The status of criticality accident dosimetry in the UK

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Outline

- Introduction
- Current status of criticality accident dosimetry in the UK
- An international perspective
- Conclusions

Introduction: A criticality excursion

- Mass of fissile material exceeds a critical value for a given matrix and geometry.
- Initial burst of ~10^{15} fissions in ~1ms - 10s
- Dose to workers close to an assembly can be lethal (>10 Gy)

See McLaughlin, T. P. *et al*., *"A Review of Criticality Accidents"*, Los Alamos National Laboratory, Los Alamos, LA-13638 (2000) for a detailed history of criticality accidents

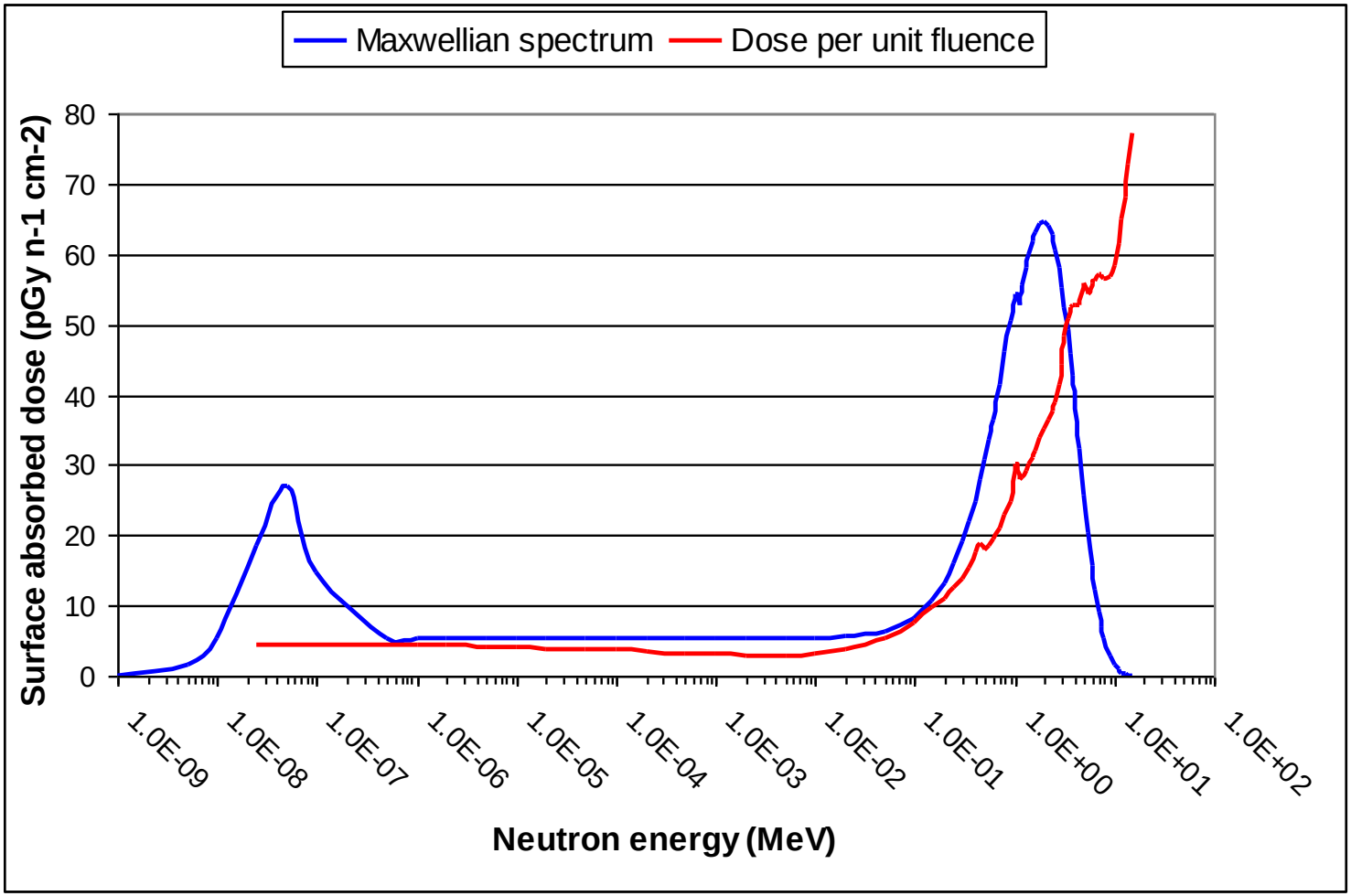
UK requirements for dose assessment

- Reporting of any individual likely to have received dose greater than 1 Gy within 8 hours of exposure
- Dose assessment with less than 50 % uncertainty within 48 hours for any dose greater than 0.5 Gy
- Dose assessment with less than 30 % uncertainty within 1 week for any dose greater than 0.25 Gy

