



Standardization in Internal Dosimetry

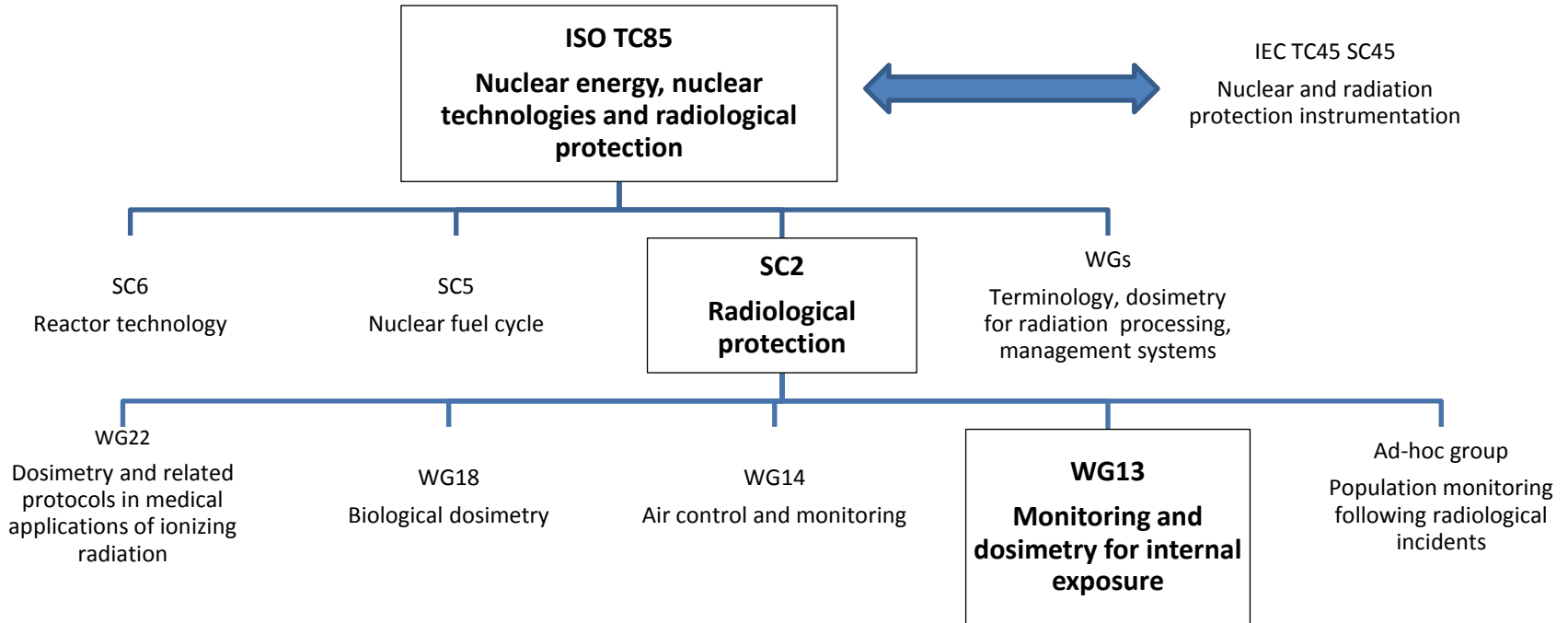
Recent Developments in ISO Standards for Internal Dosimetry

Derek Bingham

CONTENTS

- ISO and radiological protection
- Current standards in internal dosimetry
focusing on:
 - ISO 16637 Monitoring for nuclear medicine staff
 - ISO 16638:1 Inhalation of uranium compounds
- Future standards

WORK OF ISO



Standardization in the field of peaceful applications of nuclear energy, nuclear technologies and in the field of the protection of individuals and the environment against all sources of ionising radiations.

