

Radon: Where is the RP world today and what lies ahead?

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www.nrpa.no

Content

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- Norway as a case study
- Present focus
- The Future
- Conclusion



History..

- Radon is one of the most studied carcinogenic substances (BEIR VI, 1999).
- As early as the 16th century, increased mortality was documented due to disease related to breathing / the airways in the metal miners in the Erz Mountains in Germany.
- But it was not until the 1920s that respiratory disease was identified as lung cancer.
- High concentrations of radon were then detected in the mines and a hypothesis was that radon was the cause.
- In the 1950s, radon was determined as a cause of lung cancer.
- In 1988, radon was classified as a human carcinogen by the IARC.



History

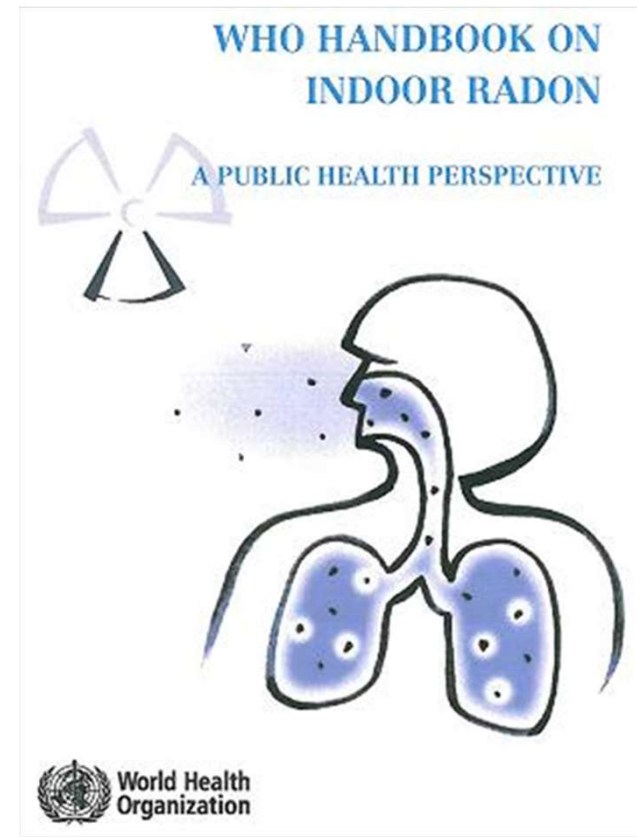
Many ICRP publications:

- ICRP Publication 24 (1977): Radiation Protection in Uranium and Other Mines
- ICRP Publication 31 (1981): Biological Effects of Inhaled Radionuclides
- Publication 65 (1993) Protection against Radon- 222 at home and at work
- Publication 103 (2007) Recommendations
- Publication 115 (2010) Lung Cancer Risk from Radon and Progeny + Statement on Radon
- Publication 126 (2014) Radiological Protection against Radon Exposure
- Publication 137 (2017) Occupational Intakes of Radionuclides, Part 3



WHO Handbook

- 2005, WHO International Radon Project (IRP).
- Strategy to reduce the number of radon induced cancer cases and to raise public and political awareness
- Reference level of 100 Bq / m³ can be defended from a public health perspective

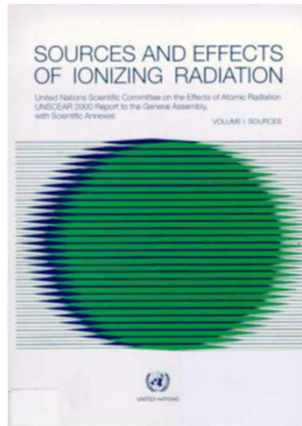


WHO Handbook

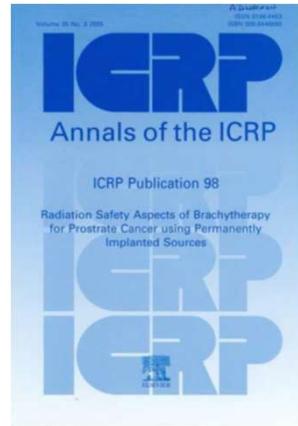
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IAEA Safety Standards



