Henkilöannosten tarkkailun tulevaisuuden näkymiä

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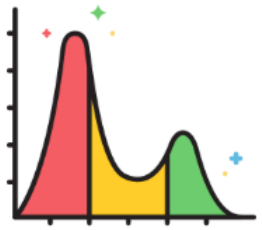
Sisältö

- Henkilöannosten mittaaminen
  - Nykytilanne
  - Tulevaisuus – hybrididosimetrit, spektrodosimetrit, AI, …, muuttuko mikään?
- Annosraja ja suureet henkilödosimetrian näkökulmasta
  - ALARA, LNT, …
  - Efektiivinen annos
  - Uudet mittaussuureet

22NRM07 GuideRadPROS - needs



X-ray spectrometry and ISO 4037 implementation

- Guidance to implement **ISO 4037** series is needed.
- **High voltage** measurements of x-ray units and the associated uncertainty estimates are needed.
- Missing data regarding **Am-241** reference fields is needed.
- Harmonized procedures for traceable **X-ray spectrometry** are needed.

Procedures for type testing standards

- There are standards with **conflicting requirements** for the same type of dosimeter.
- There are standardisation **gaps**, due to recent or upcoming developments in measurement technology (e.g. spectrodosimetry) and new technologies (e.g., machine learning, AI...).
- The standards must be **harmonized**.
- **Future needs** of standardisation must be analysed.

Future needs of standardisation

- **ICRU report 95** proposed new operational quantities to replace the current quantities
- A revision of the **type test standards** is needed.
- A **characterization study** of existing dosimeters is needed to see whether software and/or design modifications are necessary.

GuideRadPROS - objectives

- Develop a traceable, harmonized metrological approach to **x-ray spectrometry** in concordance with the ISO 4037 standard.
- Evaluate discrepancies between measured and calculated **half value layer** of x-ray spectra.
- Produce data to update **requirements** for reference X-ray fields.
- Produce data for **Am-241** reference fields.
- Evaluate methods to determine the x-ray tube **high voltage**

- Develop cost effective procedures and **guidance for the calibration** of dosimeters and determination of their response as a function of photon energy.
- Enable smaller metrology institutes and other calibration laboratories to **implement the ISO 4037** standard series and have access to guidance on new operational quantities of ICRU 95.
- Provide training to emerging metrology institutes.
- Produce open **e-learning materials** on the calibration procedures.

- Provide **guidance** on validated procedures for harmonized **type testing** based on IEC standards for the commonly used dosimeters with valid metrological solutions for situations where requirements in existing standards deviate and standardisation gaps exist.

- To assess **future** standardisation **needs**.
- To produce a **guidance** document for the implementation of the new operational quantities of **ICRU Report 95** into standards and regulations.
- To **disseminate** this to policymakers, manufacturers, regulators, metrology networks, standardisation bodies and laboratories.

EUROPEAN PARTNERSHIP

Co-funded by the European Union

METROLOGY PARTNERSHIP

EURAMET

https://lmri-met.github.io/sites-guideradpros/index.html

stuk

Mittaaminen - nykytila

Vaatimukset mittareille standardeista (ISO: kalibrointiolosuhteet, IEC: suorituskyky)

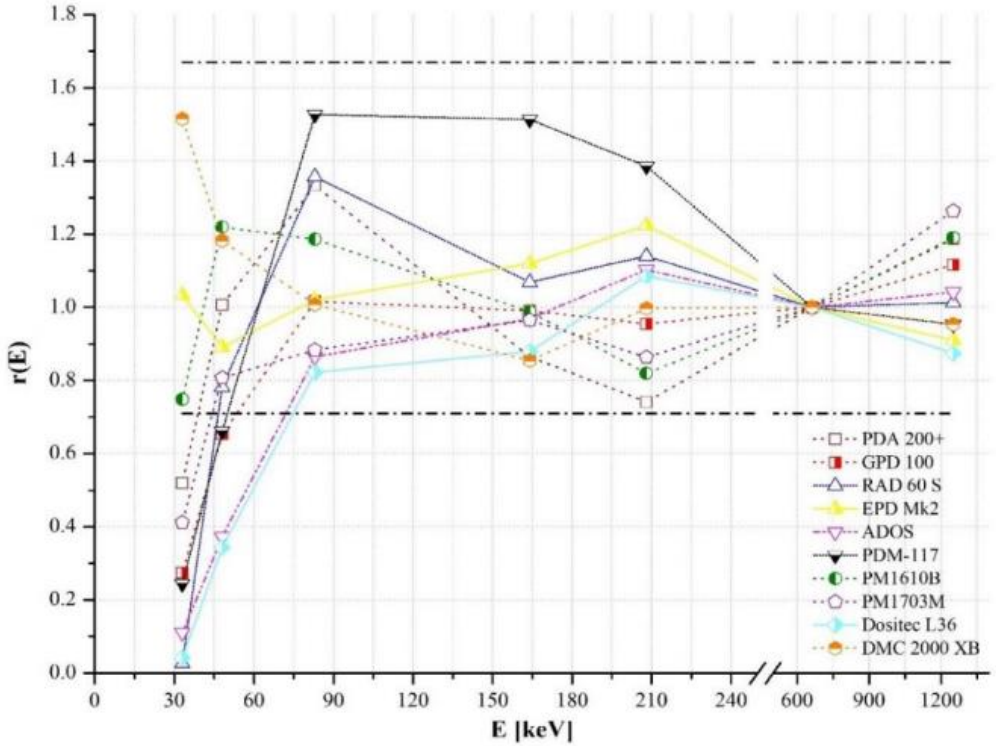


Figure 1-1. Energy dependence of APD response, with IEC 61256:2010 limits of variation in terms of relative energy response normalized to Cs-137 photon energy at 0° angle of incidence (Krzanovic et al., 2017).