WG13 – MEMBERS



- Currently 39 members, drawn from France, US, Germany, UK, Spain, Italy, Japan, Canada, India, Russia, Argentina, S Korea
- Co-convenors (Derek Bingham, Ana Rojo)
- Next meeting in Worcester, USA in June 2017

CURRENT STANDARDS IN INTERNAL DOSIMETRY

- ISO 20553 (2006) Monitoring of workers occupationally exposed to a risk of internal contamination with radioactive material.
- ISO 27048 (2011) Dose assessment for the monitoring of workers for internal radiation exposure
- ISO 28218 (2010) Performance criteria for radiobioassay
- ISO 16637 (2016) Monitoring and internal dosimetry for staff members exposed to medical radionuclides as unsealed sources
- ISO 16638-1 (2016) Monitoring and internal dosimetry for specific materials — Part 1: Inhalation of uranium compounds

INTERNAL DOSIMETRY FOR MEDICAL STAFF

Nuclear medical imaging and therapy departments use a range of short-lived isotopes, some of which are volatile, and represent an inhalation hazard.



ISO 16637 INTERNAL DOSIMETRY FOR MEDICAL STAFF

CONTENTS	
1.	Scope
2.	Normative references
3.	Terms and definitions
4.	Symbols and abbreviated terms
5.	Purpose and need for monitoring programmes in nuclear medical diagnosis and therapy
6.	Common radionuclides
7.	Reference levels
8.	Routine monitoring programmes
9.	Triage monitoring programmes
10.	Special monitoring programmes
11.	Confirmatory monitoring programmes
12.	Measurement techniques and performance criteria
13.	Procedure for the assessment of exposures
14.	Reporting and documentation
Annex A	IAEA Safety Guide RS-G-1.2 "decision factor"