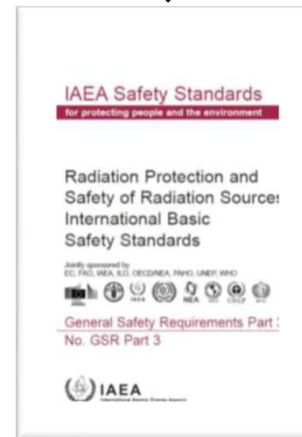
Effects of radiation



Recommendations for protection



Essential principles (moral obligation)



Essential requirements (legal obligation)



IAEA Safety Standards for Radon

- SF-1: Fundamental Safety Principles (2006)
- GSR Part 3: Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (2014)
- SSG-32: Protection of the Public against Exposure Indoors due to Radon and Other Natural Sources of Radiation (2014)



EU BSS – similar story

Also published in 2014.

Radiation protection: All sources of radiation, including natural sources of radiation.

Includes e.g., Action Plan for radon

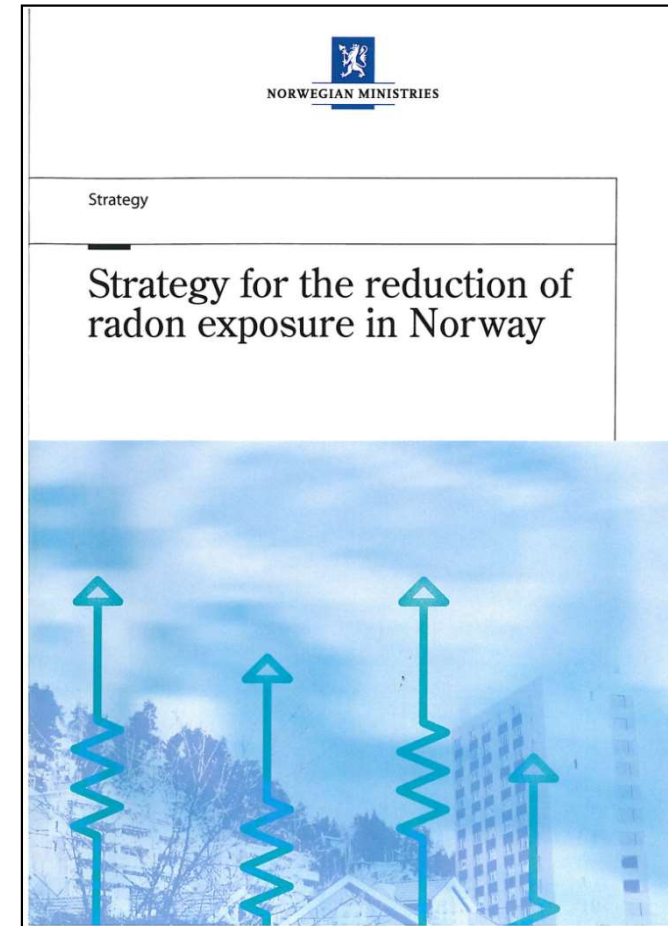
Assignment of responsibilities (governmental and non-governmental), coordination mechanisms and available resources for implementation of the action plan.

To have been implemented by all member countries February 2018.



Norway as a Case Study

- The Norwegian government adopted its **national radon strategy** 2009.
- Harmonised with WHO, IAEA and EU BSS requirements for a radon action plan.
- Two strategic goals –
 - Reducing radon levels in all buildings.
 - Reducing radon exposure in Norway as low as reasonably achievable.



National Reference levels

All buildings should have radon levels as low as reasonably achievable and within recommended limits:

