Australian Government
Australian Radiation Protection and Nuclear Safety Agency

arpansa

Minimal Report Dose

What is an acceptable level of uncertainty in Personal Dosimetry

ARPANSA's Minimum Reportable Dose

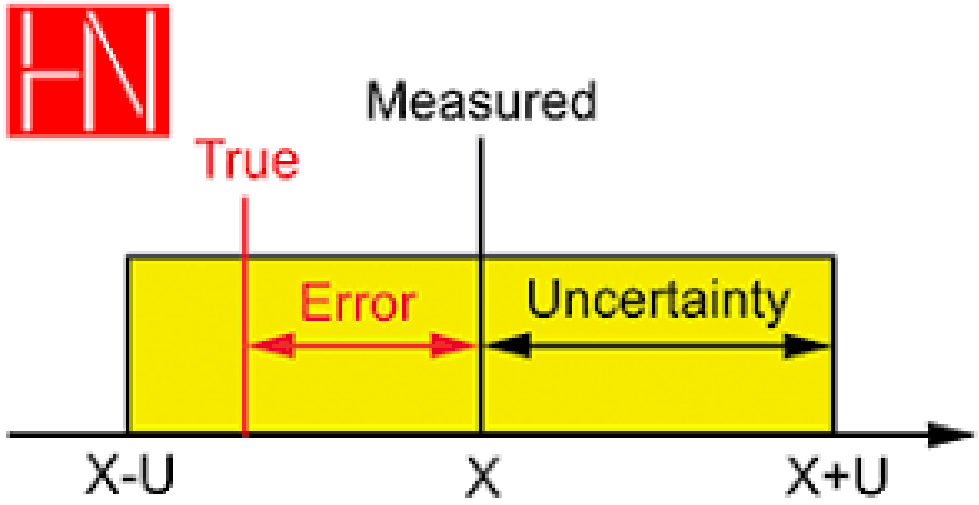
- 2016 swapped technology from TLD to OSL
- 2018 updated Minimum Reportable Dose (MRD)
  - Increased from 10uSv to 100uSv
  - Currently under review
  - Looking for feedback
- How is it that the MRD can be changed?

Detection Limits and MRDs

- Detection Limit
  - Smallest signal of interest which can be confidently detected with the applied measurement procedure
  - This determines whether or not the measurement procedure satisfies the requirements and is therefore suitable for the intended measurement purpose
- Limit of Quantification
  - The smallest signal of interest which has an **acceptable uncertainty**
  - Used by ARPANSA as the Minimum Reportable Dose (MRD)

Measurement uncertainty

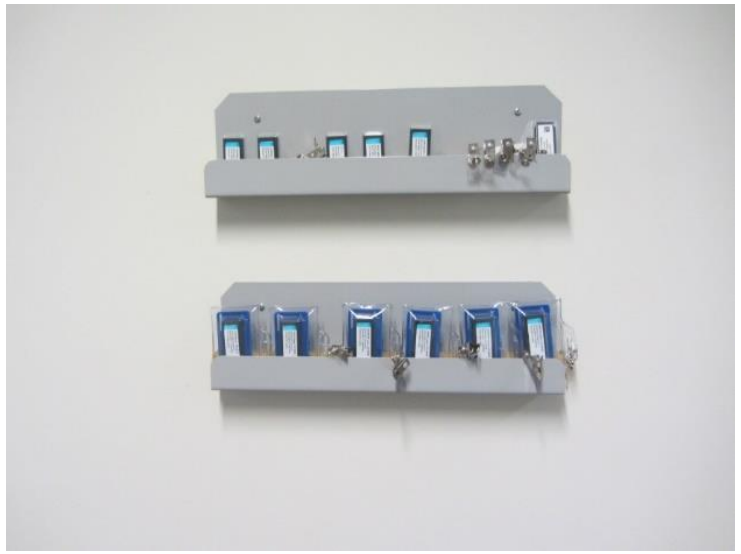
“range of possible values within which the true value of the measurement lies”

