KRISS Progress Report to the 21st Meeting of the CCRI(I)

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1. Introduction

Center for Ionizing Radiation of KRISS maintains the Korean standards of air kerma and absorbed dose, and disseminate those standards to the secondary standard dosimetry laboratories (SSDLs) and to end users (mostly hospitals). There are 8 SSDLs in Korea.

5 research scientists and 1.5 technical engineers are working in dosimetry. Among them, 2 research scientists (IJ Kim and BC Kim) and 0.5 engineer (YM Seong) have joined in dosimetry in 2013 and they are working mainly in developing the primary standards of LINAC radiation absorbed dose.

2. Air kerma standards

2.1. low- and medium-energy x-rays

Three x-ray irradiation systems have been newly built and installed. Medium-energy x-ray irradiation system with x-ray tube Comet model MXR-320/26 covers x-rays with energies in a range of 320 kV to 60 kV. Low-energy x-ray irradiation system with x-ray tube Comet model MXR-160/21 is built for x-rays of energies ranging from 10 kV to 60 kV. Mammography x-ray irradiation system with the rtw model MCD 100H-3 Mo anode x-ray tube covers the Mo-anode x-rays. Four high voltage dividers (GE model Spannungsteiler 2.5 GΩ) are used for monitoring the high voltage output of those three X-ray tubes. Granite base precision measurement stages are placed in front of the irradiation systems.

New free-air chambers (FACs) for measuring low- and medium-energy x-ray air kermas have been designed and machined recently. Absolute measurements of air kermas with new FACs are scheduled in 2013 to 2014.

2.2. ^{137}Cs and ^{60}Co gamma-rays

Three newly designed ^{137}Cs gamma-ray irradiation systems are used at KRISS. The nominal activities of the sources loaded to irradiators are 78.1 TBq, 4.8 TBq, 185 GBq, 37 GBq and 1.85 GBq. The granite-base precision stage (Figure 2.(a)) was placed in front of the two irradiation systems of 78.1 TBq and 4.8 TBq sources where the sources are fixed in standstill and beam on-offs are controlled by shutters. The ionization chamber can be positioned in three degrees of freedom with a nominal resolution of 0.001 mm. The comparison of the primary standard of air kerma has been completed successfully in 2010 (BIPM.RI(I)-K5) and the ^{137}Cs air kerma standard are maintained without change.

The KRISS ^{60}Co gamma-ray irradiator is AECL model Eldorado 8, in front of which a granite

base precision stage covering 0.9 m to 1.2 m from the source. The activity of the ^{60}Co source is 145 TBq as of 21-06-2006. The comparison of the primary standard of air kerma has been completed successfully in 2010 (BIPM.RI(I)-K1) and the ^{60}Co air kerma standard are maintained without change. New ^{60}Co irradiation system is scheduled to be designed during 2013 to 2014.

3. Absorbed dose standards

3.1. LINAC x-ray and electron radiation

Construction of a LINAC bunker (Building No. 314) has been completed in September 25, 2012 where a KRISS LINAC (Elekta Synergy Platform) has been installed. The acceptance test and commissioning have been carried out successfully. Several graphite calorimeters will be built during 2013 to 2014 for the absolute measurement of absorbed dose to water from LINAC radiation.

3.2. ^{90}Sr-^{90}Y beta-ray

We have two beta-ray irradiation systems, one for the primary standard and the other for the secondary standard. The primary standard beta-ray irradiation stand was set up on the granite base precision stage. The ^{90}Sr-^{90}Y beta-ray absorbed dose to ICRU tissue standard are maintained without change.

4. Key and supplementary comparisons

4.1. APMP.RI(I)-K1: KRISS piloted the comparison of air kerma standards at ^{60}Co which ran between 2004 and 2006. Ten laboratories participated. The report is now in Draft B stage.

4.2. APMP.RI(I)-K4: KRISS participated in the comparison of absorbed dose to water standards at ^{60}Co which ran during the period between 2009 and 2010. Fourteen laboratories participated. The report is now in Draft A stage.

4.3. APMP.RI(I)-K5: KRISS will pilot the comparison of air kerma standards at ^{137}Cs during the period of 2013 – 2014. The registration form has been submitted to BIPM.

4.4. APMP.RI(I)-S2: KRISS participated in the comparison of absorbed dose to tissue standards from beta-rays. The measurements has been started 2013.

4.5. APMP.RI(I)-S3: KRISS will participate in the comparison of ISO Wide and Narrow Series X-ray beams air kerma. The protocol for the comparison was agreed.

5. Quality system

The CIPM MRA for national measurement standards and calibration and measurement certificates issued by National Metrology Institutes (NMIs) has taken effect since 2005. One of the prerequisites for mutual recognition of calibration and measurement certificates is a proof of the establishment of quality system in conformance with ISO/IEC 17025 or equivalent.

The Korea Research Institute of Standards and Science (KRISS) is the National Metrology Institute of the Republic of Korea and a signatory to the CIPM MRA. KRISS has chosen to self-declare the state of its quality system for calibration and measurement services without third-party accreditation. In order to establish the confidence and transparency required, certification to ISO 9001 has been obtained. This provides objective evidence that the management requirements of the quality system meet international quality standards. A

review by peers from other internationally recognized NMIs is proposed to establish the technical competence of KRISS. The peer review is expected to assess KRISS in accordance to the technical requirements of ISO/IEC 17025.

Quality management system of KRISS has been certified for the calibration and testing services by Korean Foundation for Quality (KFQ) to ISO 9001. The technical competence of the laboratory and its personnel to undertake the specific calibration and testing will be reviewed against the technical requirement of ISO/IEC 17025 through the peer review process in every 5 years.

This peer review is to evaluate the calibration and testing services of KRISS against the technical requirements of the ISO/IEC 17025. The range of operation is taken as, but not limited to, the declaration of Calibration and Measurement Capabilities (CMCs) to be submitted Appendix C of the CIPM MRA.

While the ISO/IEC 17025:2005 will be used as the basis of the review, the special status of KRISS being the National Metrology Institute (NMI) of the Republic of Korea shall be considered. Also the ‘APMP Procedure for CMC entry in Appendix C(APMP-G1)’ and ‘APMP Guidelines for accepting a Quality System(APMP QS-2)’ may be taken into account whenever appropriate.

During April 24 - 26, 2012, KRISS Center for Ionizing Radiation has undergone peer review by Dr. Norio Saito (NMIJ) and Mr. Yang Yuandi (NIM). Four recommendations have been identified in the peer review process and the corrective actions to the recommendations have been submitted to the reviewer and APMP.

6. Publication list (2011-2013)

6.1. Monte Carlo calculation of response functions to gamma-ray point sources for a spherical NaI(Tl) detector, Chul-Young Yi and Suck-Ho Hah, Appl. Rad. Isot. 70 (2012) 2133 - 2136.

6.2. Measurement of national standard β-ray energy spectrum, Chul-Hang Kim, Chul-Young Yi, Hyun-Moon Kim, Suck-Ho Hah, Kook Jin Chun, Progress in Medical Physics 23(4) (2012) 285 – 291 (in Korean).

6.3. Inherent uncertainty of air kerma, Chul-Young Yi, Metrologia 50 (2013) 129 – 132.

6.4 Temperature dependence of cavity ionization chamber response, Chul-Young Yi and Hyun-Moon Kim, Metrologia 50 (2013) 146 – 152.