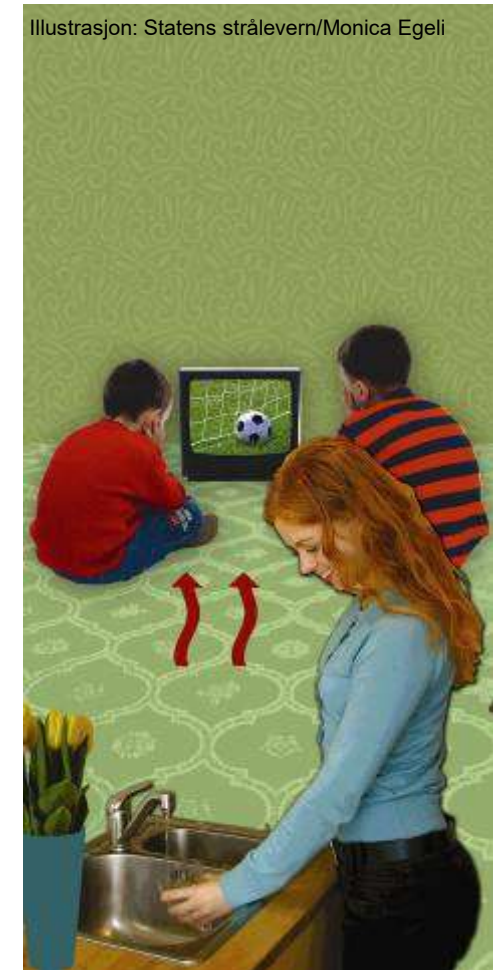
- 100 Bq/m³ – Action Limit
- 200 Bq/m³ – Maximum Limit



Six sub-strategies

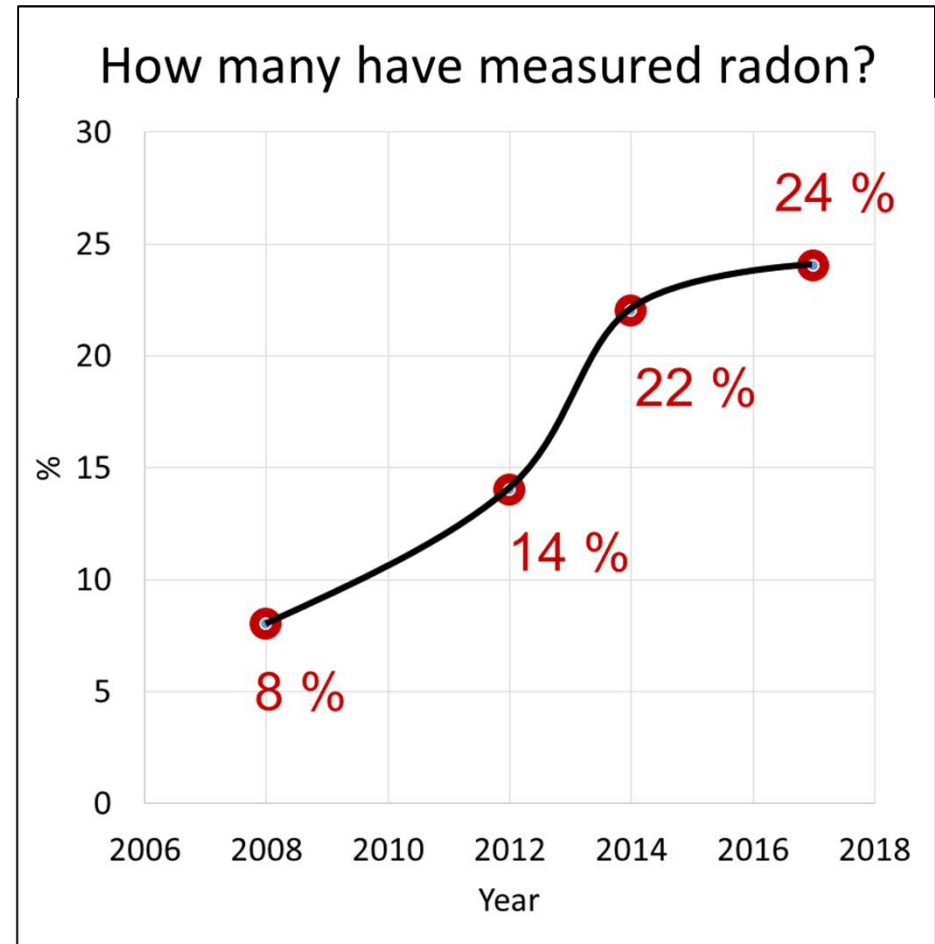
Sub-strategies all have separate goals and suggested initiatives:

