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NRLSD BULLETIN NO. 92-03

**PERFORMANCE OF RADIATION
SURVEYS IN MEDICAL INSTITUTIONS**

A. ADDRESSEES

All licensees authorized to use radioactive materials in medical institutions.

B. PURPOSE

This bulletin seeks to remind licensees of the radiation protection requirements contained in **CPR Part 3, "Standards for Protection Against Radiation"**. The conduct of area surveys and monitoring are required to promptly determine or preclude the occurrence of potential radioactive contamination of the facility and the people as well. Although this bulletin does not establish any new requirement, the licensee is expected to review its radiation protection program and consider appropriate actions to ensure compliance with applicable regulations and the conditions of the license.

C. DESCRIPTION OF CIRCUMSTANCES

Results of PNRI inspections and audits of licensed medical institutions indicate that incidents may have occurred that gave rise to unnecessary exposure to radiation workers, patients, and perhaps some members of the public. Such incidents may be attributed to insufficient knowledge of measures to minimize exposure to radiation, inadequate procedures to prevent or avoid the spread of radioactive contamination, absence of appropriate radiation detection and measuring instruments, or non-implementation of licensees' radiation safety program.

D. DISCUSSION

Pursuant to Part 3 of the Code of PAEC Regulations, licensees must ensure that its personnel, clients, or the general public are adequately protected from the adverse effects of radiation. One of the recommended measure is the performance of periodic radiation survey of the area and the personnel. This activity includes a physical survey of the location of radioactive materials and equipment in the facility, measurement of radiation levels in the working area, monitoring for contamination of personnel and working area, and monitoring of room used by a radioactive patient. Results of the survey should be documented and records maintained for inspection by PNRI.

The Radiological Health and Safety Officer (RHSO) is the responsible officer for the development and implementation of the Radiation Protection Program. As such, he should prepare the necessary procedures needed to implement the program and see to it that implementation, recording, documentation and reporting of the activities contained in the program are in compliance with regulations. **Attachment 1** provides the guidelines and explanations for the performance of radiation surveys in accordance with the program.

E. REQUIRED LICENSEE ACTION

This bulletin requires licensees to:

1. Review its safety programs and corresponding procedures for radiation surveys to determine if the program and procedures are in compliance with regulatory requirements.
2. Submit a report to PNRI on the results of the review.

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Attachment 1:

- A. Types of Radiation Surveys
- B. Frequency of Surveys
- C. Records of Surveys

Attachment 2:

Test for Non-Fixed Radioactive Contamination

Tables:

1. Survey Frequencies
2. Limits for Removable Surface Contamination in Medical Institutions

ATTACHMENT 1

A. TYPES OF RADIATION SURVEYS

1. Surveys of External Radiation Exposure Levels

Preoperational, routine and special surveys should be performed and the results recorded on areas (e.g. diagnostic areas in nuclear medicine, intracavitary source preparation areas in radiation therapy, waste packaging and disposal areas) where the occupational radiation dose to individuals may exceed 10 percent of the limits or radiation levels may be greater than **.01 mSv/h (1.0 mR/h) at one meter.**

The Radiological Health & Safety Officer (RHSO) should institute and maintain a program of surveys performed by workers other than health physics personnel. Such survey may consist of occasional instrument observations during work with radioactive materials, as necessary to determine the need to limit work time and to use protective procedures to reduce exposures as far below the limits as is reasonably achievable. The survey results obtained by these workers need not be recorded, however, they should report unusual survey findings to the RHSO.

2. Measurements of Radioactive Material Concentrations in Air

Unless it can be shown by calculation, together with monitoring of ventilation rates, that air concentrations of radioactive material are well below levels that would require routine air sampling, the concentrations of radioactive material in the air should be measured at frequencies described in **Section B.**

Air samples should be obtained in the workers' breathing zone or may be outside the breathing zone closer to the source, where the concentration of radioactive material can or is expected to be equal to or greater than the concentration in the breathing zone.

3. Surface Contamination Surveys

Control of surface contamination is necessary to limit external dose rates and the re-suspension of loose radioactive materials that may enter the body through inhalation, ingestion or skin absorption.

