

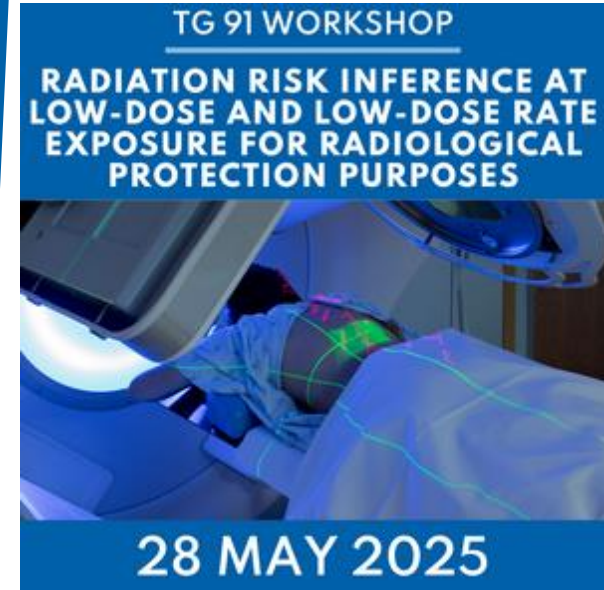
Introduction and History of DDREF

TG91 Workshop

Radiation Risk Inference at Low-Dose and Low-Dose-Rate Exposure for Radiological Protection Purposes

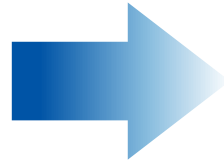
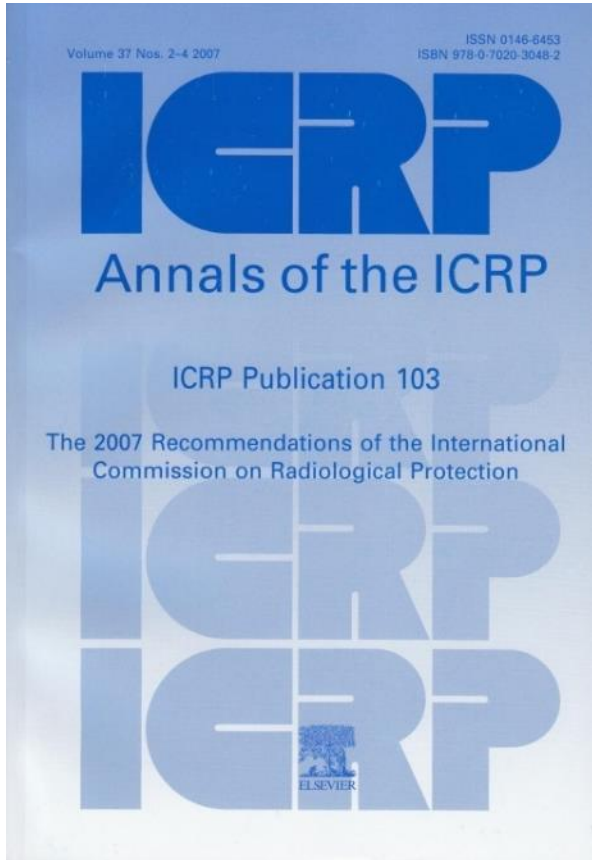
May 28, 2025

ICRP: UK Registered Charity 1166304



Werner Rühm
ICRP Chair
TG91 Chair
BfS, St-ZS

System Review: Time for Action!



