

12. CALIBRATION OF DOSEMETERS AND SURVEY INSTRUMENTS FOR PHOTON

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I. Introduction:

The protection of radiation workers from the hazards of ionizing radiation has always been a primary concern of the Philippine Nuclear Research Institute (PNRI), the country's regulatory agency. The PNRI through its Radiation Protection Unit of the Nuclear Regulations Licensing and Safeguard Division provides calibration services of nuclear instruments used by radiation workers from various institutions as part of its radiation protection program.

Periodic calibration and standardization of radiation and protection survey instruments are done to insure correct/valid radiation readings. It is also a regulatory requirement for radiation workers to use only operable and pre-calibrated survey instruments in their work with radioactive materials.

II. The Calibration Facility

The PNRI maintains and operates a Secondary Standard Dosimetry Laboratory (SSDL) which is available to provide periodic calibration and standardization of radiation monitoring and protection survey instruments used by radiation workers in the country. The SSDL also provides radiological hazards and performance evaluation surveys of radiotherapy facilities, nuclear medicine centers, RI Laboratories and similar facilities.

The laboratory uses a Nuclear Enterprises IONEX 2300, with NE 2303 30 cc ionization chamber as a standard measuring equipment for protection level photon dose, and NE 2560 NPL Secondary Therapy Level X-Ray Exposure Meter with NE 2561 ionization chamber for therapy level.

For the calibration of survey instruments, standard sources of Cs-137 and Co-60 are used.

III. Calibration Procedure

A. For Survey Meters

The laboratory uses a fixed source-to-detector distance variable-dose rate method. Upon receipt of survey meters, operational checks such as battery check, radiation response

and zero check are done.

In instruments with theoretical dose rate values of 400, 200, 100, 80, 60, 40, 20, 10, 8, 6 mR/hr, the exposure distance is computed using the inverse square law:

$$I_1 d_1^2 = I_2 d_2^2$$

The survey meter is then exposed at computed distances and actual exposure dose rate readings are recorded. From the readings taken, the Calibration Factor (C.F.) is computed. Acceptable limit ranges from 0.8 to 1.2. Survey instruments with C.F. not within the acceptable limits are sent to the Electronic Units for further evaluation and repair.

$$C.F. = \frac{\text{Theoretical Reading}}{\text{Observed Value}}$$

The calibration frequency for survey meters is on an annually or quarterly (Once in three months) basis depending upon the user's regulatory requirements.

B. For Pocket Dosimeters

Using the appropriate charging device, the dosimeter is charged to zero. At a fixed distance from the standard source, the dosimeter is exposed at varying exposure times (15, 30 minutes). The dosimeter is arranged in such a way that the longitudinal axis is perpendicular with the source axis.

The acceptable limit is from 0.70 to 1.30.

The calibration frequency for pocket dosimeters is on an annually or semi-annually basis also depending upon the user's regulatory requirements.

IV. Clients Served

Calibration Services of PNRI caters to various institutions in the country classified into medical (hospitals and individual physicians), industrial, research, and commercial. Instruments calibrated includes survey meters and pocket dosimeters. Manufacturing brands of such instruments are as follows: for survey meters - Victoreen, Dosimeter, NDS Product, Anders, Eberline, Wallac, Nuclear Chicago and Nuclear Enterprise, for pocket dosimeter- Victoreen, Dosimeter, and PHY.

A summary of PNRI licences and instruments calibrated are shown in Table 1 and Table 2 below

Table 1 Number of PNRI Licensees as of October 1994

Classification	Number
Commercial	36
Hospital/Medical Facilities	62
Industrial Radiography	28
Medical Specialist(Individual Physicians)	10
Industry (Installed Gauges)	109
Research	27
Total	272

Table 2 Number of Instruments Calibrated as of 1993

Instruments Calibrated	378
Institution Served	135

V. Personnel Dosimetry

The national film badge service of the PNRI, established in 1963, provides monitoring services not only to PNRI employees and licensees but also to medical facilities/users registered with the (RHS) Radiation Health Service of the Department of Health. The standard AERE/RPS film badge is used by PNRI national film service for personnel monitoring. It is now envisioned by PNRI that in the first quarter of 1995 the film badge monitoring will be replaced over to TLD. Until such time, the film badge will remain as the single personnel dosimeter of choice in view of economic reconsideration and relatively simple instrumentation used in dose estimation.

Exposure Dose Limits Of Radiation Workers

In accordance with the ALARA principle, the following levels of exposure doses are promulgated and adapted by the PNRI.

1. Regulatory Limit - 4mSv/month
2. Reporting Limit - 2mSV/month
3. Operating Limit - 1mSV/month

The regulatory limit of 4 mSv/month is based on ICRP recommendations computed from 50 mSv/year at 2000 hours/year, rounded to the nearest whole number. The Reporting Limit of 2 mSv/month is based on the PNRI Safety Committee recommendation of

50% of the Regulatory Limit which, when exceeded, warrants an examination of the situation to preclude unnecessary exposure in the future. The Operating Limit of 1 mSv/month is based on the ALARA principle and shall be closely adhered to by radiation workers in the course of normal work and is set at 25% of the Regulatory Limit by the PNRI Safety Committee.

Dose Distribution

The annual gamma dose equivalents distribution of a total of 2145 workers monitored in 1993 are shown in Table 3.

Dose Ranges	Number of Radiation Workers	Percentage %
< 2 mSv	2070	96.5
< 5 mSv	40	1.87
< 10 mSv	20	0.98
< 20 mSv	12	0.56
< 40 mSv	2	0.09

VI. Application of ICRU Operational Quantities:

The radiation unit for personnel monitoring is now in Sv units while for area monitoring it is still in R and R/hr units. However PNRI is now in the process of implementing the new ICRU operation unit for area monitoring of radiation fields.

VII. Problems Encountered/Recommendations

There is a need to upgrade the SSDL in terms of its physical structure, installation of additional equipment, standard sources, safety devices for the safety and convenience of the personnel performing calibration and to efficiently cater to the increasing number of instruments submitted by clients.

The SSDL Staff needs further training and experience in the field of dosimetry and maintenance and repair of instruments.

Financial support from the government is urgently needed for the upgrading of the building and in the acquisition of additional equipment and standard sources and for the maintenance of the laboratory.