4 November 2022

Occupational Dosimetry:

The Approved Dosimetry Service Perspective

Tom Grimbergen

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Mirion Dosimetry Services congratulates NCS with 40th anniversary

"promoting the appropriate use of dosimetry of ionizing radiation throughout the Netherlands (and Belgium)"

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Contents

Occupational Dosimetry

The Approved Dosimetry Service Perspective

- Position of the Approved Dosimetry Service
- Measurement quantities for occupational dosimetry
- Common activities
- Examples
- Future developments

Position of the Approved Dosimetry Service

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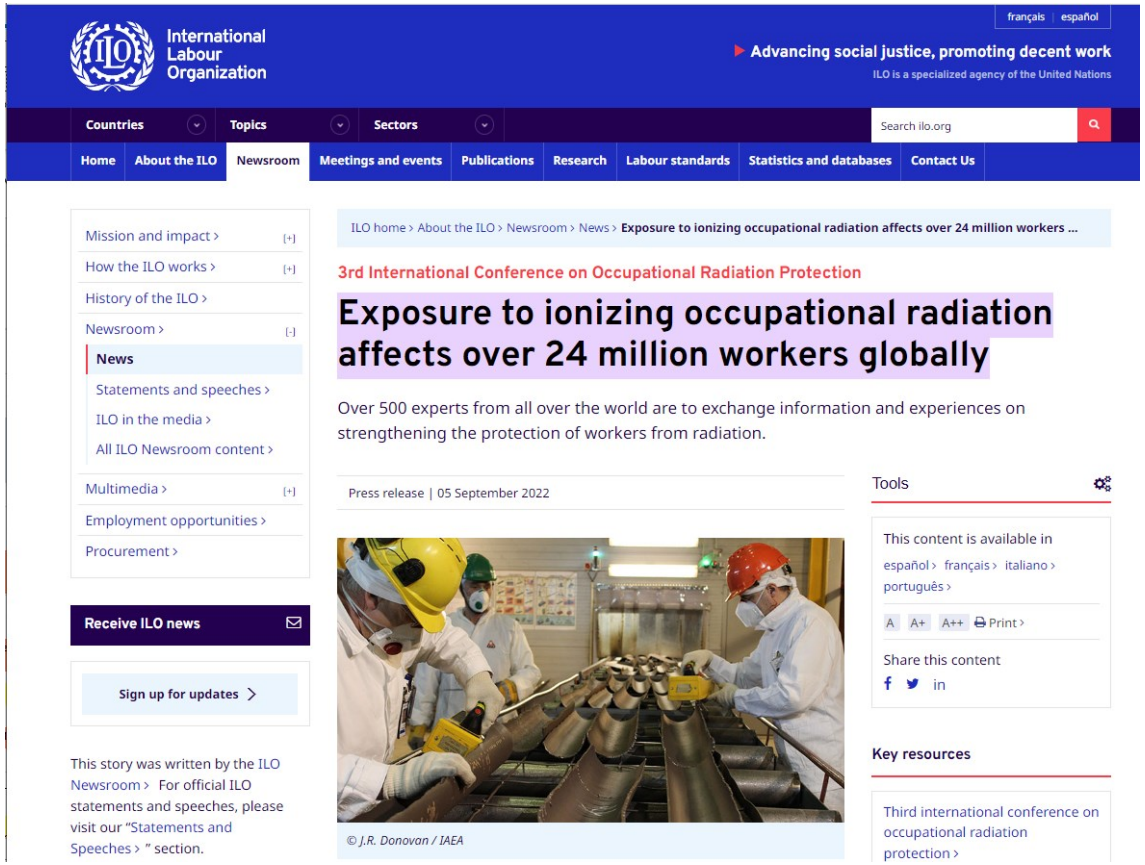
Occupational exposure world wide

- ILO: “24 million workers affected”
- UNSCEAR:
  - 11 million workers monitored – human made sources
  - 5.000 man.Sv
- ~1.000 (??) dosimetry services



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Role and position of the Approved Dosimetry Service

- Employer responsible for safe working conditions
- Employer supplies employees with monitoring from an Approved Dosimetry Service
- Dosimetry Service acts as an independent, recognized measuring service

