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NLRSD BULLETIN NO. 89- 05 **USE OF SURVEY METER IN RADIOPHARMACEUTICALS**

A. ADDRESSEES

All licensees using radioactive material for use in radio- pharmaceuticals.

B. PURPOSE

This Bulletin is issued to reiterate requirements in the regulations that a licensee shall assure that sufficient calibrated and operable radiation survey instruments to carry out the radiation surveys required by the PNRI regulations and the conditions of his license are available and functioning properly while operations are being carried out under his license.

C. DESCRIPTION OF CIRCUMSTANCES

One of the requirements in the issuance of PNRI license for the use of radioactive materials in nuclear medicine is the possession and proper use of the correct type of survey meters. Survey meters are used to determine radiation dose rates on different occasions and in specific areas in the nuclear medicine facility. It is therefore imperative that licensees in the nuclear medicine field shall provide the appropriate survey meters.

Results of regulatory inspections and audits conducted by PNRI this year revealed that out of 28 licensed nuclear medicine facilities, 27 possessed one or more survey instruments and one was renting from PNRI. Out of 36 survey meters accounted for by the 27 facilities, 1 was found inoperable while 12 were not calibrated at the prescribed interval. Only 5 facilities possessed the required types of survey instrument; the rest possessed either a detection survey meter or a measurement survey meter only.

D. DISCUSSIONS

To ensure the safety from unnecessary exposure of the patients, technicians, other hospital personnel and the public at large, the licensee is required by the regulations to conduct dose rate measurements inside the laboratory and treatment room and in adjacent areas on different occasions such as:

a) Receiving and opening of packages;

b) During emergencies, i.e. spillage;

c) During storage of radiopharmaceuticals;

d) During dispensing of radiopharmaceuticals;

e) During administration of radiopharmaceuticals;

f) During waste storage and disposal;

g) Before release of patients containing radio- pharmaceuticals;

h) Before release of room for use of next patient.

In (a), the package containing radioactive materials should be monitored as soon as possible after receipt for radiation levels outside the package, i.e., at package surface and at one meter away.

In (b), in case of radioactive material spills, survey the affected area to delineate the boundaries. Use a detection survey meter to monitor the progress of the decontamination procedures.

In (c), a survey must be made with a radiation measurement survey instrument at least once a week in all areas where radiopharmaceuticals are stored.

In (d) and (e), a survey must be made with a radiation detection instrument at the end of each day of use in all areas where radioactive materials were dispensed and administered to pinpoint contaminated areas. Promptly after the administration of the dosage, measure the dose rates in contiguous controlled and unrestricted areas with a radiation measurement survey instrument.

In (f), monitor the radiation level in solid materials before disposal as ordinary trash with a radiation detection survey meter to determine that their radiation level cannot be distinguished from the natural background radiation level. Monitor materials and items removed from the patient's room also to determine if decay in storage is required before disposal.

In (g), any patient administered a radiopharmaceutical may not be released from confinement for medical care unless the activity in the patient is less than 15 millicurie or until the dose rate from the patient as determined with a radiation measurement survey instrument is less than 25 uSv/h (2.5 mrem/h) at a distance of one meter.

In (h), survey the patient's room and private sanitary facility for contamination with a radiation detection survey instrument before assigning another patient to the

room. The room must not be reassigned until removable contamination is less than 0.04 Bq/cm^2 (720 disintegrations per minute per 300 square centimeters).

Possession of Survey Instruments

A licensee authorized to use radiopharmaceuticals for uptake, dilution, and excretion studies shall have in its possession a portable radiation detection survey instrument capable of detecting dose rates over the range 0.001 to 1 mSv/h (0.1 to 100 mr/h).

A licensee authorized to use radioactive material for imaging, localization studies and radiopharmaceutical therapy shall have in its possession a portable radiation detection survey instrument capable of detecting dose rates over the range 0.001 to 1 mSv/h (0.1 to 100 mr/h), and a portable radiation measurement survey instrument capable of measuring dose rates over the range 0.01 to 10 mSv/h (1 to 1000 mr/h).

An ideal survey meter would be portable, rugged, sensitive, simple in construction and reliable. All these features may not be available in any one instrument, but there are many that have most of them. The most common survey instruments used are of the ion chamber and GM types.