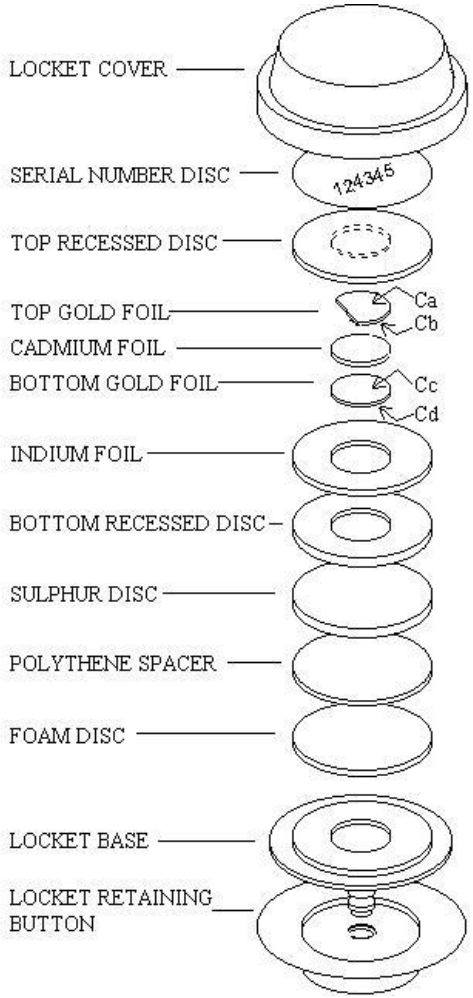
United Kingdom Parliament, *"Ionising Radiations Regulations 1999*", HMSO, London (1999)

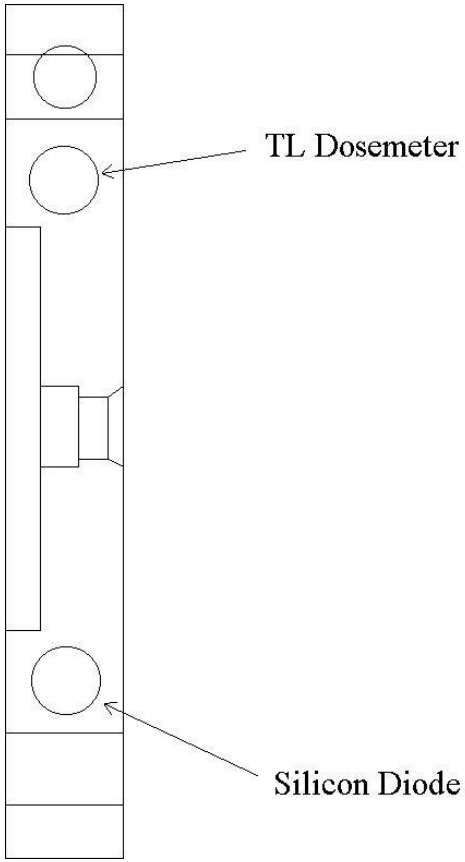
Health and Safety Executive, *"Requirements for the approval of dosimetry services under the Ionising Radiations Regulations 1999, Part 1: External radiations"*, RADS 1/2008, HSE (2008)

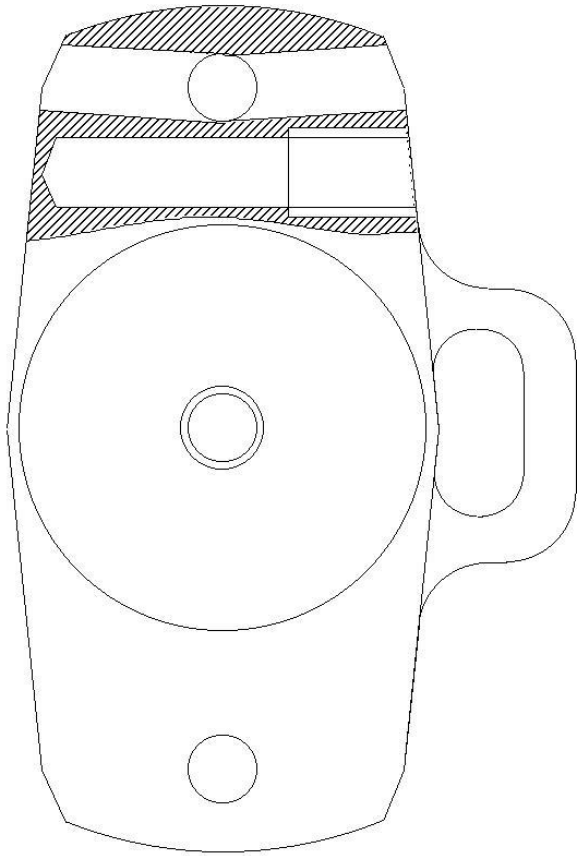
Absorbed dose as a function of neutron energy