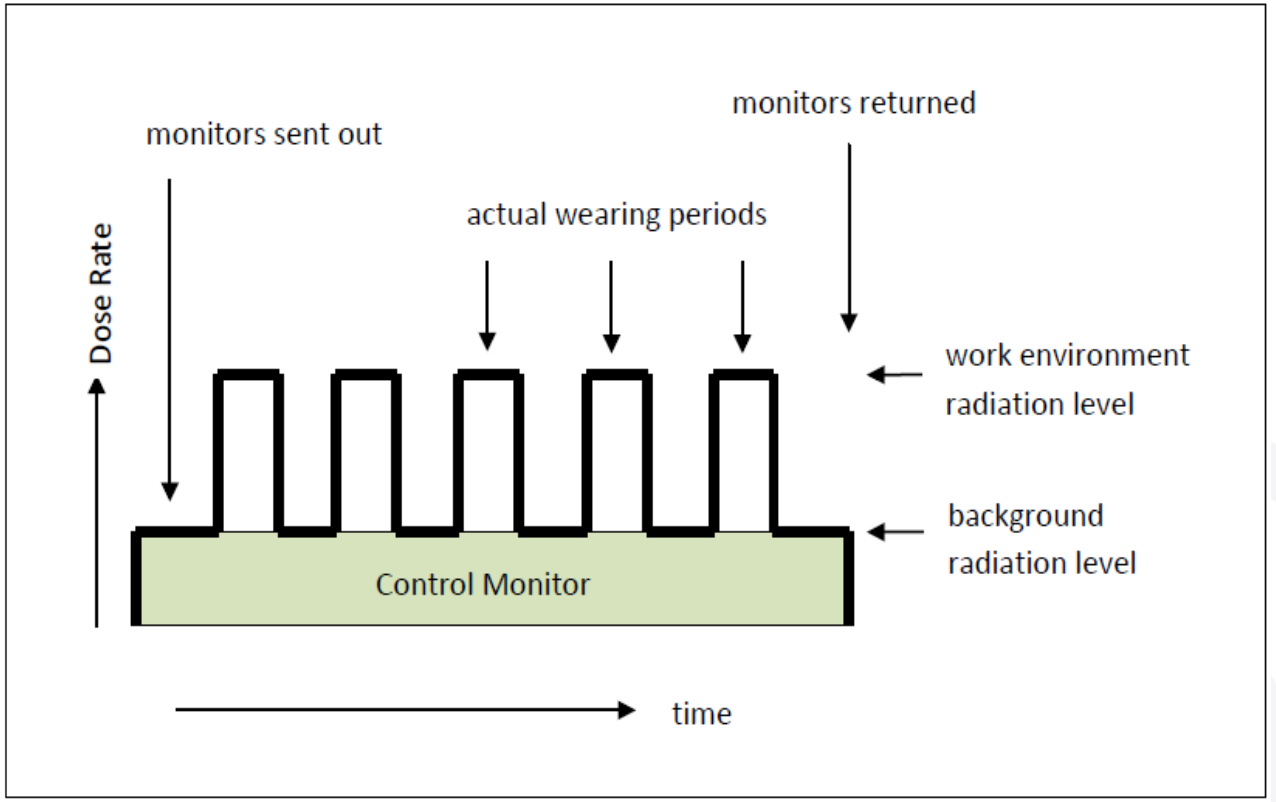


Contributions to the signal dose

- Occupational dose: the exposure of the worker due to their work (what we actually want to know)
- Background radiation at the place of work
- Exposure of the monitor in transit

Therefore, we need a control monitor:





Measuring Occupational Dose

$$D_O = D_W - D_C$$

D_O is the worker's occupational dose

D_W is the gross dose on the worker's monitor

D_C is the gross dose on the control monitor

Uncertainty in Occupational Dose

- Control Monitor: 260 µSv **±3%** = 260 ± 8 µSv
- Worker Monitor: 360 µSv **±3%** = 360 ± 11 µSv
- Occupational Dose: 360-260 = 100 µSv
- Uncertainty: $\sqrt{(8^2 + 11^2)}$ = 13.6 µSv (k=1)
- Reported Dose: 100 ± 27 µSv (k=2)

27% Uncertainty

95% confidence interval between 73 and 127 µSv

Uncertainty in Occupational Dose

- Control Monitor: 260 µSv **±3%** = 260 ± 8 µSv
- Worker Monitor: 270 µSv **±3%** = 270 ± 8 µSv
- Occupational Dose: 270-260 = 10 µSv
- Uncertainty: $\sqrt{(8^2 + 8^2)}$ = 11 µSv (k=1)
- Reported Dose: 10 ± 22 µSv (k=2)