1. Characteristics of Survey Instruments

Geiger-Mueller (GM) Instrument

The survey instrument using a GM tube as a probe is extremely sensitive. It can detect alpha and beta particles when fitted with a very thin "window". Such counter is efficient for beta particle counting but less efficient for gamma radiation. This instrument does not give uniform response for different energies and is accurate only for the type of radiation for which it is calibrated. For example, if it were calibrated for Co-60, it will not be reliable for I-131.

Moreover, the GM counters respond to the number of ionizing events within them and give no information about the energy associated with the events. Therefore, they do not respond with equal count rates to equal exposure rates from photons of different energies. They are generally used only for detection rather than measurement. GM counters are used in surveys for detection of x- and gamma-ray fields. This generally limits their use to exposure rates in the range from background up to a few mR/h.

An undesirable feature of the GM instrument is that it can become "saturated" in a field of high intensity radiation. The result is that it will read zero when placed very close to a source of radiation, which gives a false sense of security to the user at the point where the danger is greatest. GM instruments are generally of the low-range type of survey meters.

Ionization Chamber (IC) Instrument

Unlike the GM, this type of instrument does not become saturated in a field of high intensity radiation. Before using a survey meter of this type, precautions must be taken to ensure that the value indicated is the correct one. It should be allowed to "warm up", the meter adjusted to zero, and the scale selector switch checked before reading radiation dose rates.

The ionization chamber instrument can operate at relatively low voltages, which makes it particularly useful in places where atmospheric conditions are subject to large variations. This coupled with the robustness of the instrument and the fact that it can be powered by batteries, makes it particularly versatile as a portable instrument.

The IC instrument is more accurate than the GM, hence it is commonly referred to as a measurement instrument. Most of the gamma ray exposure rate measurements are made with small ionization chambers.

2. Calibration and Check of Survey Instruments

Since the characteristics of individual components cause variations in instrument response, it becomes necessary to calibrate each instrument for the intended use periodically. For use in radiopharmaceuticals, survey meters must be calibrated annually and after every repair.

Calibration certificates generally include the calibration factor for each scale or decade for deviations of 10% or less from true value or if deviation from the true value is greater than 10% but not more than 20%, a plot on a graph paper of the meter readings against the calculated intensities. With this calibration factor or curve, the user determines the "true" radiation intensity, which is the dose rate to be recorded as required by the regulations. The orientation of the instrument with respect to the source is also in the certificate. Another important information found in the calibration certificate is the dose rate from a dedicated check source. The value is obtained right after the calibration procedure and is used to check for proper working condition of the instrument. Survey instruments must be checked for proper operation with the dedicated check source each day of use.

3. Maintenance and Care

The survey meter is a delicate instrument and should be treated with care at all times. It can prevent unnecessary exposure of the user only when in proper working condition and if used correctly. Before use, all survey meters should be checked by the user to ensure that:

1. There are no physical defects;

2. Batteries are not weak;

3. The instrument is in proper working condition. If the survey meter is not

in a proper working condition, it cannot be used to meet a regulatory requirement because there is no assurance that it accomplished the task for which it was used.

4. Correct Use of Survey Instruments

Some considerations to be observed in order to ensure correct use of survey instruments:

1. Allow the instrument to warm up;

2. Ensure that the power supply is not weak;

3. Use the operational check source to verify instrument operability and check the constancy of its calibration;

4. Use the instrument in the same orientation as when it was calibrated;

5. Adjust the window to OPEN or CLOSE as when it was calibrated;

6. For work in low-energy radiation field, use an instrument which was calibrated with low-energy standard source;

7. Always convert instrument readings to their true values, using the appropriate calibration factor for the meter scale used.

E. REQUIRED LICENSEE ACTIONS

In response to this Bulletin, licensees shall:

1. Submit a listing of survey instruments including the detector type (i.e. ionization chamber, Geiger-Mueller (GM), scintillation, etc.), exposure range, name of manufacturer, model number and serial number;
2. Reiterate commitments to:

    a. Calibrate the survey instruments before first use, annually, and following repair;

    b. Maintain a record of each survey instrument calibration report for two years;

    c. To maintain records of surveys as required in the regulations.

3. Submit survey procedures for the different occasions enumerated in **C. Description of Circumstances;**

4. In case licensee does not have the required survey instrument, specify

the time frame for compliance.

F. COMPLIANCE SCHEDULE

Licensees shall inform the Institute of the actions taken to comply with this Bulletin within 60 calendar days after receipt hereof.

26 September 1989

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