L15c Validation of workplace monitoring

Dose rate measurements with handheld instruments

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Objectives

- In this lecture we will discuss a method to validate the measurement method of monitoring dose rate measurements with handheld instruments in a workplace.

The measurement challenges

- Very often radiation sources of unknown energy, with unknown attenuation, from different directions resulting in a complex radiation field.

Measurement results will often govern the time persons may work in this workplace.

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Validation plan

Target value:	lower level of 5µSv/h
Energy range	20 keV – 1.4 MeV
Uncertainty	to be defined (Trumpet curve)
Temperature	to be measured and recorded
Humidity	to be measured and recorded
Air pressure	to be measured and recorded

Monitoring instruments checked and operational

Measurement personnel trained

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Pre validation information

Energy dependence
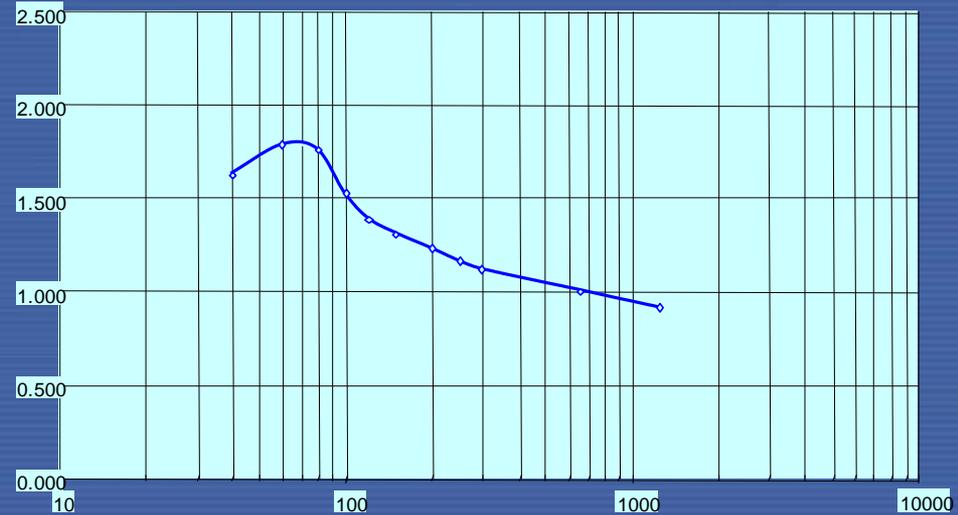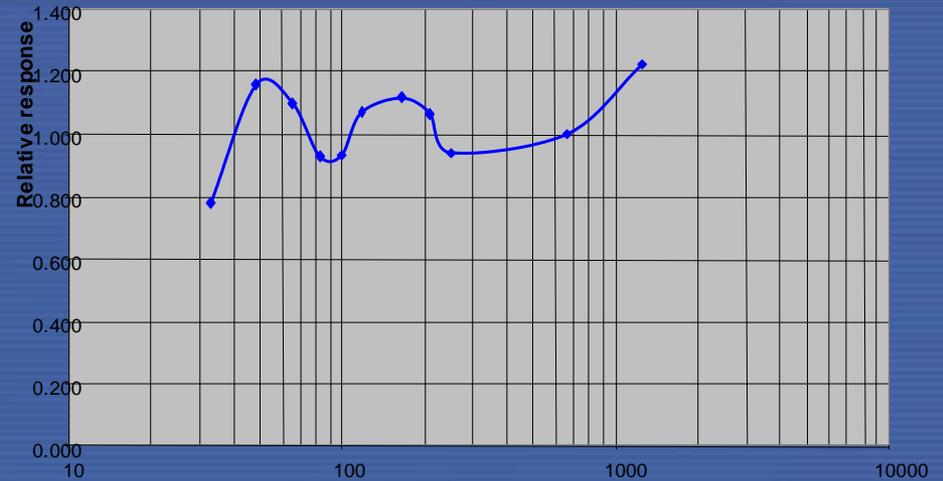
Pre validation information