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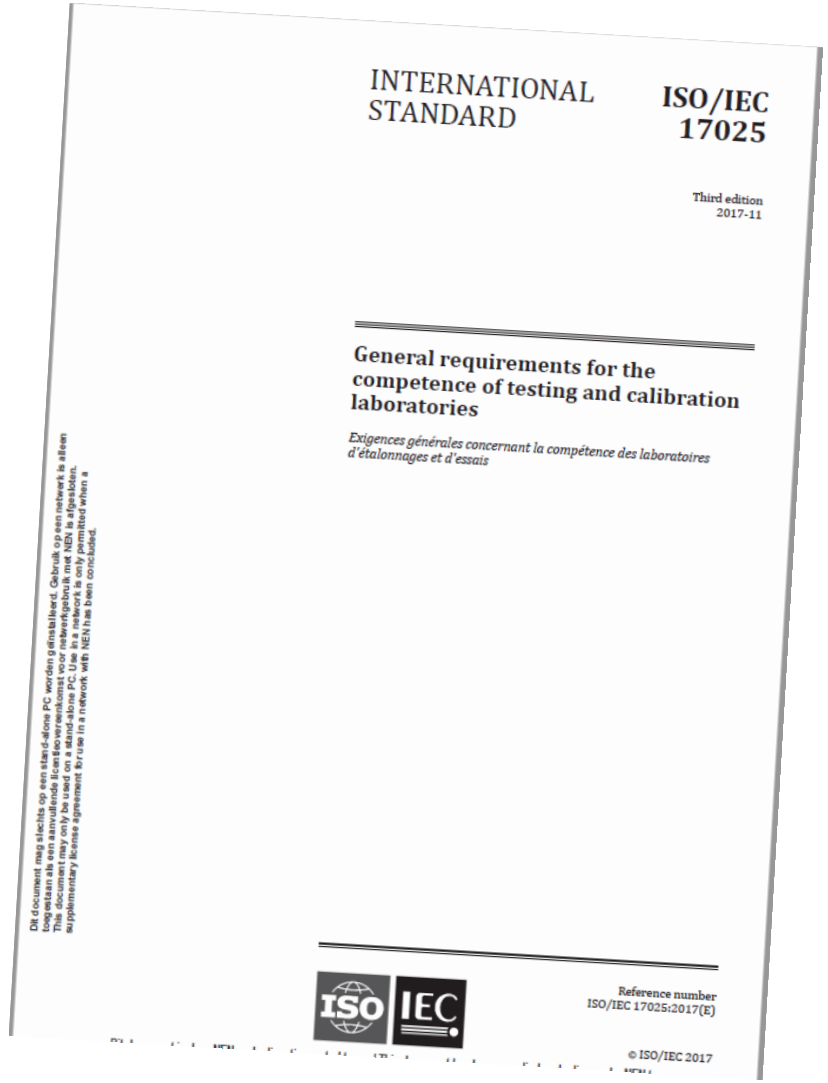
Approval and accreditation

- EU-directive 2013/59/Euratom: approval by national authority
- National authorities set (additional) rules for approval of dosimetry services
- Approvals internationally not exchangeable
- International harmonization of individual monitoring ongoing, but far from complete (EURADOS WG2)
- In an increasing number of countries, accreditation according to ISO-17025 requirement for approval

ISO-17025

- “General Requirements for the competence of testing and calibration laboratories”
- Covers ISO-9001 for Quality Management System
- In addition, specific requirements for quality of measurements, such as:
  - Ensuring metrological traceability
  - Validation of results
  - Evaluation of measurement uncertainty
- By accreditation body; in NL Dutch Accreditation Council (RvA)
- Mutual recognition of accreditation declarations (EA)


INTERNATIONAL STANDARD

ISO/IEC 17025

Third edition
2017-11

General requirements for the competence of testing and calibration laboratories

Exigences générales concernant la compétence des laboratoires d'étalonnages et d'essais

Reference number
ISO/IEC 17025:2017(E)

© ISO/IEC 2017

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Measurement Quantities

For occupational dosimetry

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Operational quantities

- Personal dose equivalent, $H_p(d)$, in mSv
- Designed to be conservative estimator of limiting quantity
- Definition: measured in the body at depth d
- Practice: measured on the body at specified location
- Calibration: on suitable phantom

Limiting quantity	Parameter *d* (mm)
Effective dose	10
Equivalent eye lens dose	3
Equivalente skin dose	0,07