- ICRP Publication 103 forms the basis of radiological protection all over the world
- It is time now to review Publication 103 given scientific and societal progress made since 2007
- Identify **basic open questions** (“building blocks”): essential work required for the next general recommendation

Review & Revision of the System of RP

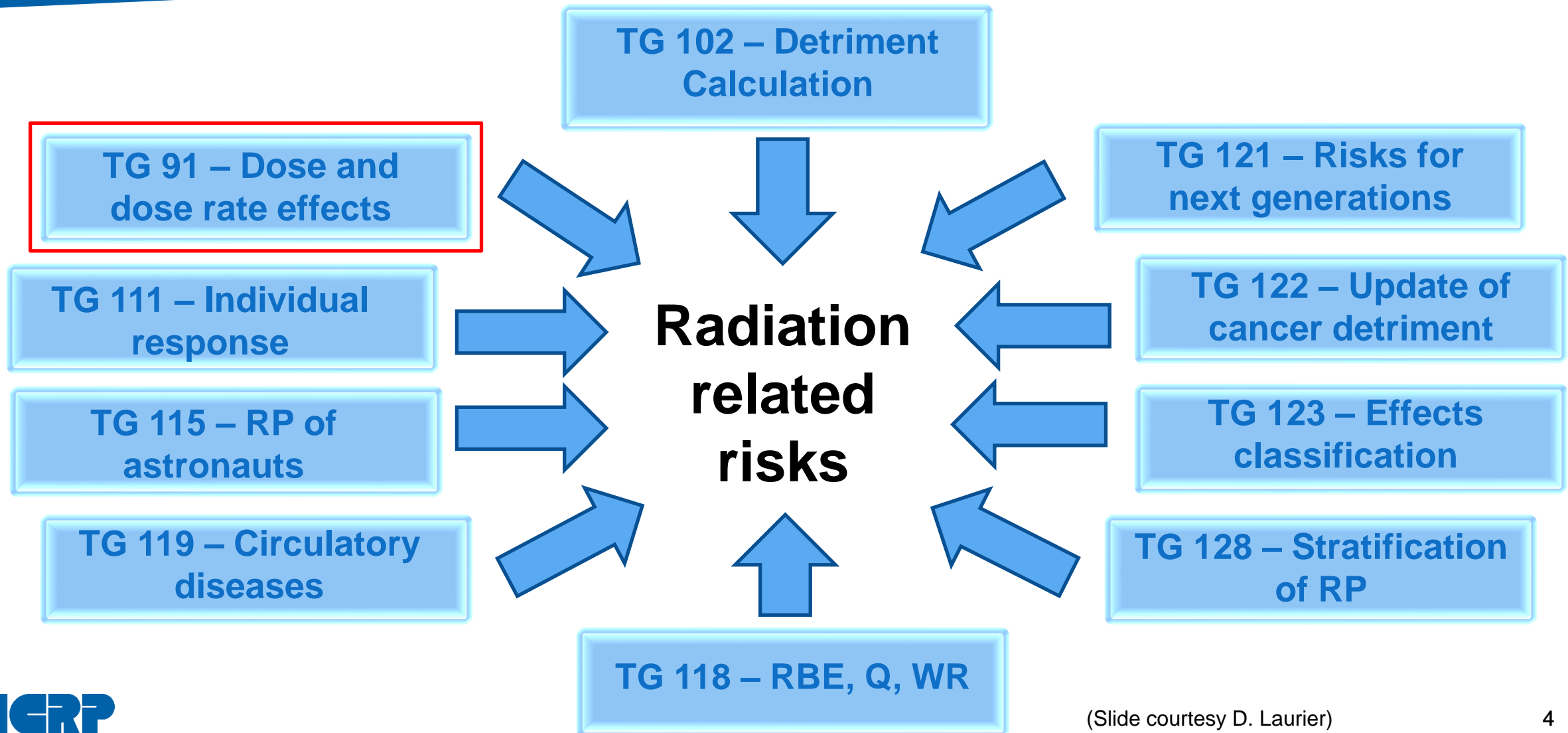
Identify topics ('building blocks') for review ✓