Removable Contamination

Methods and instruments used in surface contamination surveys should be sufficiently sensitive to detect the nuclide being monitored. For optimum detection of low-energy beta emitters (e.g. H-3 and C-14) as well as of alpha emitters and low-energy x- or gamma-ray emitters (e.g. I-125), liquid scintillation counting or use of gamma well counter is normally necessary.

The collection of smear samples may be preceded by a rapid survey with a portable, thin-end-window detector. A standardized method for smear testing of a relatively uniform area (100 cm² is acceptable) should be used in order to allow comparison of relative levels of contamination at different times and places. The contamination limits for unrestricted and restricted areas are presented on **lines 1 and 2 of table 2**. Refer to **Attachment 2** for the test for non-fixed radioactive contamination. It would be helpful to have a layout diagram for each laboratory routinely surveyed specifying key locations that are smear tested at each survey and to keep a record of:

- a) the contamination levels in specified areas;
- b) type and model number of the instruments used in the survey and in counting the smear samples; and
- c) the disintegration rate of each instrument test or calibration source.

Fixed Contamination

A total contamination survey, using instruments suitable for the radionuclides involved, should be conducted concurrently with each removable contamination survey.

4. Protective and Personal Clothing Contamination Surveys

Protective clothing should be surveyed by the wearer after use for possible significant contamination. Contaminated protective clothing should be removed and placed in special laundry containers before leaving a restricted work area. When protective clothing contamination levels exceed the values given in **Table 2**, care should be taken to avoid dispersal of contamination and to report the situation to the RHSO. Disposable gloves should be discarded in radioactive waste containers. After gloves are removed, hands should be washed and surveyed.

Contamination levels observed and procedures followed during survey and

decontamination of personal clothing should be recorded. The written record should include the names of persons surveyed, a description of prior work activities, the probable causes, steps taken to reduce future incidence of contamination, times and dates, and the surveyor's signature.

5. Personal Surveys

Individuals who work in restricted areas under conditions in which they may become contaminated should survey all exposed areas of the body, particularly the hands, hair, and bottoms of the shoes or feet before putting on personal clothing or leaving the restricted area. Detection of contamination on the body should be reported immediately to the Radiological Health & Safety Officer and decontamination attempts be done and repeated until such attempts cease to effect significant reductions. The limits for acceptable removable contamination are given in **Table 2**. Although the residual contamination exceeds the limits, the affected individual may be released, provided periodic surveys are made until the limits are no longer exceeded. The resulting dose should be determined and entered in the individual's personnel dosimetry record.

6. Surveys of Equipment Prior to Release to Unrestricted Areas

Surface contamination surveys should be conducted on potentially contaminated medical instruments or equipment before they are uncontrollably released from restricted to unrestricted areas. If contamination is detected, decontamination procedures should be instituted and repeated until additional efforts do not significantly reduce contamination levels.

7. Surveys to Prevent Ingestion of Radionuclides

Surveillance should be done to ensure that workers properly observe rules to prevent ingestion of radionuclides, e.g., rules against eating, drinking, or smoking in work areas or while wearing potentially contaminated clothing; storing foods in work areas and in refrigerators used for keeping radioisotopes; pipetting by mouth; and wearing contaminated laboratory coats outside restricted areas. Water fountains close to the radiation work areas should be smear tested regularly.

8. Surveys of Packages Received and Packages Prepared for Shipment

External radiation measurements and tests of external surfaces of packages received or packaged for shipment should be carried out near the receiving or packaging

point to avoid unwarranted radiation exposures and inadvertent contamination of personnel or the hospital. Delivery of packages within the hospital should be monitored and the labels checked. Only adequately shielded sources should be transported.

All radiation workers should be adequately instructed in performing at least an initial inspection survey for leakage or damage before transporting any packages of radioactive materials through hospital areas. The instructions should clearly indicate which packages should be transported by cart rather than hand-carried.

9. Surveys of Protective Clothing Before and After Laundry

Surveys of protective garments and linens should be performed prior to release to a conventional laundry. The contamination level should not exceed the limits set in **Table 2**, otherwise, if contamination is by short-half-life radioactive material, they should be contained in leak proof bags and transported in carts to controlled storage areas for decay. Items contaminated with long-half-life radioactive material may be disposed of as radioactive waste.