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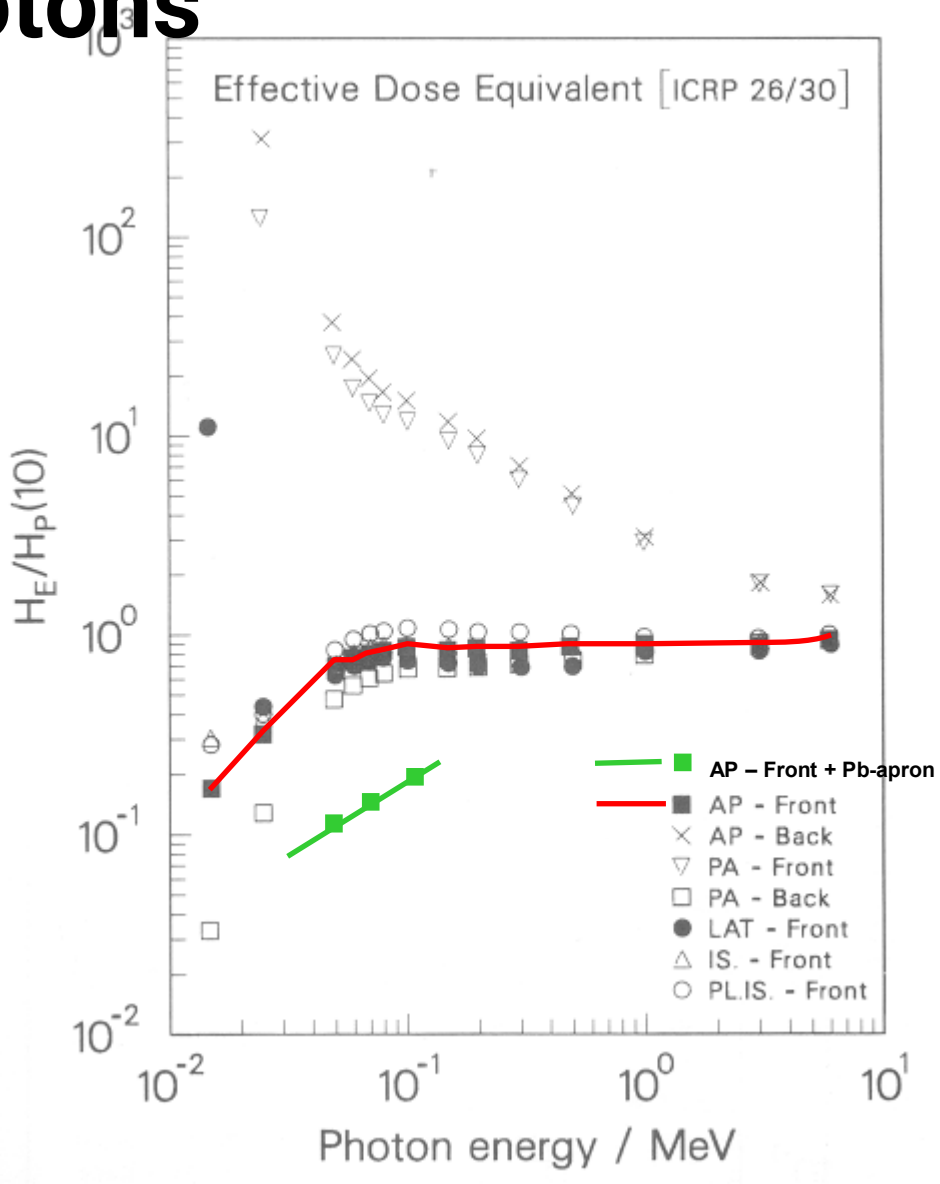
$H_p(10)$ as estimator for E for photons

- Reasonably conservative, when dosemeter worn at the side of the body facing the source
- Underestimating when dosemeter at opposite side
- Overestimating for low energy photons
- Overestimating when worn on top of apron
  - NCS Report 19: divide $H_p(10)$ by factor 5 to 15 (depending on apron specification) to reduce overestimation
  - Dutch legislation: option to apply factor 0,2
  - National Dose Register (NDRIS) stores both measured Hp(10) and optional apron-factor 0,2



