Experiences from a high radon area in Norway

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www.nrpa.no
Kinsarvik, Norway
Radon in Kinsarvik

- Very high radon concentrations in most houses. More than 99% above 200 Bq/m³
- Unusual seasonal variations
Radon in Kinsarvik

- High radon levels detected in the kindergarten 1988
- Radon measurement and mitigation project 1996-97
- 1999-2003 economic compensation for mitigation in homes
- Study of outdoor radon 2005-7
- National Strategy and action plan 2009
- New pilot project from 2011
- Still in 2012 a severe radon problem persists
Radon concentrations 1996-97

Mean: 4340 Bq/m³
Median: 2270 Bq/m³

Number of dwellings

Annual mean radon concentration (Bq/m³)

- 200-400
- 400-1000
- 1000-5000
- 5000-10000
- 10000-15000
- 15000-20000
- >20000

max. 56000
Published values based on old ICRP dose conversion factor for dwellings (risk based approach)

Effective doses

Range  3.6 - 930 mSv/year
Mean  72 mSv/year

New ICRP dose conversion factor gives effective doses twice these values
Exposure situations

High radon concentrations in

• Dwellings
• Kindergarten
• School
• Work places
• Health care institutions
• Shops and public buildings
• Outdoor areas

Radon could be seen as one exposure situation?
Radon in Kinsarvik - priorities

- Highest radon exposure in dwellings

- Regulations on radon apply to radon in new construction, workplaces, kindergardens, schools etc, but not in most existing dwellings

- Since the local administration has responsibilities for schools, kindergardens, some workplaces etc, radon reduction in these situations tend to be prioritized.
Terminal moraine

Legend
- Morain rich in boulders
- Boulder rich gravel and sand
- Marine sandy sediments

Prevailing direction of soil air

Outflow of cooled air

Outflow of warmed air

Winter

Summer
## Seasonal variations of radon 1996-97

<table>
<thead>
<tr>
<th>Area</th>
<th>Winter (Bq/m³)</th>
<th>Summer (Bq/m³)</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper</td>
<td>9840</td>
<td>1240</td>
<td>20.2</td>
</tr>
<tr>
<td>Central</td>
<td>2430</td>
<td>2900</td>
<td>2.2</td>
</tr>
<tr>
<td>Lower</td>
<td>960</td>
<td>5540</td>
<td>0.3</td>
</tr>
<tr>
<td>All</td>
<td>4660</td>
<td>3160</td>
<td>1.4</td>
</tr>
</tbody>
</table>
Stakeholders

- National authorities
- Local administration/authority:
  - political leaders
  - local planning
  - school and kindergardens
  - health care
- Secondary informants:
  - Health care workers and teachers
- Public:
  - home owners, parents
- Local industry, employers
The Kinsarvik project – 96-97

Steering group
(local political leaders and representatives of the public)

Working group
(local administration and health personnel, radon experts)

Phases
Mapping
Mitigation
Economic compensation
Extended mapping
Kinsarvik – mitigation 1996-97 and 2003

- Pilot project: Testing reduction techniques in 3 houses
- Development of mitigation plans for 96 houses
- Economic compensation for mitigation available in 1999-2003
Response of the public

- Interest and anxiety varied strongly
- Many compared their radon values with their neighbours
- Age dependent. Parents concerned with their children's health
- Many, especially older people, did not believe in the health risks
Radon mitigation

- Interest seemed to be surprisingly low. Only a few homeowners applied for economic compensation

- Uncertainty on efficiency of mitigation
  When target levels below 200 Bq/m³ were not met in the pilot study, mitigation was perceived as unsuccessful

- Focus on negative economic consequences

- Unwillingness to be associated with radon problems and cancer risk.
Outdoor radon concentrations

- Explains why it was difficult to achieve radon levels below national recommendations in dwellings
The Norwegian radon strategy

- Strategic goal of achieving ALARA
- supplemented with legally binding limits where appropriate such that authorities have a basis for enforcement and compliance.

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
NRPA recommendations for radon - 2009

- 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
- All buildings should be measured for radon regularly and always following modifications
- Radon measurements should be performed long-term during winter months using track-etch detectors
- Radon mitigation measures in existing buildings should be source-specific
- Radon measurements should be repeated after mitigation measures have been carried out
Radon in new buildings

- Population is increasing, and new homes are being built.

- Most of Kinsarvik is now categorized as a natural hazard area with specific local regulations on new building.
New pilot project

- Project leader from local public administration
- New measurements to obtain updated status on radon
- Offering advice and support about radon mitigation to members of the public
- Advice on radon to local politicians and administrators
- Seminar for municipal administrators and health sector
- Excursion to a radon prone area in Finland i planned
- No improvement from 1996-1997 when same dwelling is measured again.

- However, indications that new dwellings have lower radon concentrations. Values still too high.
Seminar on radon april 2012

Audience from local and regional public administrations including health sector
Some lessons learned

- The local authorities and the public must be involved in the planning and implementation of radon reduction projects.

- Information about the health hazards and measurement campaigns needs to be followed up immediately with efficient mitigation.

- Local health workers and public health specialists need sufficient knowledge on radon risks and synergy with smoking.
lessons learned

- Competence and experience of radon remediation companies is essential.

- The message on efficiency of radon reduction must not be unrealistic. It should be emphasized that any reductions of radon are beneficial.

- The ability of the public and local authorities to cope with the problems may be strengthened for instance by more focus on success stories and positive side effects.