Dose rate dependence

Linearity with Cs-137 normalized at 0.1 mSv/h
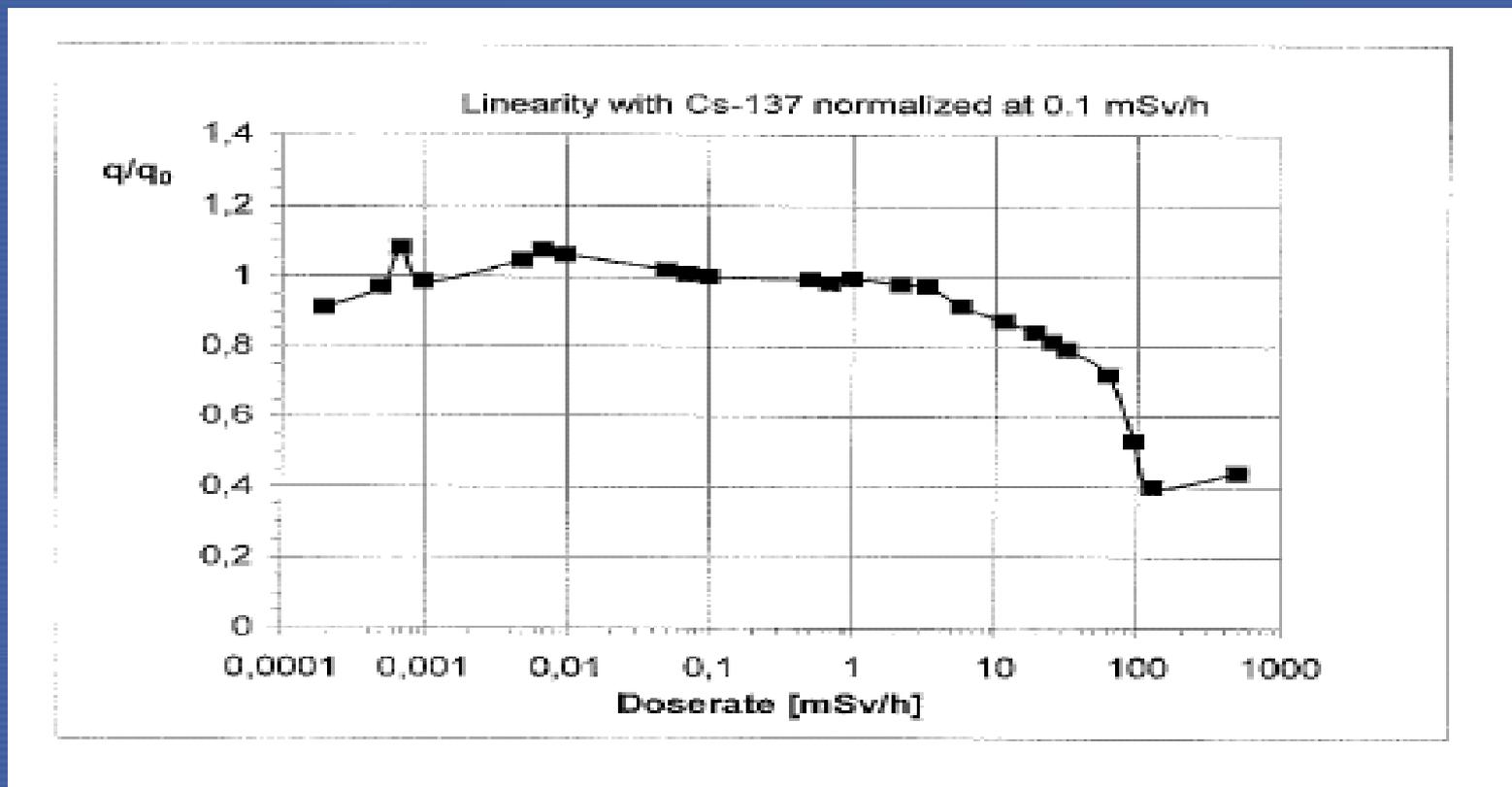
Functional test

➤ Select an area with a low, stable background.

➤ Check calibration (not older than one year).

➤ Place test source in a reproducible geometry.

➤ Meter response shall not differ by more than ± 20% from the reference reading.

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Portable dose rate meter functional test

