European ALARA Network

The application of the ALARA principle to radon in the workplace : Feedback from the European ALARA Network

The ALARA for Radon at Work (A-RAW) working group

Sylvain ANDRESZ (CEPN, France)
Ulrike KULKA (BfS, Germany)
Julie MORGAN (UKHSA, United Kingdom)
Cristina NUCCETELLI (ISS, Italy)
Martha PALACIOS (SFOPH, Switzerland)
Caroline SCHIEBER (CEPN, France)
Malgorzata SNEVE (DSA, Norway)
Nicolas STRITT (SFOPH, Switzerland)
Hugh SYNNOTT (EPA, Ireland)
and Fernand VERMEERSCH (SCK CEN, Belgium)

Context and objectives

- **The questions**
  - Challenges associated with the practical implementation of the BSS Directive 2013/59 requirements for radon
  - What are the commonalities and differences
  - Application of the graded approach for optimisation (ALARA) purposes

- **The method**
  - Established the ALARA for Radon At Work working group (EAN A-RAW) (from Jan. 2021)
  - Designed a survey : radon regulation + case studies
  - Circulated survey by email (June-September 2021)
  - Qualitative analysis of the data collected

Answers received

Country	Details of the case studies
Belgium (B)	2 cases: • Show cave • Water pumping facility
France (F)	2 cases: • Cooking equipment factory • Veterinary clinic (underground)
Ireland (IRL)	1 generic case: 4,000 schools
Norway (N)	Overview of the regulation
Slovenia (SLO)	1 case: Show cave
Switzerland (CH)	3 cases: • "A company" • An industrial building with open work space • 200 water supply facilities
United-Kingdom (UK)	2 cases: • Heritage castle • Mine

Identification of workplaces

Workplace	Scope	Location	Action
Specific workplaces	List (cave, dam, sewage, …)	All locations	Measurement
Ordinary workplaces	All workplaces at ground level	• All locations (B, CH, F, N, UK) • Radon prone area only (IRL, SLO)	Radon risk assessment (to determine if measurement required)

- Location in radon prone area (if not previously considered)
- Basement (underground areas) if "regularly occupied" (*1h/week*" (UK), "*15 h/week*" (B), "*several h/d*" (CH), …)
- Radon presence suspected
- Building characteristics

① Elevated number of workplaces concerned by the regulation

② Challenges in communication (incl. Labour Inspectorate)

③ Guidance needed for the risk assessment?

Initial measurement

- **Most protocols based on 'classical' passive measurement**
  - Winter season min. 2 months (FR, N) or min. 3 months (BE, CH, IRL, UK);
  - Min. 1 month in the winter and 1 month in the summer (for specific workplaces, CH);
- **Mixed provisions with regard to active measurement:** not stipulated (F, IRL), possible (B, UK), part of measurement (N) , mandatory (specific workplaces, BE, SLO)

Value in radon concentration	Country	Usage
100 Bq.m^{-3}	N	Action level: active measurement needed and, if the value is confirmed, remediation
200 Bq.m^{-3}	N	Maximum level: not to be exceeded
300 Bq.m^{-3}	B, CH, FR, IRL, SLO, UK	• Reference Level: remediation • In UK: ionising radiation regulations apply
1,000 Bq.m^{-3}	CH	Action level: workplace ≡ radon area, dose assessment required and ionising radiation regulations apply

① Legacy of former national radon management

② Inclusion in Ionising Radiations Regulations possible after initial measurement if > RL

Exposure assessment

The result shall be compared with "*an exposure value of 6 mSv/y or a corresponding time-integrated radon exposure value*" (2013/59/Euratom art. 35(2))

Exposure threshold	Country	Usage
6 mSv/y	F, IRL, SLO, UK	If above, ionising radiation regulation (or comparable requirements) applies In UK the regulations apply above the reference level
6 mSv/y or 0.6 MBq.h/m^3	B	
• Ordinary workplace: 0.36 MBq.h/m^3 • Specific workplace: 0.72 MBq.h/m^3	N	
10 mSv	CH	

But …

- F, SLO and UK: former coefficients published in [ICRP, 1993]
- SLO: specific workplaces where F≠0.4, coefficients in [ICRP, 1981]
- B, CH, IRL and N: recent coefficients published in [ICRP, 2010] or [ICRP, 2017]

① Time-integrated value is close to Working Level Month concept

② Exposure assessment is expected to × 2 or × 4 with most recent ICRP coefficients

③ Number of workplaces concerned by the planned exposure situation ???