5. Purpose and need for monitoring programmes

8. Routine monitoring programmes

9. Triage monitoring programmes

10. Special monitoring programmes

11. Confirmatory monitoring programmes

ISO 16637 - DETERMINING THE REQUIREMENT

Based upon airborne concentrations

Estimate possible airborne concentrations

Actual measurement data for I-131 in areas of high activity

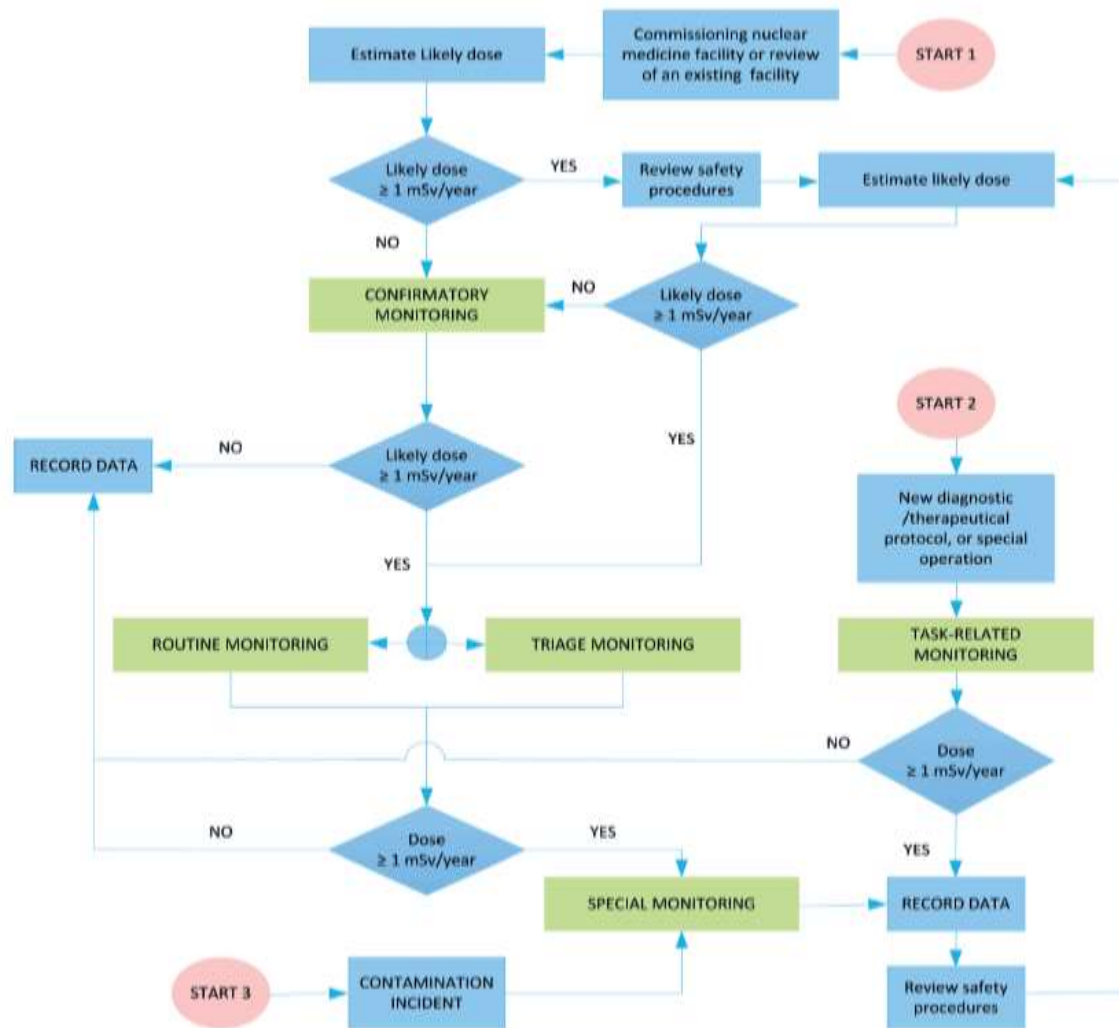


Based upon total activity handled by the laboratory

Modified IAEA Safety Guide formula – decision factor (d) in mSv

$$d = \frac{\text{Ann activity} \times e(50) \times f_{fs} \times f_{hs} \times f_{ps} \times f_{workload} \times f_{handled\ activity} \times f_{intake}}{10^{-3}}$$

ISO 16637 - SELECTING A MONITORING REGIME



ISO 16637 – MONITORING REGIMES

ROUTINE MONITORING

Be able to detect annual doses of 1 mSv.
For I-131, max interval between urine or thyroid measurements of 15 d.



TRIAGE MONITORING

Frequent monitoring at the workplace using standard laboratory instrumentation

- frequent measurements with a dose rate monitor in front of the abdomen for radionuclides with very short half-lives e.g. Tc-99m, C-11, F-18
- measurements with a hand contamination monitor for pure beta emitters e.g Y-90
- measurements with a calibrated dose rate monitor in front of the thorax for Ga-67, In-111 and Tl-201.

ISO 16637 – MONITORING REGIMES

SPECIAL MONITORING

Instigated following suspect intakes and incidents

Radionuclide	Spot urine sample	24h urine sample	WBM	Thyroid
F-18	+		++	
Y-90		++		
Tc-99m		+	++	
I-131		+		++
Lu-177		+	++	
Ra-223		++		

++ = recommended

+ = supplementary (helpful but not mandatory)

ISO 16638-1 INHALATION OF URANIUM COMPOUNDS

CONTENTS	
1.	Scope
.....	
5.	Purpose and need for monitoring programmes
6.	General aspects
7.	Reference levels for uranium
8.	Routine monitoring programmes
9.	Special monitoring programmes
10.	Task-related monitoring programmes
11.	Performance criteria for laboratories
12.	QA and QC for bioassay laboratories
13.	Procedure for the assessment of exposures
14.	Reporting and documentation
Annex A	Nuclear data of U-238 and U-235 decay
Annex B	Default classification of uranium compounds
Annex C	Measurement techniques for uranium
Annex D	CED per unit intake for uranium compounds
Annex E	Estimation of uncertainties for internal dose assessments