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Common activities

by Approved Dosimetry Services

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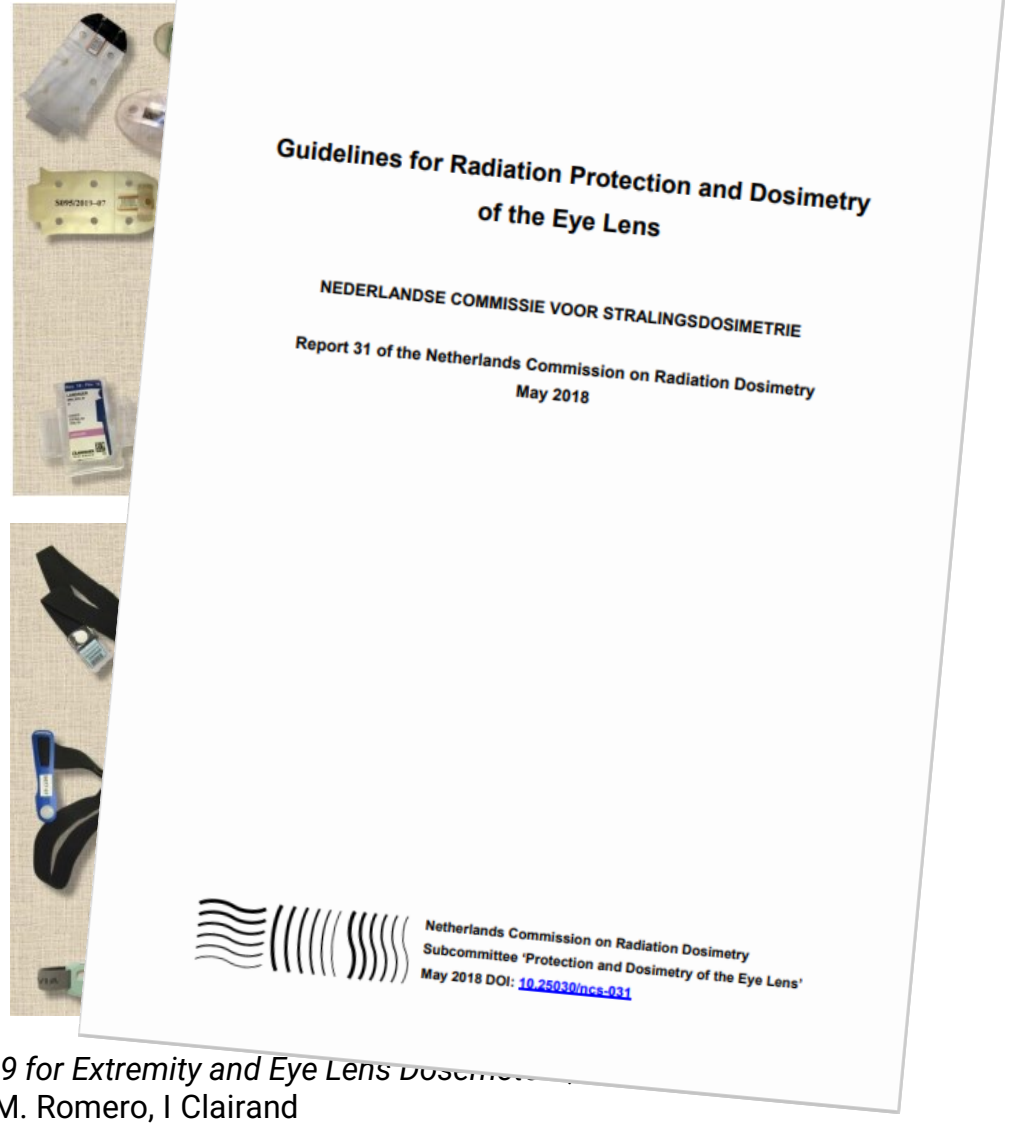
Measurement methods

- Passive
  - Film
  - Thermoluminescence (TLD)
  - Optically stimulated luminescence (OSL)
  - Radiophotoluminescence (RPL)
- Active Personal Dosemeters (APD)
- “Hybrid”
  - Direct Ion Storage (DIS)

(C) EURADOS Report 2020-03: *EURADOS Intercomparison 2016 for Whole Body Dosemeters in Photon and Mixed Radiation Fields*, H. Stadtmann, A. F. McWhan, T. W. M. Grimbergen, M. Figel, A. M. Romero, B.J. Jansen, C. Hranitzky, C. Gärtner

Differentiation

- Radiation type
  - Photons
  - Beta’s
  - Neutrons
- Application
  - Whole body
  - Extremity
  - Eye