CADUG Mk-IV criticality locket

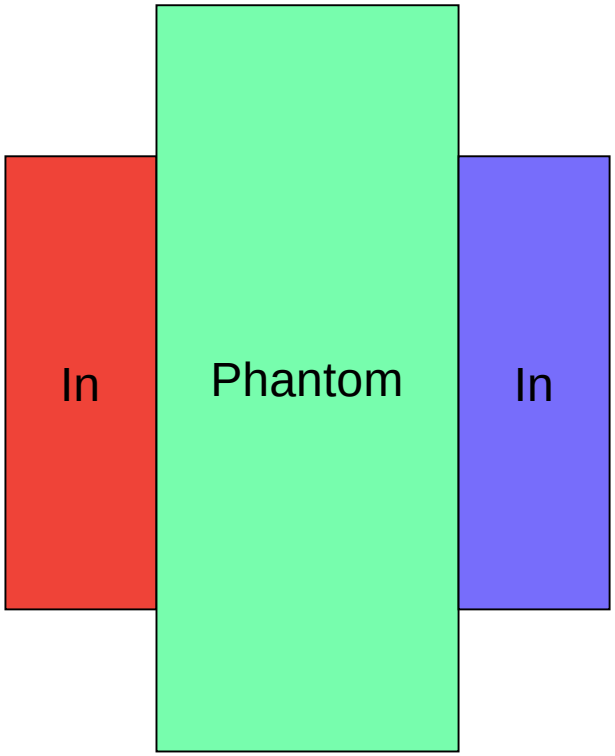


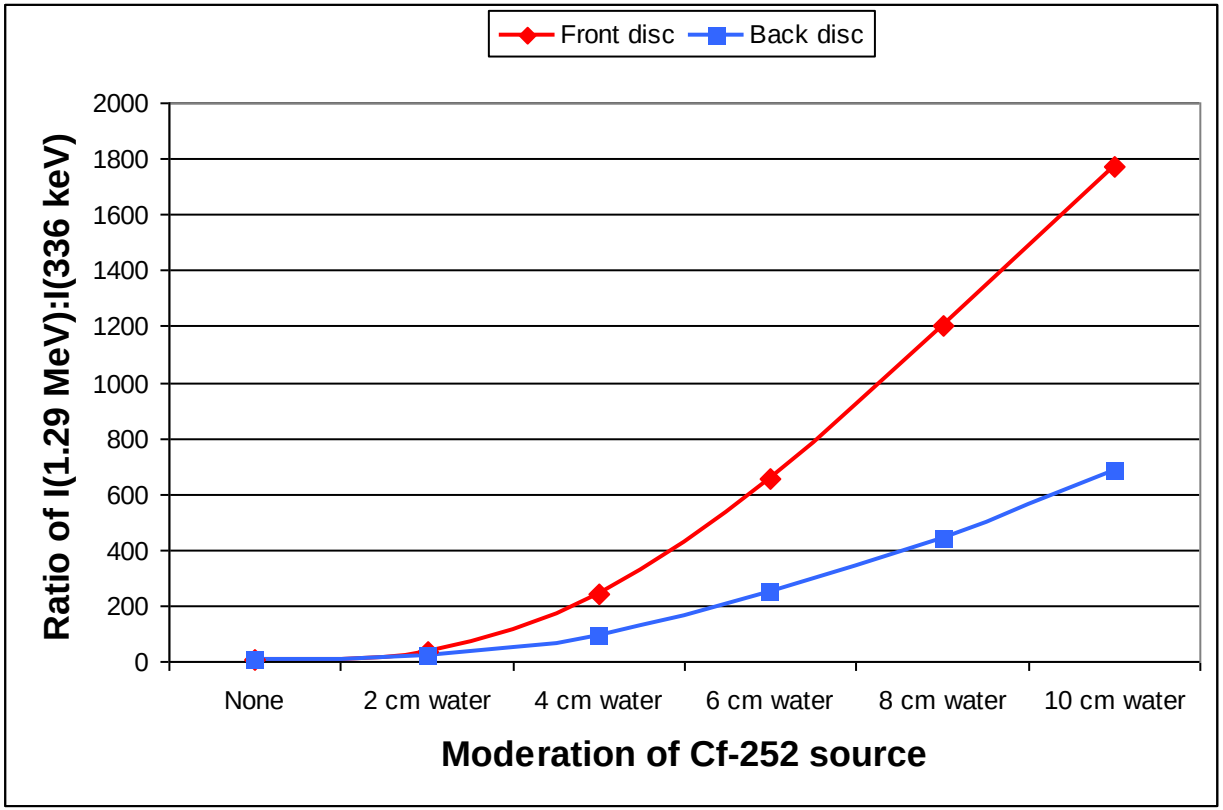




H. J. Delafield, Radiation Protection Dosimetry, **10**, pp. 237-249 (1985)

Indium as orientation and quality indicator





An international perspective

- No two nations share a common system of CAD
- US laboratories do not share a common design
- Intercomparison exercises using Silene reactor
- Limited data published on designs and methods

Development of CAD

- Monte Carlo techniques used to refine methodologies and calibrations
- Biological methods of retrospective dosimetry
- Intercomparisons highlighted relatively poor photon dose determination

Conclusions

- UK criticality accident dosimetry is subject to a programme of development to ensure the reliability of the service
- International and intra-national diversity of CAD systems hinders cooperation between laboratories
- International collaborations could enhance development and reduce costs

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