6. General aspects

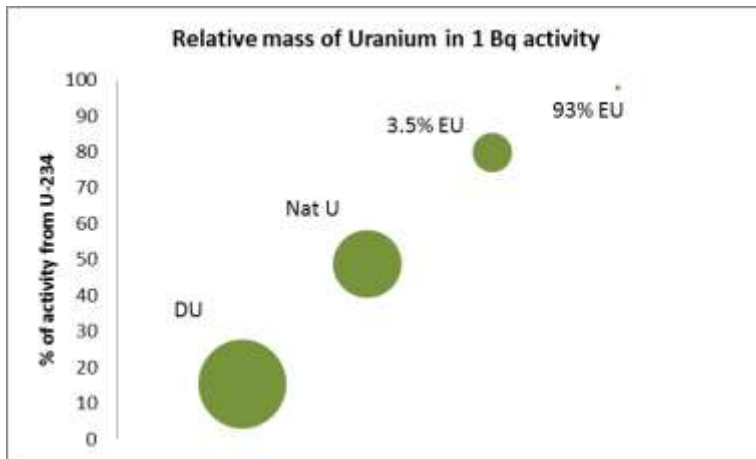
7. Reference levels

ISO 16638-1 GENERAL ASPECTS

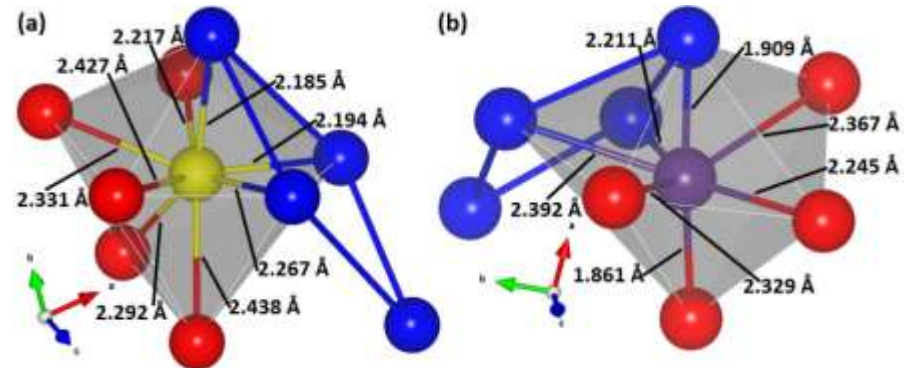
1. Toxicity



2. Different isotopic compositions



3. Different chemical forms



ISO 16638-1 MONITORING PROGRAMMES

Workplace

- Air sampling
- Surface contamination