- Radon in land planning
- Radon with regard to new-build
- Radon in existing homes
- Local communities in Norway with extreme radon problems
- Radon in buildings and localities where the public have access
- Radon in the workplace



Increased public awareness

- The radon strategy and new regulation has increase public awareness



Regulation: Construction of new buildings

Since 2010:

- Legally binding limits for indoor radon concentrations in new buildings: 200 Bq/m³
- Mandatory anti-radon measures in building constructions
- Almost 0% houses with a radon problem



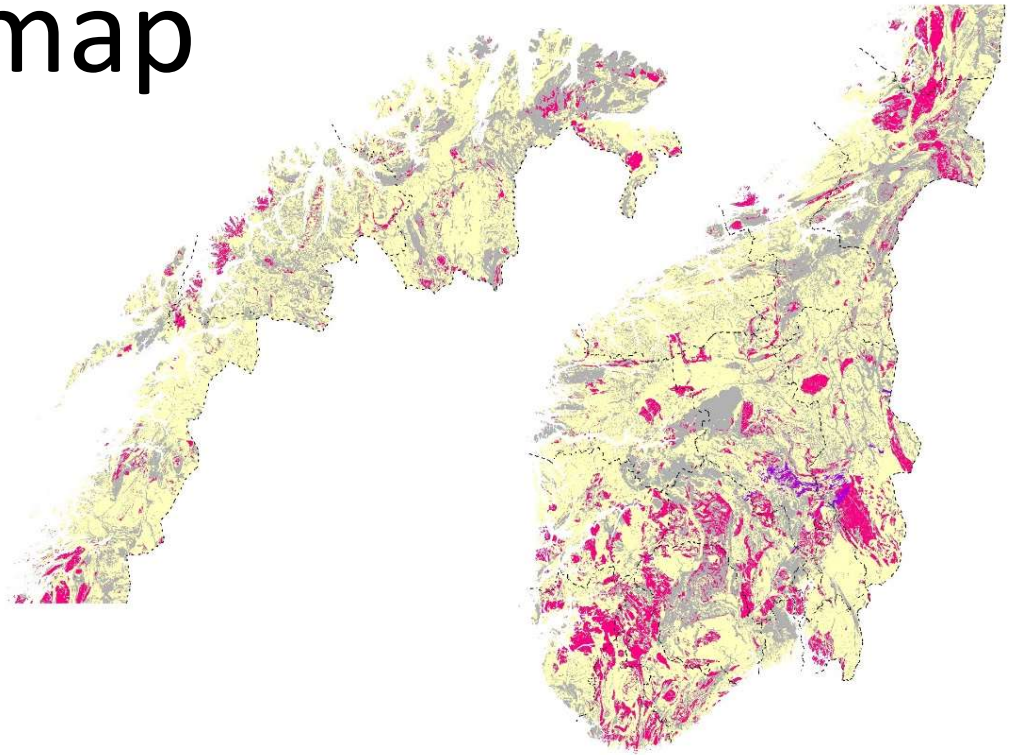
Regulation: Schools, kindergartens and rental accomodation

- Legally binding indoor radon limits, in force since 2014:
 - 100 Bq/m³ action level
 - 200 Bq/m³ maximum level



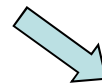
«Radon risk» map

- All of Norway defined as a «radon prone area»
- Some areas “more prone” than others
- For the municipalities in land planning etc.



Present focus

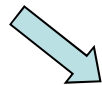
exposure



Dosimetry
DCF

Epidemiology

RISK



Public
health

effektive
dose

- **Workers**



UNSCEAR and ICRP - DCF

Org	Year	Location	Group	DCF mSv/WLM
UNSCEAR	1983	Dwellings	Public	5.7
UNSCEAR	2006	Dwellings	Public	9.6
ICRP 65	1993	Dwellings	Public	4
ICRP 65	1993	Mines	Worker	5
ICRP 126	2015	Mines	Worker	11
ICRP 123	2015	Dwellings	Public	13
ICRP OIR3	2017	Mines	Worker	11
ICRP OIR3	2017	Workplaces	Worker	22
ICRP OIR3	2017	Workplaces	Light Work	15
ICRP OIR3	2018	Mines	Worker	10
ICRP OIR3	2018	Dwellings	Public	10