220% uncertainty

95% confidence interval between -12 and 32 µSv

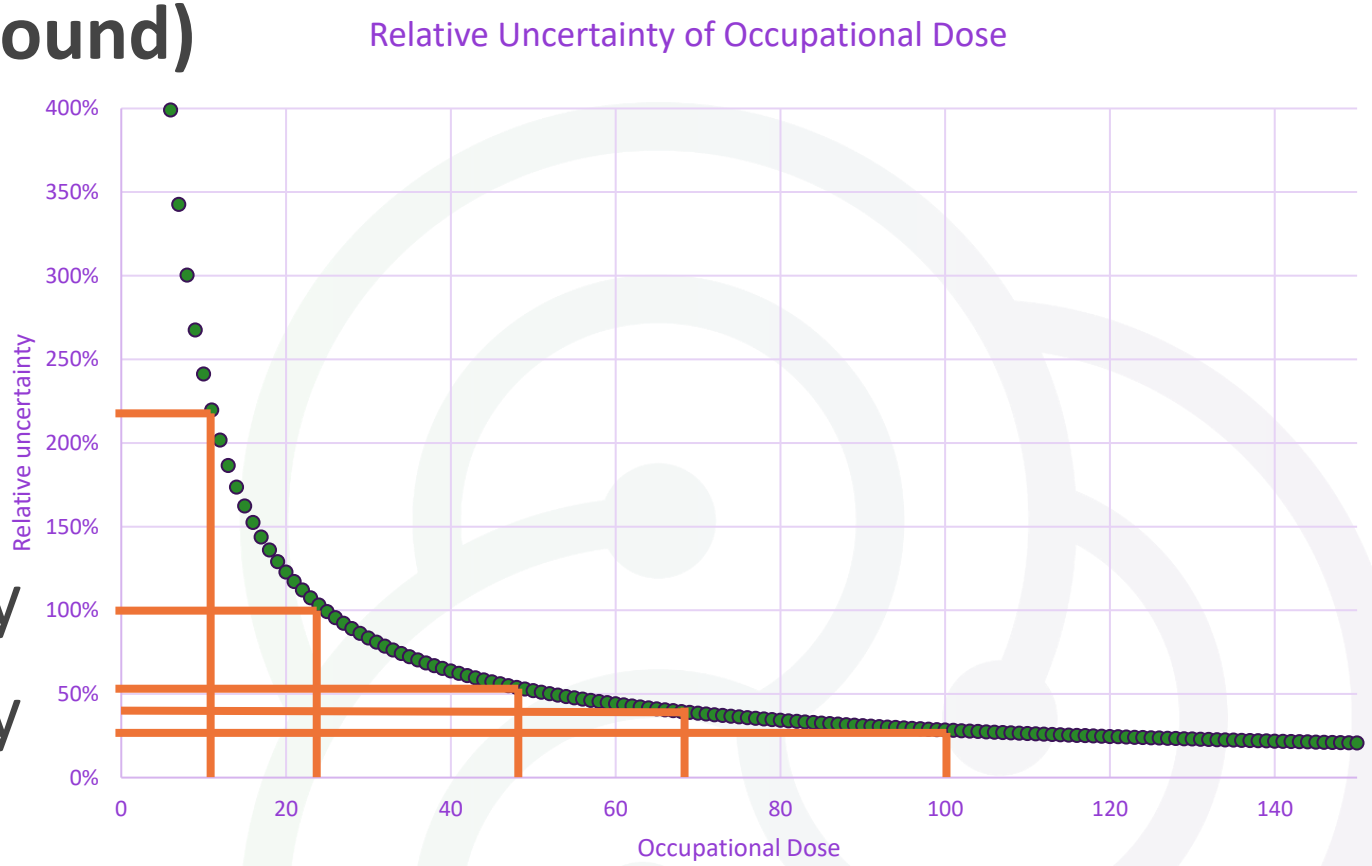
Reduce the background dose

- PRMS has analysed 2 years of control values (41,000 control)
  - Dose 267uSv
  - Measurement period 16 weeks (12 week wear period)
- Shield monitors when not in use
- Decrease the wear period
  - MRD for single measurement decreases but
  - Annual dose @MRD increases due to increase frequency
  - Validation papers that use shorter wear periods mean they have small backgrounds
- Use multiple controls
  - Historic data
  - Multiple issued control

Increase the uncertainty

The smallest signal of interest which has an **acceptable uncertainty (260uSv background)**

- 100uSv = 27% uncertainty
- 70uSv = 40% uncertainty
- 50uSv = 55% uncertainty
- 25uSv = 100% uncertainty
- 10uSv = 220% uncertainty



Food for thought

- Is a result over or approaching 100% uncertainty a useful measurement?
  - Not all clients fully understand measurement uncertainty
  - Increased false reading
- What is the driver for low MRD?
  - History?
- Public limit 1mSv (action level of 0.25mSv per quarter)

- Variations in background

- False sense of precision? Human factors

Thank you

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