→ Develop building blocks through
ICRP Task Groups

Prepare the next General
Recommendations using
the building blocks

about a decade

Integration of TGs under C1



Role of DDREF in detriment calculation

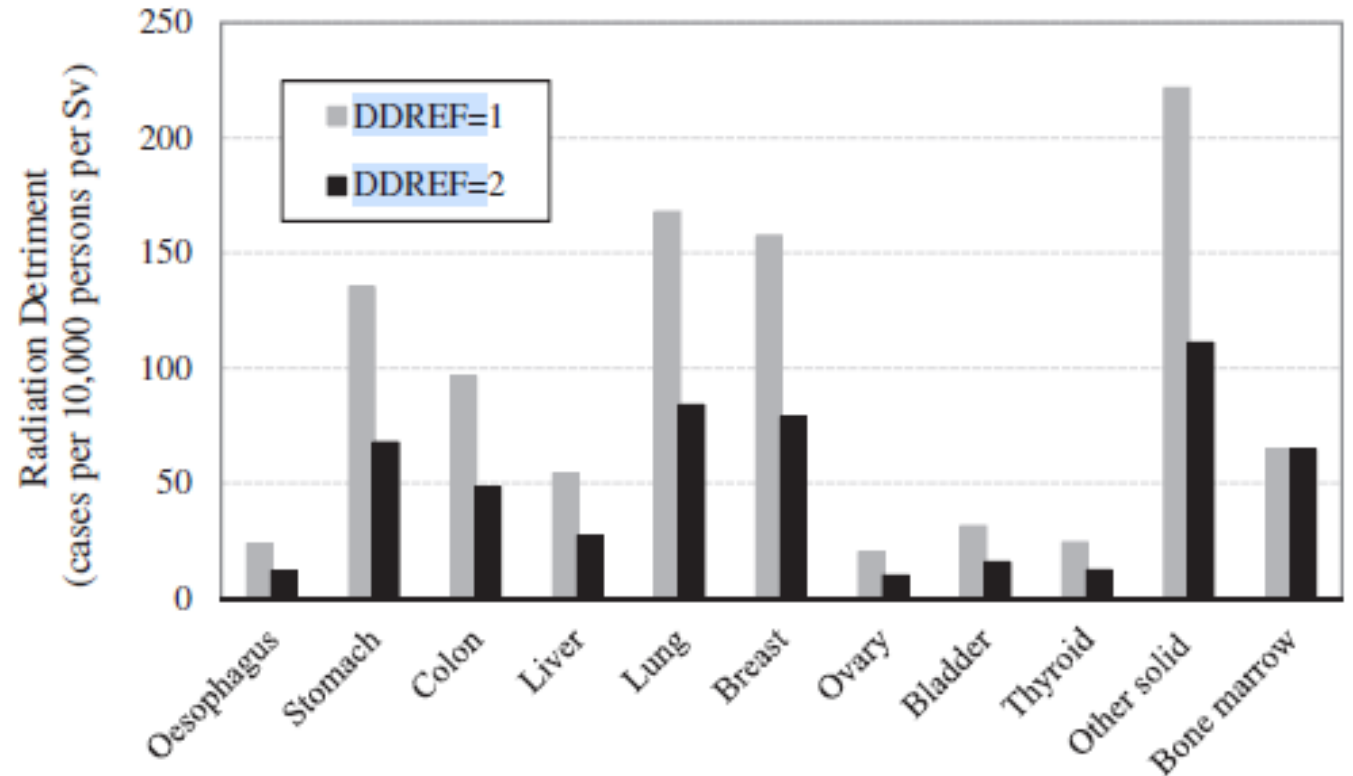
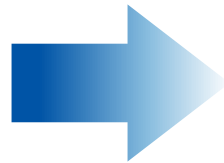
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Calculation Methodology

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„At a glance, **changing DDREF from 2 to 1** appears to have a major effect, as it **doubles the detriment** for all solid cancers“ (ICRP Publ. 152, para 101)

Task Group TG91: “Radiation Risk Inference at Low-dose and Low-dose Rate Exposure for Radiological Protection Purposes: Use of Dose and Dose Rate Effectiveness Factors”