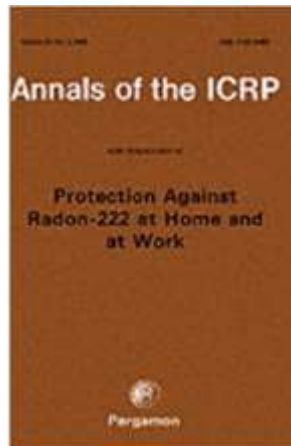
UNSCEAR and ICRP

ICRP 65 (1993)

6 nSv per Bq.h.m⁻³ EEC ~4 mSv(WLM) ⁻¹

→ 10 mSv.yr⁻¹ ~ 600 Bq.m⁻³

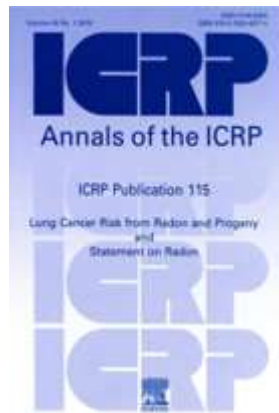
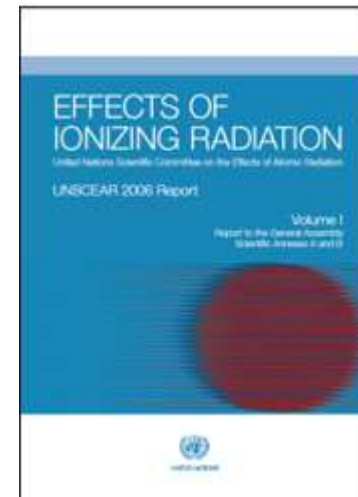
~30% greater than UNSCEAR



UNSCEAR

9 nSv per Bq.h.m⁻³ EEC

→ 10 mSv.yr⁻¹ ~ 400 Bq.m⁻³



ICRP 115 (2010)

14 nSv per Bq.h.m⁻³ EEC ~9 mSv(WLM) ⁻¹

→ 10 mSv.yr⁻¹ ~ 300 Bq.m⁻³

~30% lower than UNSCEAR



UNSCEAR radon expert group

- LUNG CANCER FROM EXPOSURE TO RADON AND TO PENETRATING RADIATION

AIM AND OBJECTIVES:

- Clarify the approaches to assessing doses and risks of lung cancer from exposure to radon and thoron,
 - based on the best and most up-to-date knowledge (including the risks from radon and thoron exposure and the risks from external exposure, and developments in dosimetry).

TIME:

- Launched 64th in 2017/ first discussion 65th in 2018 / Approval aimed 66th in 2019



UNSCEAR radon expert group

OBJECTIVES:

1. **Current status of evidence** regarding increased frequency of lung cancer for **smokers and non-smokers**, and for subgroups **of different age and sex**, due to exposure to radon and thoron? What is the confidence in any inferred risk estimates?
2. Current status of evidence regarding increased frequency of lung cancer for smokers and non-smokers, and for subgroups of different age and sex, due to **external exposure** to penetrating radiation? What is the confidence in any inferred risk estimates?
3. Should a dose be assigned to a given incorporation of radioactivity of radon and thoron in order to estimate radiation effects and risks or it be performed directly from the epidemiological evidence?
4. What dose conversion factors are to be used by the Committee in its future assessments of global exposure to radon and thoron in workplaces and homes?



UNSCEAR radon expert group

Feedback from the 65th Session:

1. Focus on radon and lung cancer (penetrating radiation and thoron to be covered but to a lesser degree).
2. Different age groups and smoking are focus areas too.
3. Including the latest data
 1. The group has been expanded to include participants from on-going studies (Canada, Germany, France, PUMA).
 2. The aim is to include some form of comparison data in the final expert group report.



The future.....

- Considering advancing technology and evolving society, what issues are there on the horizon in radiological protection?
What could/should be done?
- Ideally, where should radiological protection be a decade from now, and what is ICRP's role in getting there?



