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NRLSD BULLETIN NO. 89-06

**USE OF SURVEY METERS
IN TELETHERAPY**

A. ADDRESSEES

All licensees of teletherapy units for medical use.

B. PURPOSE

This Bulletin is issued to reiterate requirements in the regulations that a licensee shall assure that sufficient operable and calibrated 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 a PNRI license for the use of sealed radioactive materials in teletherapy is the possession and proper use of the correct type of survey meter. A survey meter is used to determine radiation dose rates on the teletherapy unit itself, inside the treatment room and in areas surrounding the facility.

Recent regulatory inspections and audits conducted by PNRI revealed that out of the 10 teletherapy licensees, two have survey meters of their own but only one is operable and calibrated. The other eight licensees do not have their own survey meter; but two of them are borrowing the survey instruments of their respective Nuclear Medicine Departments.

In view of these findings, the Licensing Review and Evaluation Section required those licensees without survey instruments to submit their procurement program to comply with the regulatory requirement on possession of a survey instrument.

D. DISCUSSIONS

It is the responsibility of the licensee of a teletherapy facility to ensure the safety from unnecessary exposure of the patients, technicians and other hospital personnel, and the public at large. To ensure continued radiation safety in his facility, the licensee is required by the regulations to conduct dose rate measurements on the unit itself, inside the treatment room and in areas surrounding the facility on different occasions such as:

- a) Each time the teletherapy source is replaced or changes are made in the mode of use of the teletherapy unit that could increase radiation levels;
- b) After each repair or maintenance of the unit that involves the source drawer, shutter, or collimator that could partially expose the source;
- c) After each transfer of the unit to another location;
- d) During leak tests of the source; and
- e) During any malfunction of the source mechanism that may result in an exposed or partially exposed source, if the permanently installed area radiation monitor is inoperable.

In (a), (b) and (c), radiation surveys shall be conducted on the teletherapy source housing, with the source in the "off" position whereby the maximum and average dose rates at 1 meter from the source shall not exceed 10 mR/hr and 2 mR/hr, respectively. The dose rates outside the facility shall not be greater than 2 mR/hr when the source is in the "on" position.

In (d), safety precautions such as ensuring that the shutter is properly in place when swipe samples are taken from selected accessible surfaces of the teletherapy head, and that the activity in the swipes can be safely handled are observed. The selected accessible surfaces for swipe tests should be those surfaces on which one might expect contamination to accumulate if there were to be leakage and shall include the inner surfaces of the most frequently used treatment cones or beam collimating device.

In (e), if the permanently installed area radiation monitor is inoperable, use a portable survey instrument (or audible alarm personal dosimeter) to monitor for any malfunction of the source mechanism that may result in an exposed or partially exposed source.

Possession of Survey Instruments

A licensee authorized to use radioactive material in a teletherapy unit shall have in its possession a portable radiation measurement survey instrument capable of measuring dose rates over the range 0 millirem per hour to 1,000 millirem per hour.

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 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 and is commonly referred to as a detection survey instrument. 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 close to the source of high intensity radiation. This 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 position 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 fact that the instrument is robust and 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 teletherapy, survey meters must be calibrated at intervals of no longer than six months. Survey instruments must be checked for proper operation with the dedicated check source each day of use.

Calibration certificates generally include the following:

- a) Calibration factor for each scale or decade for deviations of 10% or less from true value or if greater than 10% but not more than 20%;
- b) A plot on a graph paper of the meter readings against the calculated intensities. With this calibration curve, the user determines the "true" radiation intensity which is the dose rate to be recorded as required by the regulations;
- c) The orientation of the instrument with respect to the source;
- d) 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;

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:

- a) There are no physical defects;
- b) Batteries are not weak;
- c) The instrument is in proper working condition. If the survey meter is not in proper working condition, it cannot be used to meet a regulatory requirement because there is no assurance that it will accomplish the task for which it will be used.

4. Correct use of Survey Instruments

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

- a) Allow the instrument to warm up;
- b) Ensure that the power supply is not weak;

- c) Use the dedicated operational check source to verify instrument operability and check the constancy of its calibration;
- d) Use the instrument in the same orientation as when it was calibrated;
- e) Adjust the window to OPEN or CLOSE as when it was calibrated;
- f) For work in low-energy radiation field, use an instrument which was calibrated with low-energy standard source;
- g) 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:

- a) Submit a listing of survey instruments including the detector type (i.e. IC, GM, scintillation, etc.), exposure range, name of manufacturer, model number and serial number.
- b) Reiterate commitments to:
 - 1. Calibrate the survey instruments before first use, semi-annually and following repair and maintain the certificate of each survey instrument calibration for two years;
 - 2. Perform a radiation survey and to submit a survey report each time the teletherapy source is replaced or whenever any changes are made in the shielding, location, or mode of use of the teletherapy unit that could affect radiation levels in surrounding areas;
 - 3. Conduct radiation survey after maintenance or repair of the teletherapy unit that involves work on the source drawer, the shutter, or other mechanisms that could expose the source, reduce the shielding around the source, or compromise the safety of the unit and result in increased radiation levels inside the room and adjacent areas;
 - 4. Use a survey instrument or audible alarm personal dosimeter to monitor for any malfunction of the source mechanism that may result in an exposed or partially exposed source, if the area radiation monitor is inoperable.
- c) Submit for approval procedures for performing periodic radiation surveys

on different occasions as enumerated in **C. Description of Circumstances.**

F. COMPLIANCE SCHEDULE

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

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