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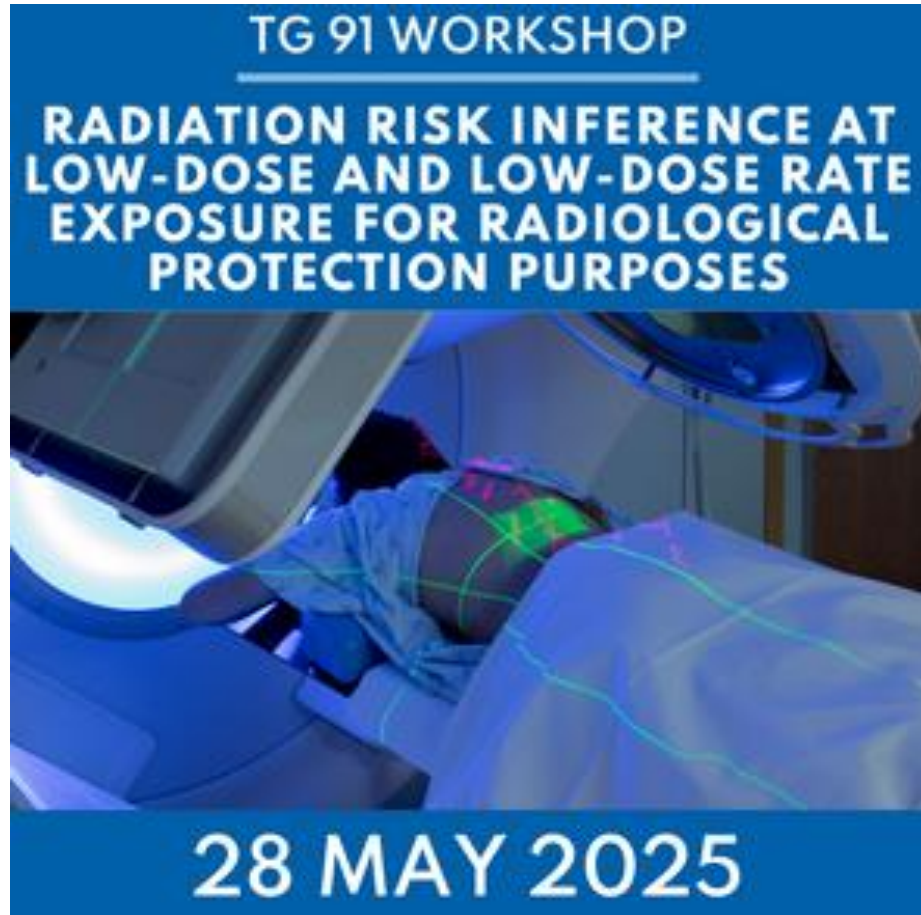
Current Situation

- ICRP uses risk estimates from high dose rate study (atomic bomb survivors)
- Suggests a dose and dose rate effectiveness factor (DDREF) of 2 to apply those risk estimates to the occupational setting

>> TG91 to review the current scientific evidence with focus on LDEF (low dose effectiveness factor) and DREF (dose rate effectiveness factor)

• Low dose: < 100 mGy • Low dose rate: < 0.1 mGy / min averaged over 1 hour

TG91 ICRP-Workshop on DDREF



TG91 Draft Report is online for public consultation

- Since 12 March 2025
- Report describes the **Scientific Evidence** Relevant to the Assessment of **Solid Cancer** Radiation Risk at Low Dose and Low Dose Rate.
- Report is available **until 13 June 2025**
- Workshop addresses **important points** of the report through presentations by Task Group members. Attendees will have an opportunity to participate through a **moderated Q&A session**

The draft report – content and major points



DRAFT REPORT FOR CONSULTATION: DO NOT REFERENCE

ICRP ref. 4904-3744-8231

Annals of the ICRP

ICRP PUBLICATION XXX

Scientific Evidence Relevant to the Assessment of Solid Cancer Radiation Risk at Low Dose and Low Dose Rate