10. Ventilation Surveys

Measurements of the face velocity at the entrance of enclosures (e.g., fume hoods) should be made and **recorded quarterly** to ensure that the airflow is adequate (**average face velocity of 125 - 200 fpm and minimum face velocity of 100 fpm**). Such measurements should be made by using a properly calibrated thermoanemometer or velometer. If one is not available, hang a strip of tissue paper about 1 inch wide and 3 inches long from the bottom of the sash; at the proper face velocity, it will be gently deflected into the hood*. Corrective action should be taken as soon as possible when the face velocity is found to be deficient.

11. Surveys in In-Hospital Unrestricted Areas

Unrestricted areas should be surveyed periodically to ensure that radiation and radioactive material are adequately confined in restricted areas. Surface contamination surveys (e.g., random smear testing of floors) and radiation surveys should be performed and recorded **quarterly** or more frequently (e.g., daily or weekly) if contamination is found or exposures occur.

* **Reference:** USNRC Regulatory Guide 10.8, "Guide for the Preparation of Applications for Medical Use Programs", August 1987 (Rev. 2).

12. Surveillance

1. Surveillance by Individual Performing Surveys

Observations of radiological working conditions in restricted areas made by the person who performs the routine radiation and contamination surveys is necessary for radiation safety personnel to: a) identify ways of preventing or minimizing occupational exposures, b) select appropriate times for making radiation safety measurements, and c) adequately prepare for emergency conditions.

2. Regular Inventory of Radioactive Material, Audit of Procedures, and Instruction of Personnel

The surveillance program includes:

- a. Regular inventory of radioactive materials and their locations;
- b. Frequent audits of radiation safety procedures and the uses and amounts of material in process compared to licensed possession limits; and
- c. Discussions with personnel to ensure their continued awareness of safety procedures and the appropriateness of their instruction and training for the tasks they are performing.

B. FREQUENCY OF SURVEYS

The frequency of routine surveys depends on the nature, quantity, and use of radioactive materials, as well as the specific protective facilities, equipment, and procedures that are designed to protect the worker from external and internal exposure. The minimum frequencies of routine surveys are given in **Table 1**.

Surveys should be performed during the following occasions:

- a. Before radioactive materials are used in a new procedure and area in order to establish a baseline of background radiation levels and radioactivity from natural sources, including structural components of the facility, and any already existing operations with radiation sources in nearby rooms or facilities;
- b. After routine procedures begin with normal levels of radioactive material and with potentially exposed persons present and carrying out their functions;

- c. After significant changes in the quantities of radioactive material handled or in the quantities present at any one time;
- d. After changes in protective equipment or procedures.

C. RECORDS OF SURVEYS

Survey records should be preserved for **2 years**, except that records of air monitoring and (in the absence of personnel monitoring data) records of surveys to determine external radiation dose are to be maintained until PNRI authorizes their disposal. Records may be maintained in logbooks or on special forms as long as they are clear, legible, understandable, and authenticated by authorized personnel.

Record of dose rates and contamination survey results must include the following information:

- a. The date of survey, area surveyed, and equipment used;
- b. The name or initials of the person who made the survey;
- c. A drawing of the areas surveyed with contamination and dose rate action levels as established by the RHSO;
- d. Measured dose rates or contamination levels;
- e. Actions taken in the case of excessive dose rates or contamination.

TABLE 1. SURVEY FREQUENCIES

1. All radiopharmaceuticals elution, preparation, and administration areas should be surveyed **daily** with a survey meter and decontaminated if necessary.
2. Radiopharmaceutical storage and radiopharmaceutical waste storage areas should be surveyed **weekly** with a radiation detection survey meter.
3. Laboratory areas where only small quantities of radioactive material (**less than 8×10^6 Bq (200 μ Ci)** at any one time) are used should be surveyed **monthly**.
4. Sealed source and brachytherapy storage areas should be surveyed **quarterly** with a radiation measurement survey meter.
5. The **weekly and monthly** surveys should consist of the following:
 - a. A measurement of radiation levels with a survey meter sufficiently sensitive to detect **1 μ Sv (0.1 mR) per hour**;
 - b. A series of smear tests to measure contamination levels. The method for performing smear tests should be sufficiently sensitive to detect the limits in **Table 2** to one significant digit.
 - c. Any air sample measurements necessary in cases where calculations alone are not sufficient.

