Gloves shall be worn whenever leak testing of sources.

7.1D Radium sealed sources.

A simple method of testing leakage of Radium sources is by wrapping the source, or plugging the container where the source is kept with absorbent cotton for a period of not less than 24 hours. Then the cotton is removed and checked with a GM survey meter.

7.1E Schedule of tests.

7.1E1 For alpha emitting sealed sources test will be performed at least every three months (90 days), except for Radium sources in storage which are to be checked weekly (See 7.1D).

7.1E2 For beta or gamma emitting sealed sources a test will be performed at least every six months.

See Reference cited in 7.1B2 above

7.1F Records

Leak tests will be recorded in Form 612.

SEALED SOURCES CONTAINING
ALPHA-EMITTING RADIOISOTOPES

The present procedures of the Atomic Energy Commission for the allocation of alpha-emitting radioisotopes for purposes of manufacture, distribution, and use of sealed sources are discussed in this announcement. Federal Regulations on Manufacture and Use of Sealed Sources are pending and will, upon publication, supersede these procedures. The provisions discussed below define the principal responsibilities of the manufacturer and user with respect to leak testing of sealed sources:

I. Definitions

- a. Sealed Source: "Sealed Source" means a radioisotope that is encased in, and is to be used in, a container in a manner intended to prevent leakage of the radioisotope.
- b. Source Container: "Container" means the chamber, box, or other enclosure which, immediately surrounds a radioisotope.
- c. Source Holder: "Source Holder" means the chamber, box, or other enclosure which, as an integral part of a device, houses the container of a sealed source.

II. Description of Tests for Leakage

A. Cap and Wipe Test

1. Capping: A cap or cover with an impervious and smooth surface (such as metal or glass) is placed over a sealed source and the sealed source, thus enclosed, is stored on the premises of the manufacturer for a period of at least seven days. The area of the inner surface of the cap shall not exceed twice the area of the surface of the container, provided that no dimension of the inner surface of the cap shall be less than two centimeters.
2. Wiping: At the end of such seven-day storage period the inside of the cap or cover and all exposed external surfaces of the container are wiped thoroughly with a piece of filter paper of high wet strength moistened with a solution which will not attack the material of which the container is made and which, under the conditions of this test, has been demonstrated to be effective in removing the byproduct material involved. The paper is allowed to dry. Then the radioactivity on the paper is measured.

B. Wipe Test

All exposed external surfaces of the object to be tested are wiped thoroughly with a piece of filter paper of high wet strength and absorption capacity, moistened with a solution which will not attack the material of which the container or source holder is made and which, under the conditions of this test, has been demonstrated to be effective in removing the by-product material involved. Then the radioactivity on the paper is measured.

III. Testing Requirements for Sources Emitting Alpha Particles

A. Preliminary Testing By Manufacturer

1. The manufacturer of a sealed source emitting alpha particles shall perform a cap and wipe test on the container thereof as provided under Section IIA. If the test reveals the presence of more than 0.005 microcurie of radioactivity the manufacturer shall neither use nor deliver the sealed source to another person until such source has been repaired and the testing provided for in this sub-paragraph shall have been repeated and such repeat test fails to reveal the presence of more than 0.005 microcurie of radioactivity.
2. After successfully meeting the requirements of the cap and wipe test provided for in subparagraph 1, the manufacturer need make no further tests for leakage provided delivery of such source is made to another person within 30 days from date of completion of the cap and wipe test. If delivery is not made within such 30 day period, a wipe test, as described in Section IIB shall be performed not more than 30 days prior to delivery (1) on the container or (2) on the accessible surfaces of the sealed source holder if the container is incorporated in a source holder in such a manner that its removal from the source holder is impractical. If the test reveals the presence of more than 0.005 microcurie of radioactivity, the manufacturer shall neither use nor deliver the sealed source to another person until such source has been repaired and the testing provided for in this subparagraph shall have been repeated after an interval of at least 7 days and such repeat test fails to reveal the presence of more than 0.005 microcurie of radioactivity.
3. If the manufacturer places the sealed source emitting alpha particles in use on his own premises, said manufacturer at intervals of not less than 7 days nor more than 90 days shall perform or cause to be performed a wipe test, as described in Section IIB on the (1) container or (2) on the accessible surfaces of the sealed source holder if the container is incorporated in a source holder in such a manner that its removal from the source holder is impractical. If the test reveals the presence of more than 0.005 microcurie of radioactivity, the manufacturer shall neither use nor deliver the sealed source to another person until such source has been repaired and the testing provided for in this subparagraph shall have been repeated and such repeat test fails to reveal the presence of more than 0.005 microcurie of radioactivity.

B. Subsequent Testing

At intervals of not more than 90 days and not less than 7 days the person holding legal title to a sealed source emitting alpha particle, except as otherwise provided in A above, shall perform, or shall cause to be performed a wipe test, as described in Section IIB on the accessible surface of (1) the container, or (2) the source holder, if the container is incorporated in a source holder in such a manner that removal of the container from the source holder is impractical.

Revised: January 2, 1963

If the test reveals the presence of more than 0.005 microcurie of radioactivity such person shall remove, or shall cause to be removed, from use such source until repaired and a subsequent test fails to reveal the presence of more than 0.005 microcurie of radioactivity.