(C) EURADOS Report 2021-05: *EURADOS Intercomparison 2019 for Extremity and Eye Lens Dosim*
Dobrzynska, H. Stadtmann, T. W. M. Grimbergen, M. Figel, A. M. Romero, I Clairand

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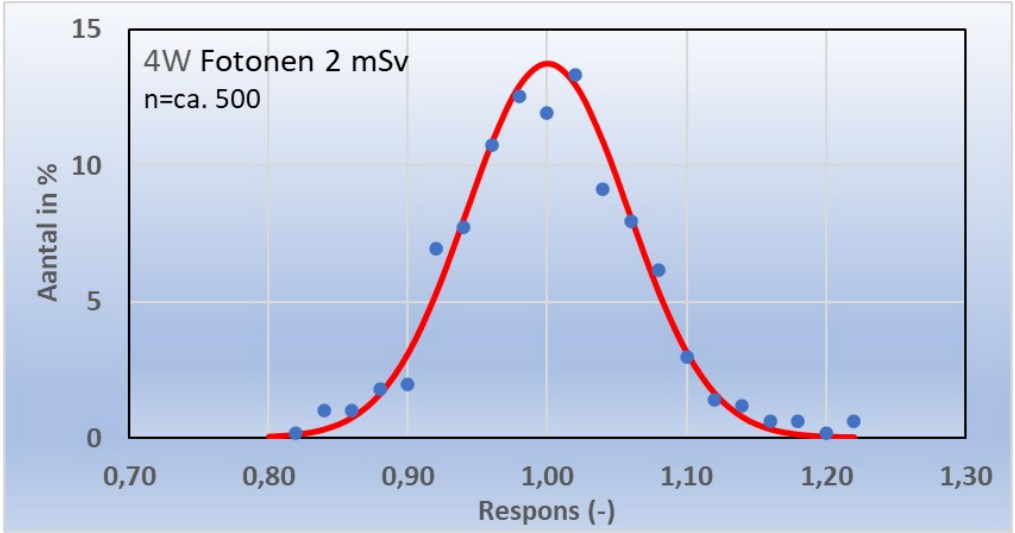
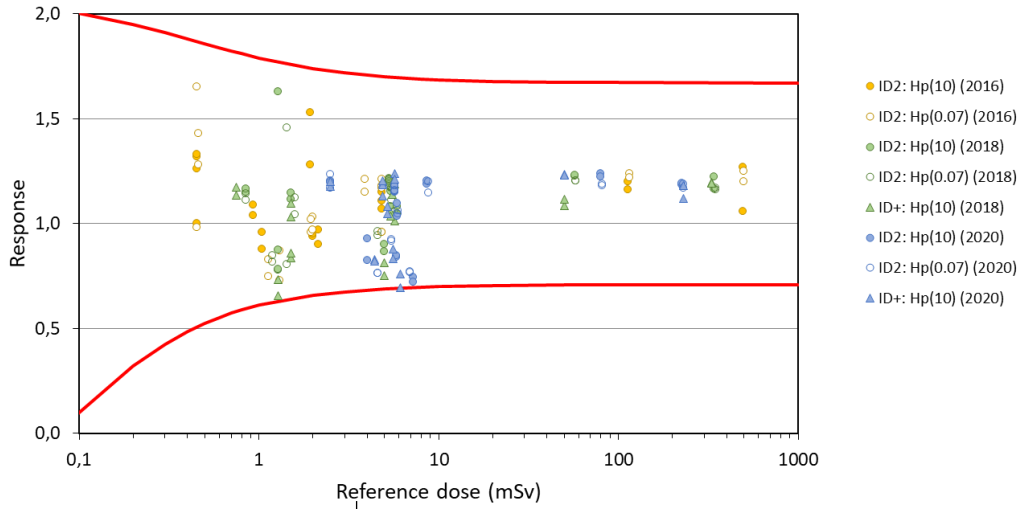
Running an Approved Dosimetry Service

- Measurement Quality Control
  - Dosemeters, Reader equipment
  - Reference irradiations
  - Blind tests, intercomparisons
  - Audits
  - ….
- Logistics
  - Assembling, dissembling
  - Assigning, labeling dosemeters
  - Shipping
  - Delivering reports
- IT
- Customer Service





