5. ACTIVITIES ON CALIBRATION OF RADIATION PROTECTION INSTRUMENTS IN INDONESIA

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INTRODUCTION

As the use of ionizing radiation emitted by radionuclides or produced by modern machines in Indonesia has increased significantly since the past two decades, demand for radiation protection measures has also grown up very rapidly. Ionizing radiation, mainly alpha, beta, gamma, and netron is a unique one, because until a certain amount it can not be seen or felt by any sensor of human body. But unfortunately it always brings contemporary issues which very easily spread around the world.

In the mind of Indonesian people at the moment, ionizing radiation or sometime also called atomic radiation is always and almost associated with atomic bomb, which could make disaster for human living. Regarding the mentioned condition, Indonesian Government through the Act. No. 31/1964 has set up National Atomic Energy Agency (BATAN) headed by a Director General who is responsible directly to Presiden Republic of Indonesia. BATAN which has responsibility in research & development, implementation, and inspection of safe-use of ionizing radiation for peaceful purposes, always put a great concern on radiation protection matter. Since then the Centre for Standardization and Radiation Safety Research (CSRSR) has been appointed to implement research and services in the field of radiation safety, standardization, dosimetry, radiation health, as well as the application of nuclear technique in medicine.

In order to provide a national reference in term of radiation dosimetry and calibration, by 1984 a Secondary Standard Dosimetry Laboratory was completely set up in Jakarta through a

technical assistance project funded by IAEA. It is so called SSDL Jakarta. Since that time SSDL Jakarta has been recognised as a member of IAEA/WHO SSDLs Network. The laboratory is integrated within the BATAN headquarter and run by the Centre for Standardization and Radiation Safety Research. Through Decree of Director General BATAN No. 79/DJ/V/1984 the Centre has been appointed as National Radiation Calibration Facility.

A further demand for accuracy and precision in radiation dose measurement is always considered by the Centre in order to always maintain and further establish the National Radiation Calibration Facility. Since 1984, our laboratory has actively been involved in international intercomparison of radiotherapy dose conducted by IAEA using TLDs. The deviation of doses stated by our laboratory are always well within the acceptance limit established by IAEA dosimetry laboratory. According to current regulation in Indonesia the Secondary Standard must be calibrated in Primary Standard Dosimetry Laboratory at least once every three year. Based on bilateral international-cooperative work, the instrument so far is routinely calibrated in PSDL-ETL, Japan.

Radiation instruments used to determine radiation output in air, e.g. exposure or kerma rate, must be calibrated against a reference standard instrument. Decree of Director General BATAN No. 78/DJ/V/1984 then further renewed by Decree No. 82/DJ/VI/1991, requests that all radiation protection instruments used within the Republic of Indonesia must be calibrated at least once a year or whenever something suspectious happens by National Radiation Calibration Laboratory or any Local Laboratory. In addition to the National Radiation Calibration Facility at the mean time we are going to set up a Local Calibration Facility for radiation protection purposes in Yogyakarta.

AVAILABLE FACILITIES

In the case of photon calibration of radiation protection instruments, the Centre has been facilitated with a number of radiation sources and instruments which are routinely used for calibration service and research. All equipments are well maintained in air conditioned room at a certain relative humidity.

Radiation Instruments

NPL Dosemeter type 2560 together with chamber detector of 0.325 cc type NE 2561 is currently employed as a Secondary Standard instrument on photon dosimetry for therapy level. In order to establish standard exposures of photon beams used for calibrating radiation protection instruments, we use mainly two dosemeters,

1. Digital Farmer Dosimeter NE 2570 connected to ionization chamber detector of 600 cc NE 2575, and
2. Electrometer ALOKA connected to ionization chamber detector of 400 cc, RIC-DRM.

Measurements are carried out free in air. Standard exposures at various distances from source are tabulated. Values written in the table are used as reference values by technicians when performing calibration of radiation protection instrument, e.g. survey instrument.

Radiation Sources

Our laboratory has been equiped with photon source machines as follow.

1. Gamma calibrator, OB.2, Buchler
   It contains a collimated Co-60 source having original radiation activity of 100 mCi.

