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Practical implementation of anticipated radon dosimetry changes in the mining industry

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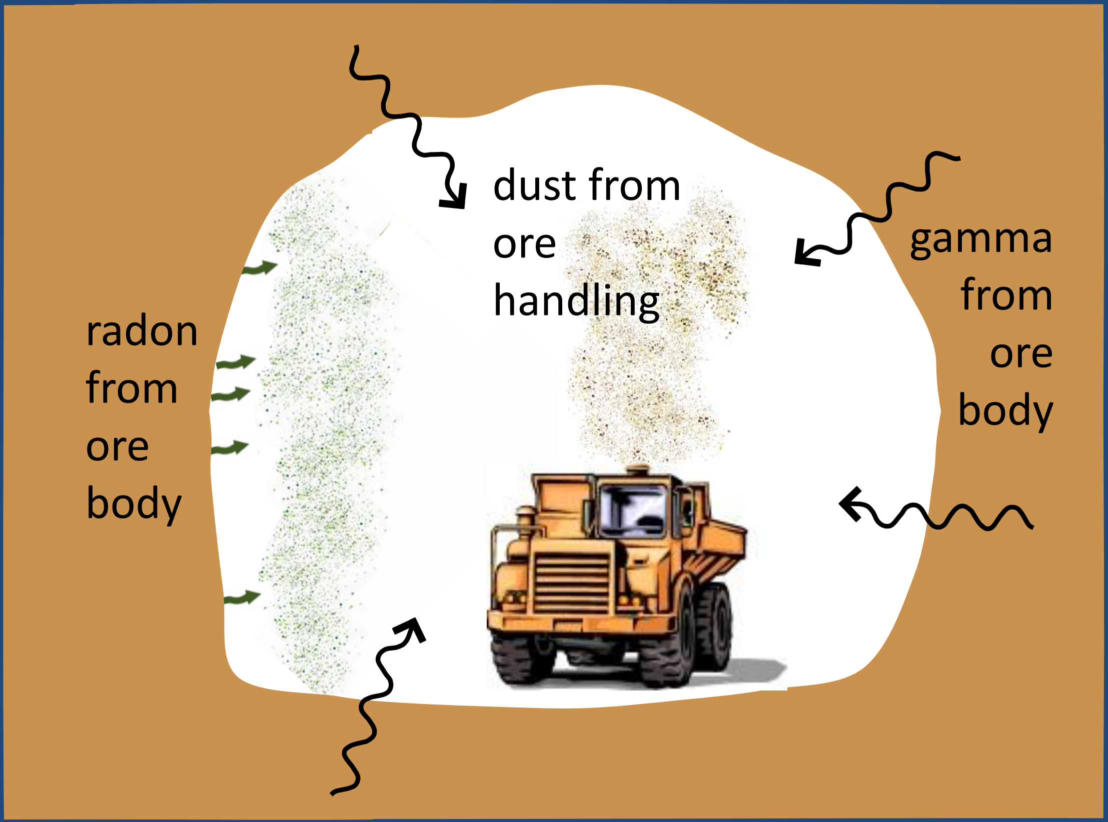
Assessing doses from radon

Radon Decay Product (RDP) exposure is measured in terms of PAEC (Potential Alpha Energy Concentration) in (mJ m^{-3}) and time.

^{222}Rn exposure is measured in terms of activity concentration in (Bq m^{-3}) and time.

Effective dose is calculated from a recommended dose conversion factor (DCF)

Radiation exposure in a mine



Currently: DCF = 1.4 mSv per (mJ h m^{-3})

Why the change?

Epidemiology

ICRP 60 and 65

Radon risk:
8 x 10^{-5} per (mJ h m^{-3})

Effective dose risk:
5.6 x 10^{-5} per mSv

Equating risks:
DCF: 1.4 mSv per (mJ h m^{-3})

ICRP 103 and 115

Radon risk:
8 x 10^{-10} per (Bq h m^{-3})

Effective dose risk:
4.2 x 10^{-5} per mSv

Equating risks:
DCF: 3.4 mSv per (mJ h m^{-3})

→ Increase: 2.4 times (Dose conversion convention)

Dosimetric modelling

Statement on Radon†

DCF: 3.0 mSv per (mJ h m^{-3})*

→ Increase: 2.2 times (Dose coefficient)

†Move to dosimetric modelling

*Draft OIR Part 3 – for mines

What to do?