References: USNRC Regulatory Guide 10.8, "Guide for the Preparation of Applications for Medical Use Programs", Appendix N, August 1987 (Rev.2).

USNRC Regulatory Guide 8.23, "Radiation Safety Surveys at Medical Institutions". 1981

**TABLE 2. LIMITS FOR REMOVABLE SURFACE CONTAMINATION
IN MEDICAL INSTITUTIONS***

Type of Surface	Type of Radioactive Material**		
	Alpha Emitters Bq/cm ² (μCi/cm ²)	Beta or X-ray Emitters Bq/cm ² (μCi/cm ²)	Low-Risk Beta or X-ray Emitters Bq/cm ² (μCi/cm ²)
Unrestricted areas	0.004 (10 ⁻⁷)	0.04 (10 ⁻⁶)	0.4 (10 ⁻⁵)
Restricted areas	0.04 (10 ⁻⁶)	0.4 (10 ⁻⁵)	4.0 (10 ⁻⁴)
Personal clothing worn outside restricted areas	0.004 (10 ⁻⁷)	0.04 (10 ⁻⁶)	0.4 (10 ⁻⁵)
Protective clothing worn only in restricted areas	0.04 (10 ⁻⁶)	0.4 (10 ⁻⁵)	4.0 (10 ⁻⁴)
Skin	0.04 (10 ⁻⁶)	0.4 (10 ⁻⁶)	0.4 (10 ⁻⁵)

* Averaging is acceptable over inanimate areas of up to 300 cm² or, for floors, walls, and ceiling, 100 cm². Averaging is also acceptable over 100 cm² for skin or, for the hands, over the whole area of the hand, nominally 300 cm².

** Beta or x-ray emitter values are applicable for all beta or x-ray emitters other than those considered low risk. Low-risk nuclide include C-14, H-3, S-35, Tc-99m, and others whose beta energies are <0.2 MeV maximum, whose gamma or x-ray emission is less than 0.1 R/h at 1 meter per curie, and whose permissible concentration in air is greater than 10⁻⁶ μCi/ml.

Reference: USNRC Regulatory Guide 8.23, "Radiation Safety Surveys at Medical Institutions", 1981.

ATTACHMENT 2

Test for Non-Fixed Radioactive Contamination

The level of non-fixed contamination, i.e. contamination which can be removed from a surface by wiping with a dry smear, may be determined by wiping an area of 300 cm² of the surface concerned (or the total surface area if less than 300 cm²) by hand with a filter paper, or a wad of dry cotton wool, or any other material of this nature. When large surface areas are involved, the number of smear samples taken and the places where they are taken should be such as to ensure a reasonable representative assessment of the contamination of the whole surface. The dry smear, by removing a certain activity from the contaminated surfaces, gives a practical means of detecting the contamination on large packages such as flasks for irradiated fuel.

The problem would be to determine the ratio between the activity removed by the smear and the initial non-fixed contamination. Experience has shown that a ratio of 10% is reasonable. However, for contamination which is readily removable, it is likely that more than 10% will be removed. This ensures that measurements will be pessimistic. This ratio does not take into account the efficiency of counting instruments required to convert counts into disintegrations per second for the evaluation of surface contamination in $\mu\text{Ci}/\text{cm}^2$. Such efficiency depends on the type of instrument and the energy of the radiation.

It is recommended that users develop specific contamination measurement techniques for use on their own establishments. Such techniques include the use of smears and contamination survey instruments appropriate to their own circumstances. The instruments and detectors selected should take into account the likely isotopes to be measured. Particular care is necessary in selecting instruments of appropriate energy dependence when low-energy-or-emitters are present. It is likely that the efficiency of measurement of a particular detector will have to be determined by using standard sources of contamination. It must be recognized that the size of the smear and the size of the sensitive area of the detector are very important factors in determining overall efficiency.

Reference: IAEA Safety Series No. 37, Advisory Material for the Application of the IAEA Transport Regulations, 1982. **Republic of the Philippines**
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