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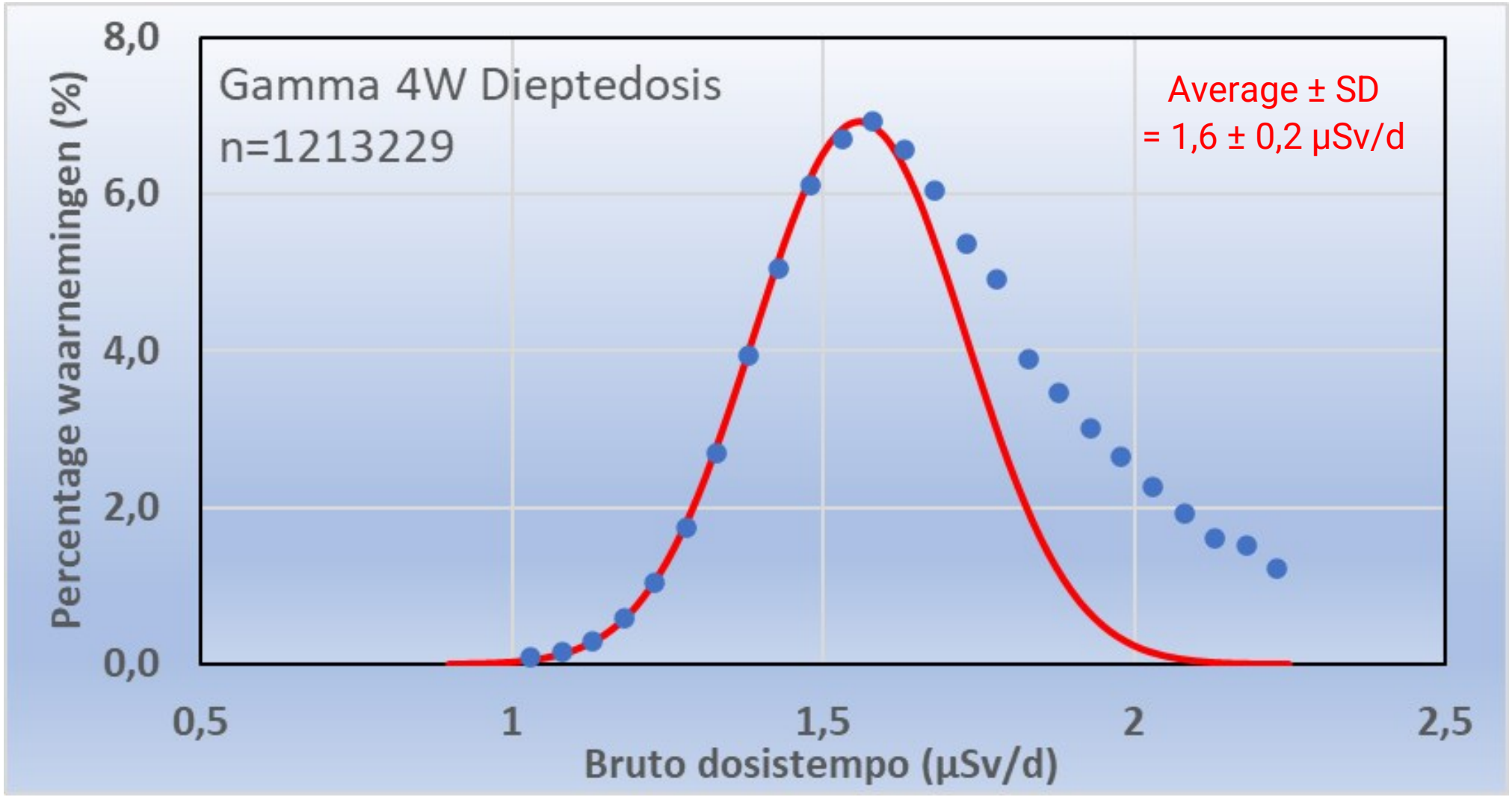
Example results

Measurement results converted to dose rate (uSv/d)