Electro-mechanical test OK ?
— No →

Yes ↓

Background indication OK ?
— No → Meter contaminated ?
— No

Yes ↓

Meter contaminated ?
Yes ↓
Mark as out of service and decontaminate

Calibration older than one year ?
— Yes → Mark as out of service and calibrate

No ↓

Test source response OK ?
— No → Mark as out of service and repair

Yes ↓

Meter operational
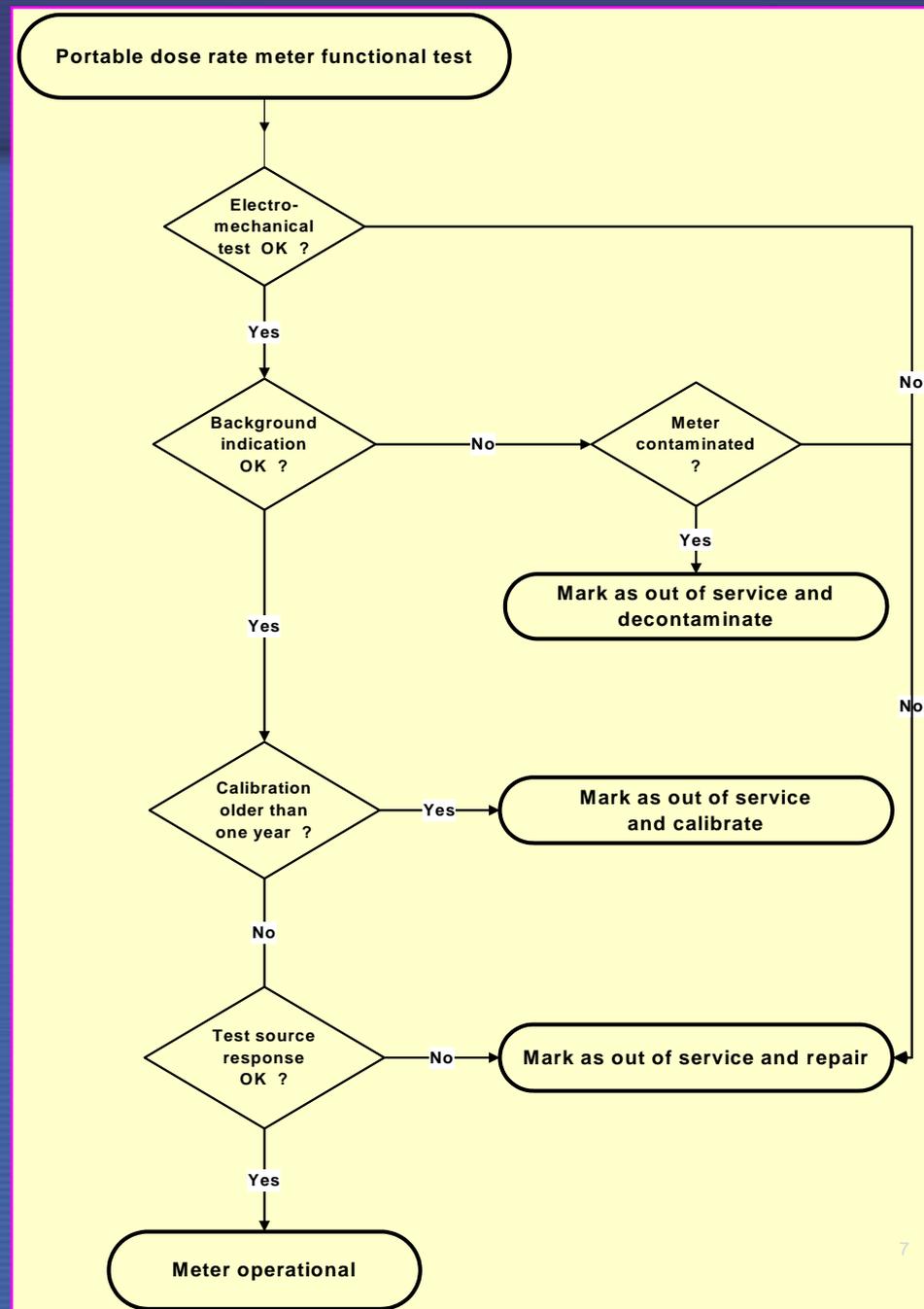
Source setup

- A gamma field was produced using a Buchler γ- calibrator OB 34/1 loaded with a 740 MBq Ci ^{137}Cs panoramic source.

- A place was marked on the floor of the bunker at a distance of 3 m from the source where the dose rate H*(10) was 5.7 µSv/h.

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Measurement

Measurement performed according to the usual routine, with standard equipment and by all of the technicians.