Need for review:

- Assess effective doses using the new DCF;
- Review the adequacy of the dose assessment program;
- Review the optimization of protection of the workforce; and
- If necessary, take action to reduce exposure to radon.

Anticipate the change:

- Be prepared: all of the above can be assessed in advance;
- Engage with the workforce: explain what is likely to happen;
- Engage with the regulatory body: agree on the strategy; and
- If necessary, source equipment suppliers and service providers, and develop drafts of new procedures.

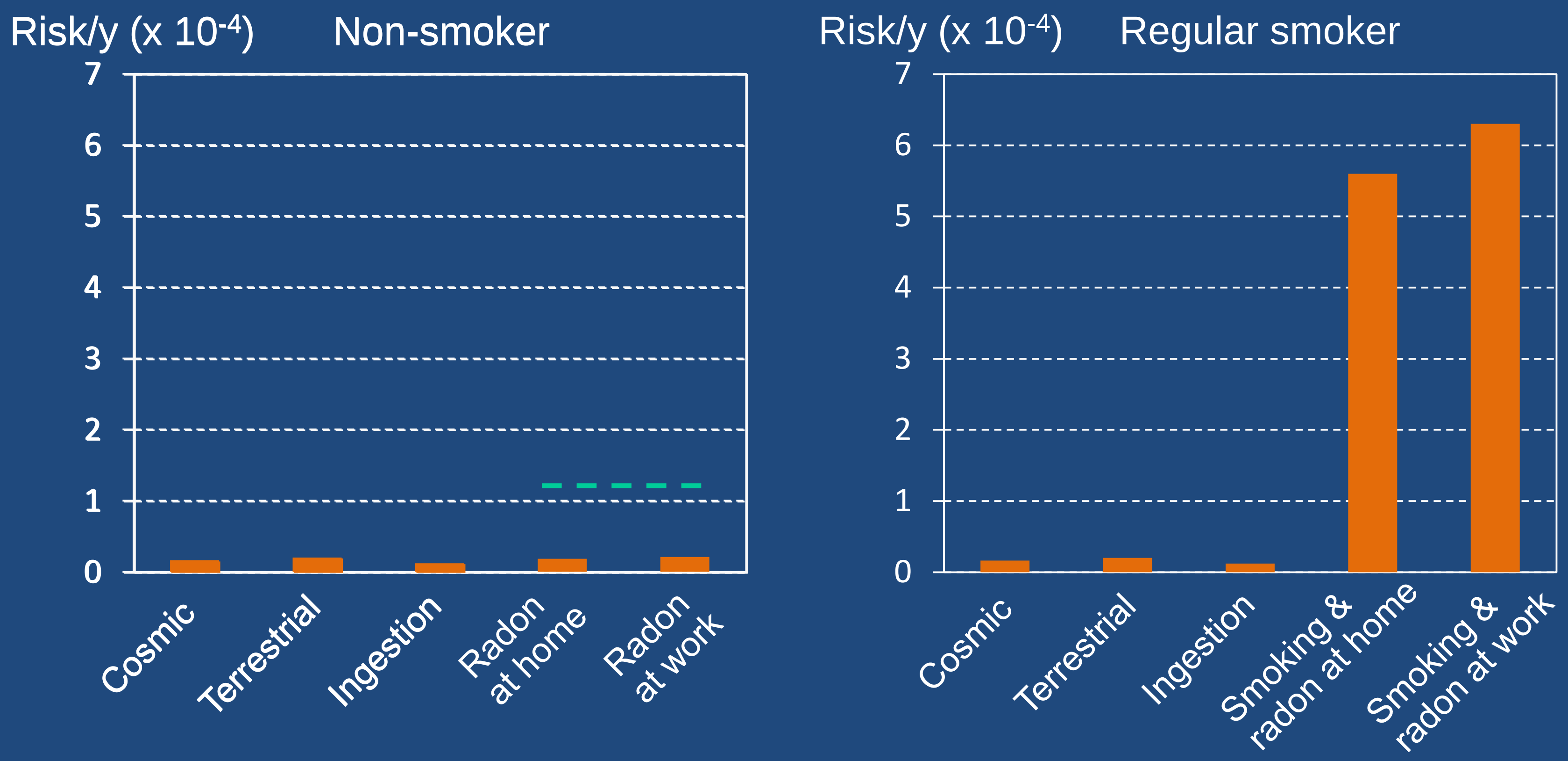
Review dose assessment

Greater accuracy needed?