2. Gamma calibrator, OB.6, Buchler
   It contains a collimated Cs-137 source having original radiation activity of 1 Ci.
3. Gamma calibrator, OB.34, Buchler
   It contains a number of panoramic sources of Co-60 and Cs-137. (Co-60 : 3.7 MBq, 25.9 MBq, and 370 MBq;
   Cs-137: 7.4 MBq, 74.0 MBq, 740 MBq, and 7.4 GBq).
4. Gamma calibrator, OB.85, Buchler
   It has three radionuclides, Co-60 (37 GBq), Cs-137 (740 GBq), and Ra-226 (1 mg), each housed in its home. When machine operating, the source moves to a fixed position and a collimated gamma beam comes out. This machine is also facilitated with two lead absorbers that can be placed at just outside collimating material. Using those absorbers we can make variation of exposure rate at a certain distance. Exposure rate for Co-60 at one meter distance from source without absorber is around 550 mR/hr and for Cs-137 is around 5200 mR/hr.
5. X-ray machine MG-420, Philips.
   This machine produces X-ray beams in the range from 10 kV upto 420 kV. Originally it is used to facilitate calibration of therapy level instruments, but it is also used for radiation protection purposes.

CALIBRATION AND PERSONAL MONITORING SERVICES

In order to obtain correct reading, every radiation instrument, such as surveymeter, for monitoring area or for other radiation protection purposes must be calibrated routinely. At the moment CSRSR is the only one that provides calibration service for all radiation instruments used in Indonesia. Calibration of radiation protection instrument is carried out free in air, in term of *exposure rate*. Each scale on the instrument is calibrated at three different points, e.g. 30%, 50%, and 80% of maximum reading and calibration factor is given for each corresponding scale.

Demand for calibration of radiation protection instruments has increased continuously from time to time. Requests for calibration usually come from private or industrial companies, research institutes, hospitals, and as well as military institutions. The number of calibration services for the past five years can be seen from table shown below.

Tabel 1. CALIBRATION SERVICES PERFORMED AT THE CENTRE FROM 1989 - 1993

Type of Calibration	Number of Instruments for Year				
	89/90	90/91	91/92	92/93	93/94
1. Radiation Surveymeter	461	458	448	491	616
2. Pocket Dosimeter	274	406	377	474	520
3. Contamination Monitor	43	51	29	50	69
Total	778	915	854	1015	1205

In Indonesia we also have a number of fixed radiation monitors, such as gate monitor, hand & foot monitor, and stack monitor installed in several radiation laboratories. However we still have problem in order to calibrate them in our laboratory.

CSRSR also provides personal monitoring service for radiation workers who work in various industrial sectors, research institutions, and private hospitals. More than 5,000 radiation workers are covered by the personal monitoring serivice conducted by CSRSR using Film and TLD personal monitoring badges. All radiation workers under the National Atomic Energy Agency (BATAN) are covered by a TLD service. The remaining industrial, research and medical institutions are covered by a Film badge service. We produce records of occupational dose received by workers wearing Film badges on a monthly basis. On the other hand for workers wearing TLD badges, we apply a three-monthly periode. In addition

to personal monitoring provided by CSRSR, personal monitoring service for radiation workers in government hospitals are conducted by Ministry of Health using Film badges only.

Calibration of personal dose monitoring is performed free in air using gamma beam of Cs-137. To convert the exposure unit to become air kerma unit we apply:

$1\ R = 2.58 \times 10^{-4}$ C/kg and

W/e = 33.97 J/C.

and therefore the relationship between Exposure and Air Kerma would be:

K_a (Gy) = 8.76×10^{-3} . X (R)

In order to obtain personal dose equivalent, $H_p(10)$ in mSv unit, we assume H'(10) equivalent with $H_p(10)$ and therefore apply a conversion coefficient, $H_p(10)/K_{air}$, of 1.18 Sv/Gy with regarding a correction for backscatter radiation. So far our Centre has not provided personal dose monitoring in term of $H_p(0.07)$ yet.

CONCLUSION

The task of the Centre for Standardization and Radiation Safety Research coincidences with the 2nd IAEA/RCA personal dosimetry programme. We definetely will support the proposed programme that are going to be started by 1995. We would like to be involved and to participate in the next personal dosimetry intercomparison.