Technology: Measurement devices

- CRM – Continuous Radon Monitors record real-time continuous measurements of radon gas and reports the results, generally in hourly increments
 - CRM could greatly influence the amount of radon measurement, both at work and in the home.
 - They can also make ensuring regulatory compliance a much easier task.
 - Possibilities exist to improve risk assessments too.
- .



Radon mitigation

- Focus - cost effective actions
- Trust and quality of workmanship
 - Training of building entrepreneurs
- Practical



New Build

- Gradually the housing stock can become more radon-safe
- Regulation is important
- Technological developments in construction can facilitate better mitigation methods in existing buildings



A public health issue

- Public health is "the science and art of preventing disease, prolonging life and promoting human health through organized efforts and informed choices of society, organizations, public and private, communities and individuals".
- Public health is interdisciplinary



Source: Colorado official state webportal

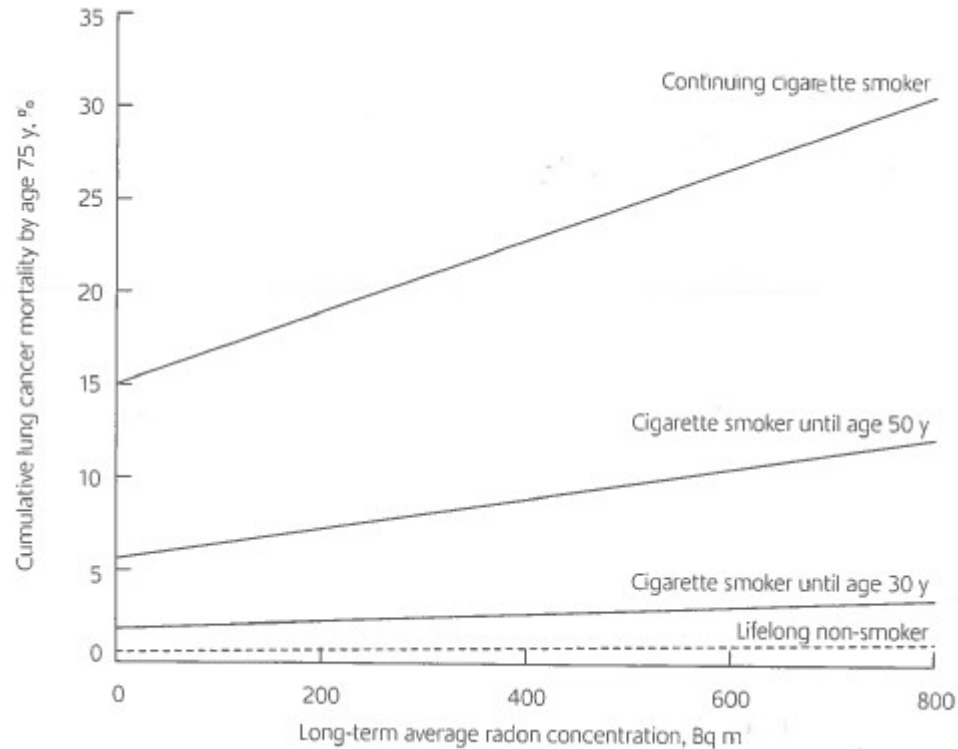


Radon as a public health issue

- Radon is not only an RP issue
- Many sectors in society need to be involved
- Working towards a more common approach for radon and other health risks
 - Working with health authorities is vital
- The role of smoking needs more attention



Smoking and radon and the Sv



Cumulative absolute risk of death from lung cancer by age 75 years versus long-term average radon concentration at home for continuing cigarette smokers, ex-smokers and lifelong non-smokers (in UK, source: HPA)



Other health effects than lung cancer

- Leukemia ?
- Skin cancer ?



Conclusion

- UNSCEAR, WHO, IAEA and ICRP all have an important role to play
 - Finding the best available epidemiological evidence
 - Disseminating information about risks
 - Protecting the population, where appropriate
 - Graded approach for workplaces
- Radon, also a public health issue = more tools than solely RP...
 - Guidance
 - More established routes of communication to the public
 - Contact with health authorities
 - Regulation
 - Harmonization



Acknowledgment

- William Standring
- Stephen Solomon