Individual

- Personal air sampling
- Bioassay measurements

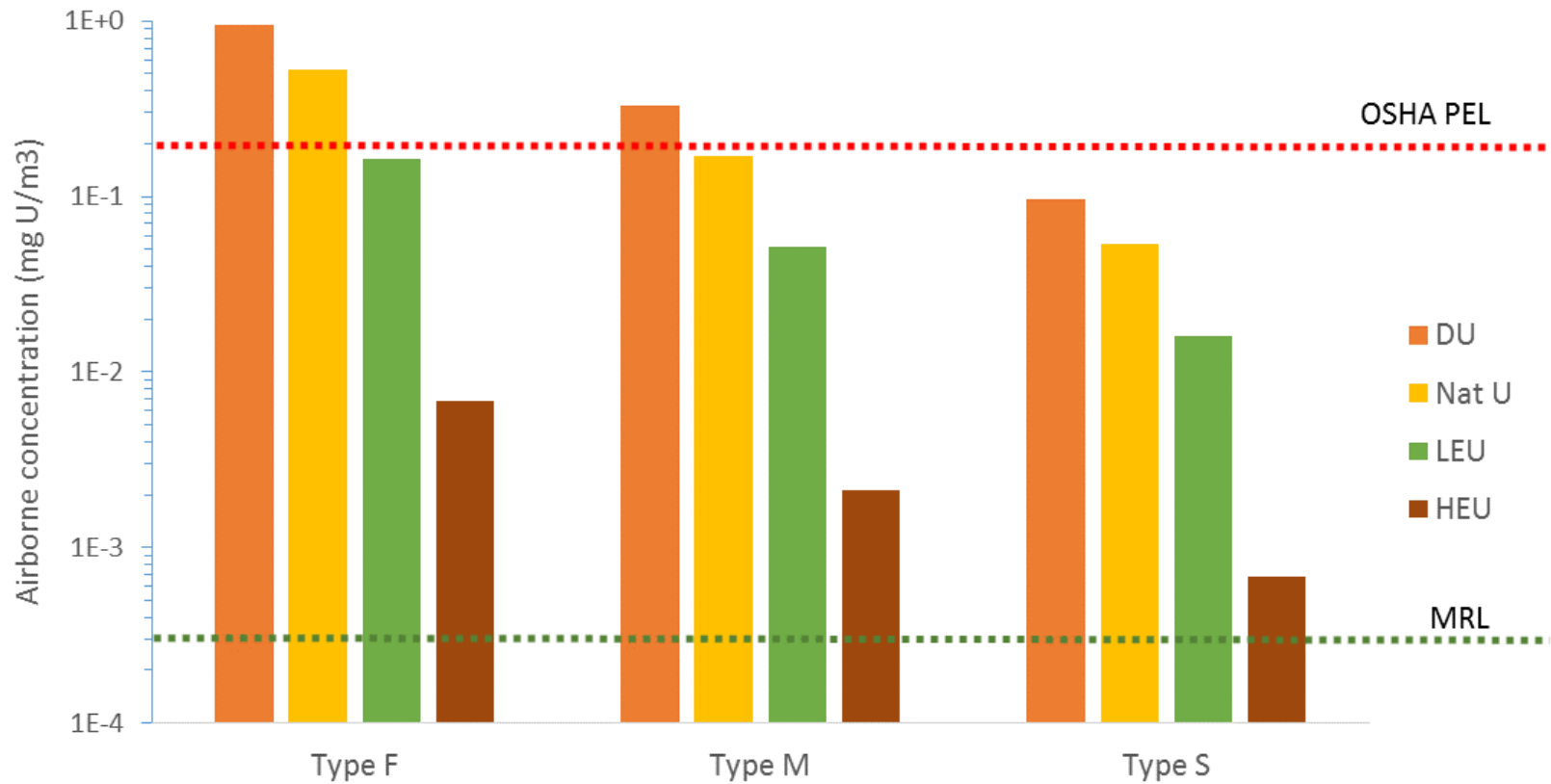
Maximum time interval for routine monitoring programmes

Radionuclide /material	Absorption type	Urine Max interval (days)	Faeces	Lung
UF ₆ , ADU..	F	30*		
UO ₃ ..	M	90	180	180
UO ₂ ..	S	90	180	180