Technician	Equipment used	Dose rate µSv/h	Dose-rate /5.7 µSv/h
A	Radigem	6.4	1.12
B	Mini-rad	7.0	1.22
C	FH-40	4.4	0.77
B	Bicron	6.0	1.05
B	FH-40	5.0	0.87
C	Radigem	6.6	1.15
A	SSM-1	6.0	1.05
A	Ram-ion	5.0	0.87
C	Mini-rad	7.0	1.22
C	Ram-ion	5.0	0.87

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Acceptance limits

- The response, H_{pm}/H_{pw}, of the dosimeters must meet the following criteria (RS-G-1.3):

- For pure photon radiation

$$\frac{1}{1,5}\left(1 - \frac{2H_{p0}}{H_{p0} + H_{pw}}\right) \leq \frac{H_{pm}}{H_{pw}} \leq 1,5\left(1 + \frac{H_{p0}}{2H_{p0} + H_{pw}}\right)$$

- H_{pm} value measured by the participant,
- H_{pw} conventional true value stated by the irradiating laboratory,
- H_{p0} lower limit of dose range

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Apply acceptance limits

Dose rate measurement validation
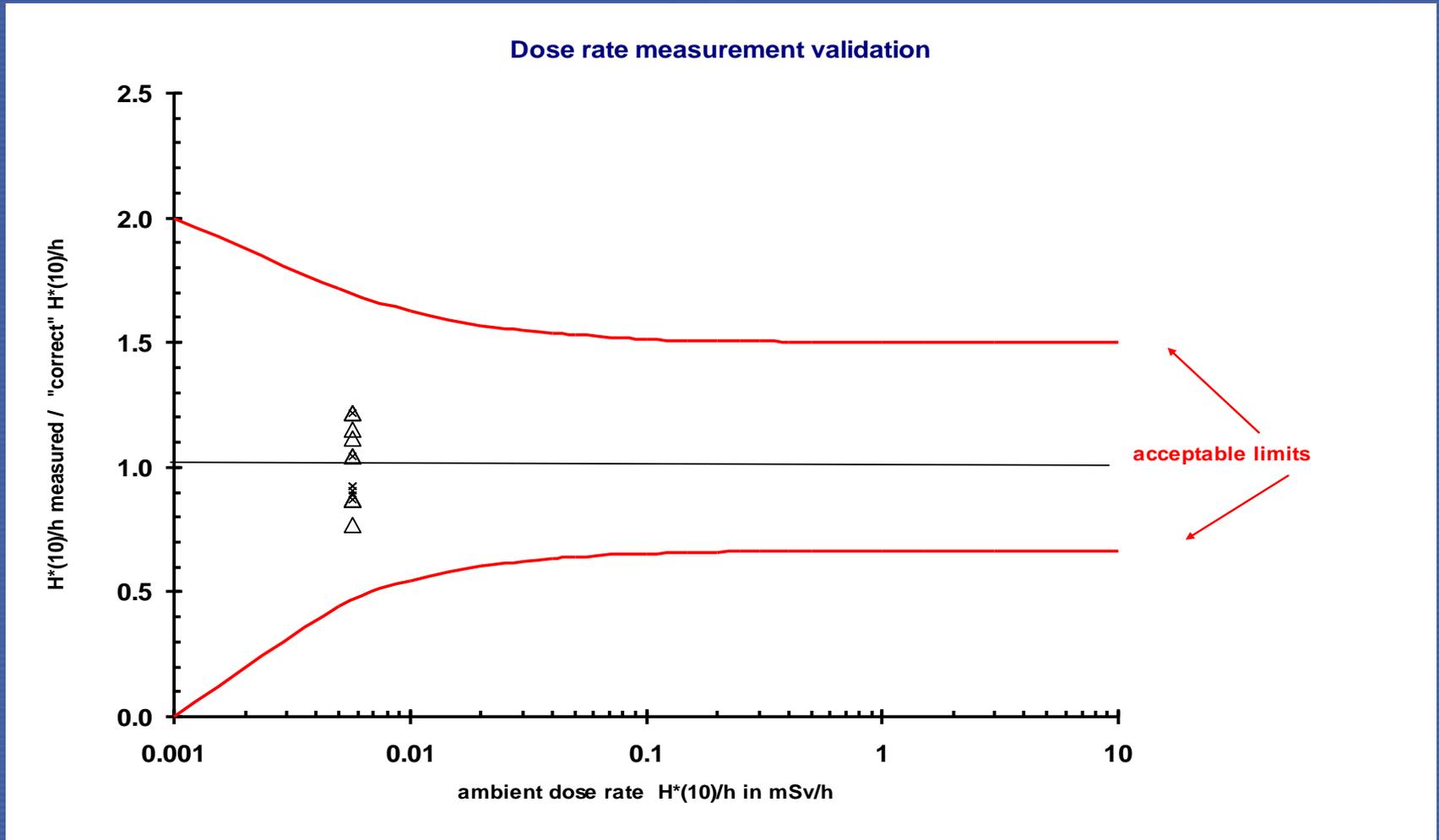
Validation statement

- The results show that the technicians and the available dose rate measuring instruments are able to measure the dose rate in the photon field with uncertainties within the acceptable limits.

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