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PHILIPPINE NUCLEAR RESEARCH INSTITUTE
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NRLSD BULLETIN NO. SDS 91-01

**USE OF SURVEY METER IN
INDUSTRIAL RADIOGRAPHY**

A. ADDRESSEES

All licensees engaged in the use of radiographic exposure devices for industrial radiography.

B. PURPOSE

This bulletin is issued to reiterate requirements in the **PNRI regulations, Sections 15(g) and 15(i) of CPR Part 2, and Section 8 of CPR Part 11**, that licensees shall assure that sufficient calibrated and operable radiation survey instruments are available and functioning properly while operations are being carried out under his license.

C. DESCRIPTION OF CIRCUMSTANCES (OCCASIONS OF SURVEY)

The licensee of a radiographic facility* is required by the regulations to conduct dose rate measurements in order to ensure the safety from unnecessary exposure of the personnel and the public. In general, a survey shall be performed each time a source is manipulated or moved. Surveys shall be conducted in such occasions as:

1. Determination after each exposure that the source has returned to the safe storage position (i.e., shielded position). The entire circumference of the radiographic device must be surveyed. If the radiographic exposure device has a source guide tube, the survey must include the guide tube.
 2. Determination of the boundary of the restricted area.
 3. Determination of radiation levels at external surfaces of storage facilities **(permanent installations)**.
 4. Determination of radiation levels in and around vehicles used for transporting or storing sources and devices.
 5. Determination that the source is in a safe storage position after securing the locking mechanism of the radiographic exposure device (completion of day's work).
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* Refers to permanent radiographic installation or field radiography (see **CPR Part 11**).

6. Determination that containers prepared for shipment comply with the requirements of **CPR Part 4, "Rules and Regulations for Safe Transport of Radioactive Materials in the Philippines"**.
7. During leak testing.
8. During any malfunction of the source exposure mechanism that may result in an exposed or partially exposed source (e.g., stuck-up source in the guide tube due to frayed drive cable, detached source).
9. Monitoring of the storage area in field radiography.
10. During source replacement.

In items 1, 6, 7 and 10, radiation surveys shall be conducted on the radiographic exposure device or camera. The camera shall have no radiation level in excess of 2 mSv/h (200 mrem/h) at any surface (contact) and 0.1 mSv/h (10 mrem/h) at one (1) meter from any surface.

In item 2, radiation survey shall be conducted at the boundary of the cordoned (**roped off**) working areas to verify the actual radiation levels with the source in the unshielded (**i.e. "on"**) position.

In items 3, 4 and 9, radiation surveys shall be conducted from the external surface of the storage facility or vehicle. The dose rates shall not be greater than 0.02 mSv/h (2 mrem/h).

In item 7, ensure that the source is in its safe position and the activity in the swipes can be safely handled.

In item 8, use a survey instrument to pinpoint the location of the source in the guide tube.

D. DISCUSSIONS

A licensee authorized to use radioactive material in a radiographic facility shall have in its possession a portable radiation measurement survey instrument capable of measuring dose rates over the range **0.01 mSv/h (1 mrem/h) to 10 mSv/h (1,000 mrem/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 instruments that have most of them. The most common survey instruments use ion chamber and GM type probes.

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**". 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 Ir-192, it will not be reliable for Co-60. Moreover, the GM counters respond to the number of ionizing events within them but give no information about the energy associated with the events. Therefore, they do not respond with equal count rates or equal exposure rates from photons of different energies. They are generally used only for detection rather than measurement. This limits their use to exposure rates in the range from background up to a few mSv/h (mrem/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 a source of high intensity 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 position checked before reading radiation dose rates.

The ionization chamber instrument can operate 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 using 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 radiography, survey meters must be calibrated, regardless of whether it has been used, at **intervals of no longer than three (3) months and after each instrument servicing and/or repair.**

Calibration certificates generally include the **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%,** a plot on a graph paper of the meter readings against the calculated intensities. With the 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 calibration source is also indicated in the certificate. Another important information found in the calibration certificate is the dose rate from a dedicated check source which 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 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:

- a. There are no physical defects;
- b. Batteries are not weak;
- c. The instrument is in proper working condition;
- d. All appropriate accessories are complete.

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 battery power supply is not weak;

- c. Use the operational check source to verify instrument operability and check the constancy of its calibration;
- d. Use the instrument in the same orientation of the probe (detector) with respect to the source as when it was calibrated, i.e., perpendicular or parallel;
- e. Adjust the window to **OPEN** or **CLOSE** position as when it was calibrated;
- f. For work in low-energy radiation field, use an instrument which was calibrated with low-energy standard source, e.g., Cs-137;
- 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:

1. Submit a listing of survey instruments including the detector type (i.e. ionization chamber, Geiger-Mueller (GM), etc.), exposure range, name of manufacturer, model number and serial number, last date of calibration and status (defective or operable, under repair).
2. Reiterate commitments to:
 - a. Calibrate the survey instruments before first use, quarterly, and following repair, and maintain the calibration certificate of each survey instrument for two years;
 - b. Perform a radiation survey each time the radiographic source is replaced or returned to its shielded position after every exposure or whenever any changes are made in the location of radiography source or mode of use that could affect radiation levels in surrounding areas;
 - c. If the radiation monitor is inoperable, use a survey instrument or audible alarm personal dosimeter in a permanent installation to monitor, for instance, any malfunction of the source exposure mechanism that may result in an exposed or partially exposed source.
3. Submit for approval procedures for performing periodic radiation surveys on

different occasions such as those 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.

April 11, 1991

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REFERENCES

1. Bulletin : **Use of Survey Meter in Teletherapy.**
2. CPR Part 11: **Licenses For Industrial Radiography and Radiation Safety Requirements For Radiographic Operations.**
3. **Nondestructive Testing Handbook, Volume 1**, Robert C. McMaster, 1959 edition.
4. Draft Regulatory Guide: **Guide for the Preparation of Applications for Use of Sealed Sources and Devices for Performing Industrial Radiography.**
5. CPR Part 2: **Licensing of Radioactive Material**