* Spot samples can be used for screening for toxicological risks

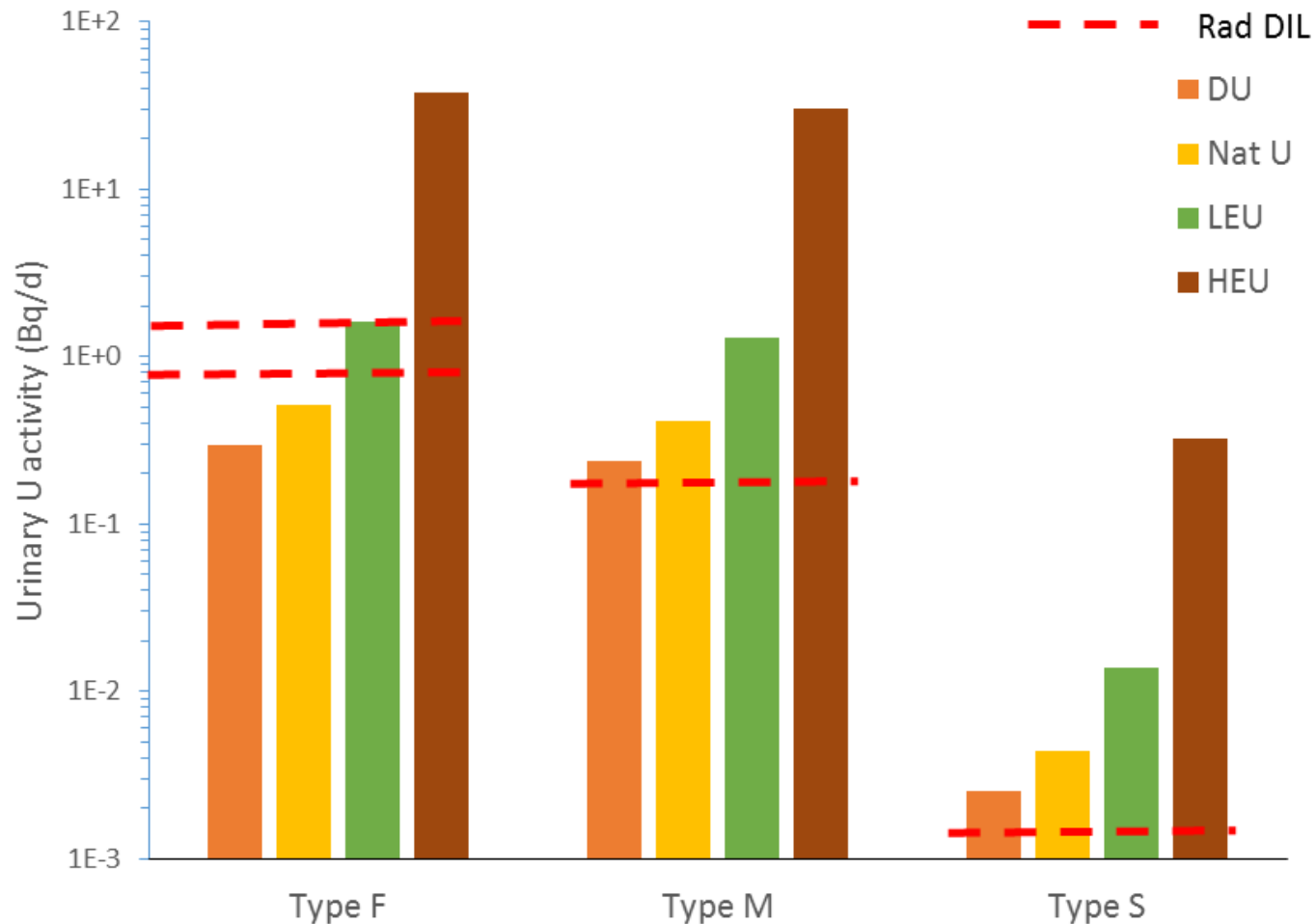
ISO 16638-1 AIRBORNE REFERENCE LEVELS

Bars show continuous air concentrations that would lead to a dose of 20 mSv over 1 year



ISO 16638-1 URINARY REFERENCE LEVELS

Bars show urinary DILS based on a kidney concentration of $3 \mu\text{g g}^{-1}$



STANDARDS IN PREPARATION

ISO/CD 16638-2 Monitoring and internal dosimetry for specific materials
— Part 2: Ingestion of uranium compounds

ISO/NWIP 20031 Monitoring and dosimetry for internal exposures due to
wound contamination with radionuclides

ACKNOWLEDGEMENTS

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- ISO 20031 project leader Fabrice Petitot

Anyone who has commented on a standard!

AWE plc

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