- Does the current procedure make conservative assumptions which could be reduced? For example, is time in air-conditioned cabins taken into account?
- Will some (or more) workers need to be assessed through personal monitoring?
- If doses are high, is characterization of the mine atmosphere needed? For example, would amendment of the DCF for particle size be implied?
- Note that dose records will need to include the DCF used.

Discourage smoking!

Nominal risks* from natural background and from 0.5 µJ m^{-3} at work



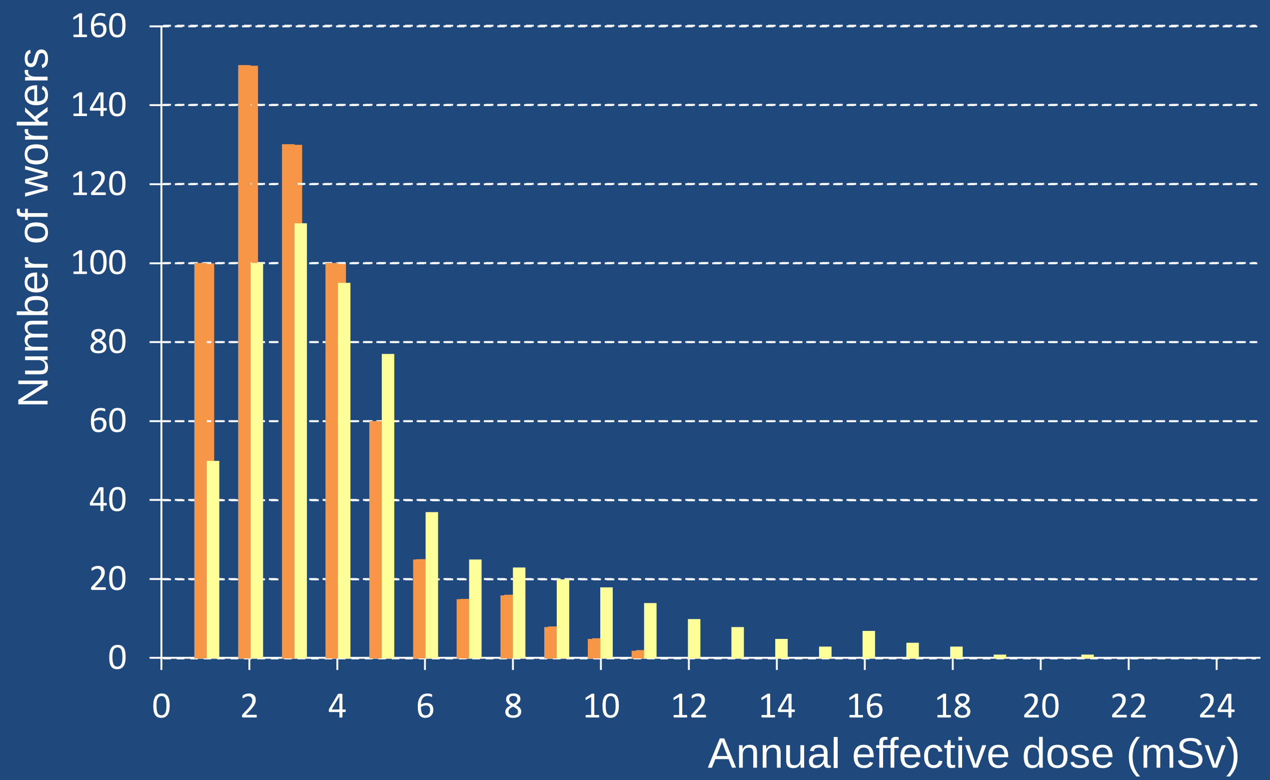
*risk coefficients from ICRP103 and ICRP115; cosmic, terrestrial and ingestion global average doses from UNSCEAR 2008; radon: 50 Bq m^{-3} at home, 0.5 µJ m^{-3} at work; *approximate* non-smoker risk (avg /6) and regular (>25 cig/day) smoker risk (avg x5).