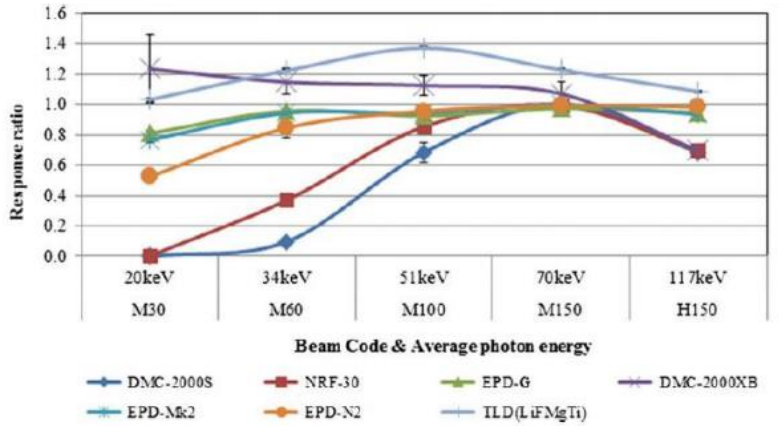


Figure 1-8. Relative energy response of several APDs and TLD normalized to S-Cs with NIST radiation beams (Lee et al., 2016).

Mittaaminen - nykytila

Mittaus → Efektiivinen annos → RIski

Vaatimukset riippuvat käyttökohteesta – milloin on tarpeen pyrkiä äärimmäiseen tarkkuuteen? Tasapainoilu vaatimusten ja riskin välillä

Mittaaminen - tulevaisuus

Spektrodosimetrit – mittaavat säteilyn energiaspektrin annosarvion pohjaksi

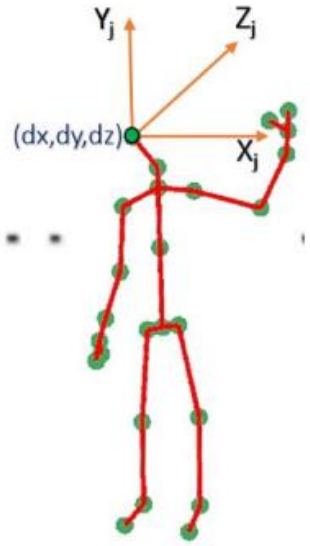
- Useita (passiivisia) ilmaisimia, jotka ovat herkkiä eri energia-alueille
- Puolijohde tai tuikeilmaisin, jolla mitataan energiaspektri

Laskennallinen dosimetria

- Esim. PODIUM-projekti
- Validointi (vrt. lentohenkilöstön annokset)
- Tekoälyn hyödyntäminen, Monte Carlo edelleen kultainen standardi

Tekoäly

- GuideRadPROS: ei odotettavissa nopeaa muutosta
- Kehitys tällä hetkellä enemmän annosarvioalgoritmien ja laskennan puolella



EUROPEAN JOINT PROGRAMME FOR THE INTEGRATION OF RADIATION PROTECTION RESEARCH
CONCERT

PODIUM
Personal Online DosImetry Using computational Methods

31.1.2025 I Ajankohtaista I Kolumni

Hävittääkö tekoäly työpaikkoja? Ei ainakaan toistaiseksi

Kässi Otto

Monet maalailevat kauhukuvia tekoälystä, joka pyyhkii työmarkkinat tyhjiksi ihmisistä. Tuore tutkimuksemme kuitenkin osoittaa, että ChatGPT on vienyt lähinnä muutaman tunnin mittaisia keikkoja – samalla kun uusia työpaikkoja on syntynyt jopa entistä enemmän.

Currently, the use of AI in routine dosimetry is still very limited.

The use of AI for spectral unfolding and in the dose calculation algorithm does not change current practices fundamentally. There are currently also other non-linear algorithms used in the dose calculation.

stuk

LNT-mallin tulevaisuus?

- The NRC utilizes safety models that posit there is no safe threshold of radiation exposure and that harm is directly proportional to the amount of exposure. **Those models lack sound scientific basis and produce irrational results**, such as requiring that nuclear plants protect against radiation below naturally occurring levels. A myopic policy of **minimizing even trivial risks** ignores the reality that substitute forms of energy production also carry risk, such as pollution with potentially deleterious health effects.
- Adopt science-based radiation limits. In particular, **the NRC shall reconsider reliance on the linear no-threshold (LNT) model for radiation exposure** and the "as low as reasonably achievable" standard, which is predicated on LNT. **Those models are flawed**, as discussed in section 1 of this order. In reconsidering those limits, the NRC shall specifically consider adopting determinate radiation limits, and in doing so shall consult with the Department of Defense (DOD), the Department of Energy (DOE), and the Environmental Protection Agency.

Tulevaisuus säteilysuojelusysteemin näkökulmasta

ALARA ja LNT

- Keskustelu mallien soveltuvuudesta
- Alaraja ALARAn soveltamiselle?
- LNT-mallin käyttö
- Eettiset ja sosioekonomiset tarkastelut luonnontieteiden lisäksi
- Utilitarismista individualismiin
- Annostarkkailun tarve?

Uudet mittaussuureet

- Uusia mittaussuureita ehdotettu
- Muutokset erityisesti alle 100 keV alueella
- Kustannus vs hyöty vs tiede
- Kytkentä efektiivisen annoksen määritelmään
- ICRP → BSS → Säteilylaki

Efektiivinen annos

- Siirtymä henkilökohtaisempaan suuntaan, ml. riskiarviot
- Systeemin monimutkaistuminen – mahdollinen koko-, sukupuoli- ja ikäriippuvuus
- Teoreettinen tarkkuuden paraneminen
- Kytkentä mitattaviin suureisiin