Editor-in-Chief
C.H. CLEMENT

Associate Editor
K. NAKAMURA

Authors on behalf of ICRP
xxx

PUBLISHED FOR

The International Commission on Radiological Protection

by



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<https://www.icrp.org/consultation.asp?id=AABD4A34-8877-4A67-8F88-0CC192C8AC29>

TG91 ICRP-Workshop on DDREF

Programme

Reflects the content of the report

12:00
UTC



Introduction and History of DDREF
Werner Rühm (ICRP & BfS, Germany)

12:10
UTC



Evidence from Cellular Studies
Simon Bouffler (ICRP & UKHSA, UK)

12:20
UTC



Evidence from Experimental Animals
Gayle Woloschak (Northwestern University, USA)

12:30
UTC



Evidence from Epidemiology & Dose Rate Meta Analyses
Linda Walsh (University of Zurich, Switzerland) & Roy Shore (New York University School of Medicine, USA)



12:40
UTC



Evidence from Epidemiology & Dose Curvature Analyses
Mark Little (National Institutes of Health, USA) & Kotaro Ozasa (Kyoto Prefecture University of Medicine, Japan)



12:50
UTC



Evidence from Mechanistic Modelling
Michiaki Kai (Nippon Bunri University, Japan) & Werner Rühm (ICRP & BfS, Germany)



13:00
UTC



Conclusions of the Report
Werner Rühm (ICRP & BfS, Germany)

13:10
UTC

Q&A

A Bit of History

NCRP 1980

- Introduced the “dose-rate effectiveness factor (DREF)”
- For a variety of endpoints **in animal models values between 2 and 10 were observed**

UNSCEAR 1988

- “... such a factor certainly **varies very widely with individual (human) tumour type** and with dose rate range. However, an appropriate range to be applied ... should lie between 2 and 10”

ICRP 1991

- Introduced the “Dose and Doserate Effectiveness Factor (DDREF)” **with a value of 2**
- Acknowledged that the chosen **value of 2 might be somewhat arbitrary**, and it was felt that **it may be conservative**

UNSCEAR 1993

- **Suggested a value of about 2 for DDREF**, based on radiobiological information, animal data, and human data from epidemiological studies
- **Substantial uncertainties with this value were acknowledged**

A Bit of History

UNSCEAR 2006 (approach confirmed recently in 2017)

- Fitted the LSS data using a dose-response curve that included a quadratic component
- In this way, an LDEF was implicitly taken into account
- *Values of DDREF of about 2 consistent with this approach*

BEIR VII, 2006 (US)

- Bayes analysis yielded a range of values: 1.1 – 2.3 with a point estimate of 1.5

WHO 2013 (Fukushima Report)

- Did not use a DDREF

SSK 2014 (Germany)

- Suggested a DDREF of 1

SENES Report 2017 (To be used in the US for compensation claims)

- Suggests 1.3 (50%) and a range of values of 0.47 – 3.46 (5% – 95%)

Review done ✓

In Rühm, W., Woloschak, G. E., Shore, et al. (2015) Dose and dose-rate effects of ionizing radiation: a discussion in the light of radiological protection. Radiat Environ Biophys 54: 379-401

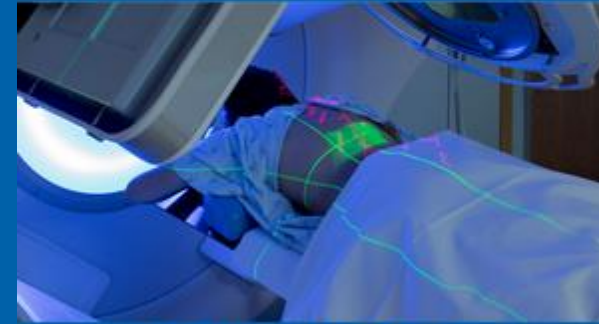
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THANK YOU!

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TG 91 WORKSHOP

RADIATION RISK INFERENCE AT
LOW-DOSE AND LOW-DOSE RATE
EXPOSURE FOR RADIOLOGICAL
PROTECTION PURPOSES



28 MAY 2025