Applying ALARA – below reference level

- Occupancy considerations
- Optimised ventilation procedures
- Monitoring required if just below reference level

Applying ALARA – above reference level

- Remediation is recommended in all cases
- Timeframe typically <12 months
- Cost benefit analysis
  - Consider radiation mitigation options
  - Dose savings (individual and collective)
- Hierarchy of controls
  - Engineering controls
  - Procedural controls (if engineered solutions are not sufficient)

Applying ALARA – above exposure value

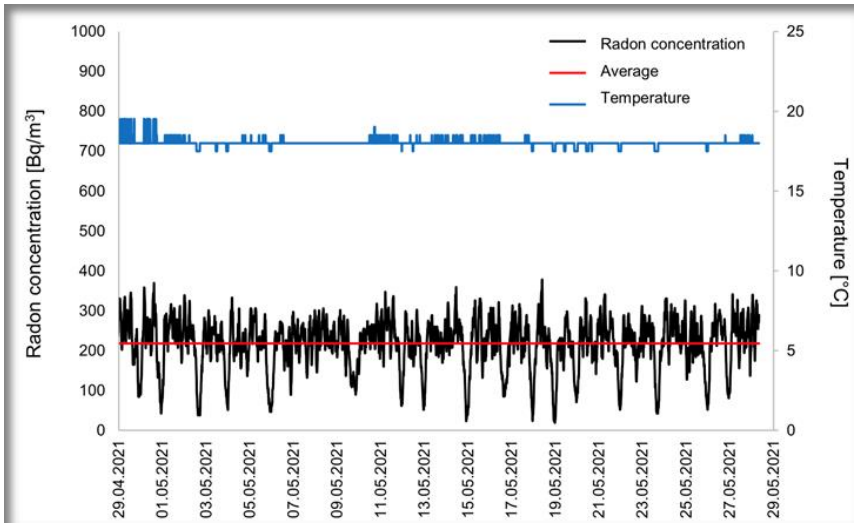
- For doses > 6mSv per year
  - Expert advice mandatory (RPE)
  - Designated areas (radiation controlled areas, radon zones), warning signage
  - Classification of workers (not all countries)
  - Written systems of work to limit exposure
  - Personal dosimetry and area monitoring
  - Active monitoring with personal radon detectors
  - Seek innovative radon mitigation strategies

Case study 1: Switzerland

A company (2020)

- Passive measurements found radon concentration of 350 Bq/m^3 in basement office
- Occupancy of area was ~ 2000 hr / y
- Automatic window opening system in place
- Radon consultant: proposed automatic ventilation system whereby the opening of a window was linked to a dedicated radon detector
- Owner of the building: responsible for radon management

Case study 1: Switzerland



- Test performed to find the threshold and sampling period (300 Bq/m^3 and t=15 min)
- Remediation success validated by passive measurement

Factors that may impact optimisation

- Cost – engineered mitigation options
- Continuous radon measurements are expensive
- Function checks for extraction fans difficult to implement
- Radiation protection culture and training
- Perception of radon as a ‘natural’ source and therefore lower risk

Factors that may impact optimisation

- General lack of awareness that radon regulation may apply
- Radon measurement uncertainties
- Availability/experience of remediation contractors

Next steps and future work

- Share results with RP community
  - Meetings, conferences
  - EAN Newsletter
  - Journal publication

- Further surveys and/or collation of examples of good practice
- Continue the discussion on transversal issues:
  - Integration of radon regulation within existing regulations
  - Applying the graded approach and ALARA principle under the prevailing circumstances

EUROPEAN ALARA NETWORK

Gaining interest in the EAN and its activities?

And remember that EAN is an open network!