Optimize protection

- Do the changes imply a need to reduce exposure?
  E.g. Could the most exposed workers exceed dose constraints?
- Review mine ventilation, especially underground.
  E.g. More clean air? (Watch out for unattached fraction.)
- Are there sources that can be better controlled?
  E.g. Dewatering? Control of other pathways?
- Apply engineering controls where possible.
  E.g. Air-conditioned cabins on mobile equipment. Automation/robotics?
- Apply administrative controls.
  E.g. Review reference levels for mine clearance, etc.
- Use personal protective equipment.
  E.g. Respirators, filtered-air hardhats.

Increase in assessed doses

- Dose constraint exceeded?
- Dose limit exceeded?



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Engineered controls

Some examples

Air-conditioned cabins

Before

After

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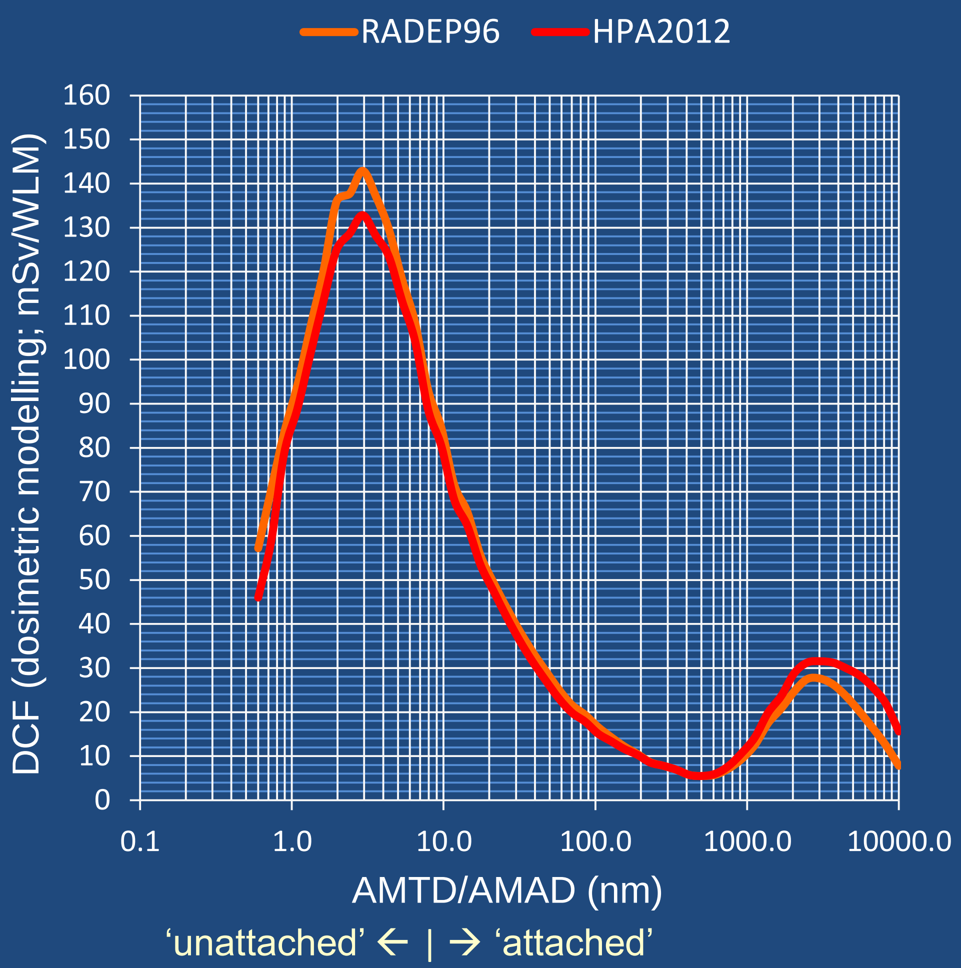
The particle size issue

ICRP126: use the default DCF!

Theoretically, the DCF may need to be modified to take account of mine air characteristics, such as particle size.

Note: filtering out radon decay products may also reduce the concentration of nucleation sites, resulting in a higher unattached fraction.



Planned vs. Existing Exposure Situations

Mines currently treated as existing exposure situations

- Review the radon reference level value: decrease by 2?
- Continue to optimize protection below the new reference level.
- If not possible, consult with the regulatory body:
  the requirements for planned exposure situations may need to be applied.

Mines regulated as planned exposure situations (summary)

- Review dose assessment and optimization of protection.
- Minor improvements, as outlined, are likely to be adequate to continue to meet regulatory requirements.
- In some cases of high radon or RDP concentration, significant reduction of exposure may be needed.