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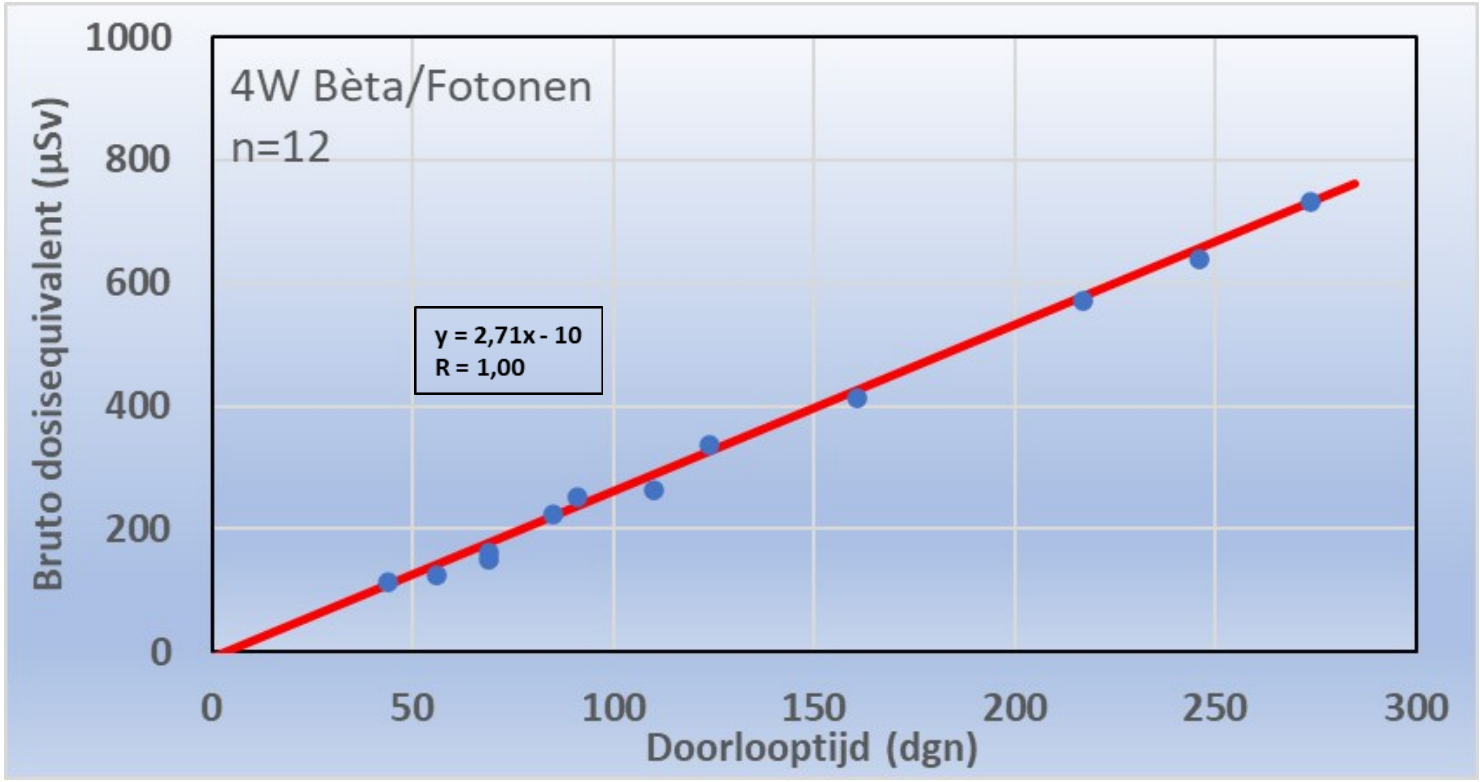
Example: false positive

- Employee long term sick leave
- Dosemeters not used, not returned
- Returned all at once
- Doses varied from 0,03 – 0,25 mSv
- Customer: aging effect dosemeters?



- Increased background dose rate caused by building materials

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Future developments

Future developments (1)

- From science to service providing
  - International harmonization
  - Continuing scale increase
  - Digitalization, IT, IOT
  - Customer service

- Hybrid dosemeters
  - Produce intermediate results
  - Reduced logistics

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Future developments (2)

- New operational quantities
  - ICRU 2020. Report 95. Operational Quantities for External Radiation Exposure. Journal of the ICRU 20.
  - Redesign dosemeters?
  - EURADOS: *“introduction of the new quantities should be phased over tens of years”*

- Go fully computational?
  - “Podium” feasibility study

PODIUM
Personal Online DosImetry
Using computational Methods

EUROPEAN JOINT PROGRAMME FOR THE INTEGRATION OF RADIATION PROTECTION RESEARCH
CONCERT

Thank you for your attention!

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