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Laboratory Report
Institute of Nuclear Energy Research

Section 1: Laboratory Related Matters

The Institute of Nuclear Energy Research (INER) was entrusted by the Bureau of Standards, Metrology and Inspection (BSMI) Ministry of Economic Affairs (MOEA) of Taiwan to establish the National Radiation Standard Laboratory (NRSL) to maintain national standards in the area of ionizing radiation. NRSL/INER has developed 14 measurement standard systems covering the areas of photon, beta, neutron and radionuclides activity and all of them are maintained under the quality system complying with the ISO 17025. The first accreditation of NRSL was granted by TAF (Taiwan Accreditation Foundation) in 2001 and NRSL continued to pass the on-site re-assessments every three to five years and the nearest re-accreditation took place in 2015.

In 2017, the main scientific activities of NRSL/INER were as follows.

1. Constructed the graphite calorimeter: To measure the high-energy photon, electron and proton dose directly, the graphite calorimeter has been constructed since 2011. Currently, the graphite calorimeter for high energy photon was done and we keep studying the graphite calorimeter techniques for the high energy electron and proton dosimetry.
2. Constructed Co-60, Cs-137 and Am-241 irradiation fields in the dose rates of environmental level: New irradiation fields of Co-60 were constructed, whose background dose rate was around 0.01 μSv/h and the strength of the irradiation field was between 0.03 μGy/h and 6 μGy/h; standard uncertainty was between 5.5 % and 0.7 % .
3. Evaluated the shadow effect of free air chamber: Cylindrical free air chamber is the primary standard instrument of air kerma for X-ray in INER. In 2017 we evaluated the shadow effect caused by the electrode of the free air chamber to

improve the accuracy of the instrument. The correction factors between 1.015 and 1 were found for the 300 kVp to 50 kVp X-ray radiation beams.

4. Set air kerma standard for the IEC 61267 RQA X-ray beams: Based on the IEC 61267 RQA Radiation Qualities, 8 X-ray radiation beams whose air Kerma rates standards were set at INER. The energy of the radiation beams was between 50 kVp and 150 kVp and the standard measurement uncertainties were around 0.3 %.
5. Standardized the radionuclide of Mn-54: Mn-54 was standardized and the counting results showed good agreement with PTB's results.
6. Handled proficiency testing programs: In 2017, we handled two proficiency testing programs. The first was the proficiency testing for the passive personal dosimeter based on the TAF-CNLA-T08 Guide. 8 laboratories joined this program. This program has been finished this year and all of them got passed. The final results showed that all of the results tended to have En < 1. The second was the proficiency testing of survey meters. Six laboratories participated in this program and this program will be finished in 2018.

Section 2: CIPM MRA Related Activities

1. Status for Signatory of the MRA

NRSL/INER signed the CIPM MRA on June 4, 2002.

2. Status of Quality Systems

NRSL/INER's quality system complies with ISO/IEC 17025:2005. In 2001, NRSL/INER passed the TAF accreditation after being reviewed by peer reviewers from NMIJ/AIST and ARPANSA. Afterwards, there were TAF on-site peer re-assessments in 2004, 2007, 2010 and 2015. NRSL/INER passed all the TAF accreditation programs and no unconformity was found in 2015.

3. CMCs Submission

NRSL/INER's CMCs Tables comprised of 89 items. Among them, 78 radioactivity standards were entered into Appendix C in February 2005. Seven dosimetry standards and four neutron standards were entered into Appendix C in October 2006.

Section 3: International and Regional Cooperation

1. NRSL/INER piloted the APMP.RI(I)-K3 comparison of air kerma for medium energy X rays and 12 NMIs participated in this comparison . The standard instruments are being circulated among participants from 2015 to 2017.
2. NRSL/INER participated in the APMP.RI(I)-K8 comparison piloted by NMIJ/Japan. 8 NMIs joined this comparison and we will finish the measurement in 2017.
3. NRSL/INER participated in the EURAMET project No. 1398 , EURAMET.RI(I)-S16 - EURAMET supplementary comparison of personal dose equivalent at 0.07 mm and 3 mm depths, Hp(0.07) and Hp(3), for beta radiation. 17 NMIs joined this comparison and we will finish the measurement in 2019.

Section 4: Activities relevant to APMP's "Focus Groups"

[Members are invited to include here any current activities or planned initiatives relevant to the work of the established focus groups: Medical Metrology, Energy Efficiency, Food Safety, Climate Change, and Clean Water.]

High energy proton beam became one of the therapeutical methods of cancer in Taiwan. NRSL/INER planned to measure the absorbed dose rate of proton beams directly by the graphite calorimeter techniques

Section 5: Future Plans, Priorities and the Role of APMP

Future Plans of NRSL/INER

1. Study the graphite calorimeter techniques to measure the absorbed dose of high energy electron beams and high energy proton beams directly.

2. Handle the proficiency testing of passive personnel dosimeter based on the TAF-CNLA-T08 Guide.
3. Standardize the Cr-51 radioactivity.
4. Set the air kerma measurement standard of IEC 61267 RQA X-ray beams.
5. Pilot the APMP.RI(I)-K3 comparison - Air kerma for medium energy X rays.
6. Participate in the APMP.RI(I)-K8 comparison - Reference air kerma rate for HDR Ir-192 brachytherapy sources
7. Participate in the EURAMET project No. 1398, EURAMET.RI(I)-S16,- EURAMET supplementary comparison of personal dose equivalent at 0.07 mm and 3 mm depths, Hp(0.07) and Hp(3), for beta radiation.