Regional Workshop for Sharing the Best Practices in the Implementation of Radon Action Plan

(Velingrad, Bulgaria, 09-12 April 2019)

RER9153 - Enhancing the Regional Capacity to Control Long Term Risks to the Public due to Radon in Dwellings and Workplaces

Counterpart from Portugal – Maria de Lurdes Dinis

FEUP - Faculty of Engineering, University of Porto, Portugal

CERENA Polo FEUP - Research Centre for Natural Resources and the Environment
Content


2. Main highlights of the (previewed) RAP: elements and measurable targets.

3. Challenges, lessons learned and good practices from previous studies.

4. Achievements of RAP so far - First Stage of “Start Taking Actions” to Develop a National RAP.

National Radon Action Plan: main involved parties and coordinator; Roles and responsibilities

National Radon Action Plan: main involved parties and coordinator

• No draft of Radon Action Plan until now;

  • Shall be enforced within 120 days – 2 April 2019;

• Main involved parties and coordinator in the Radon Action Plan:
  • APA, I.P.;
  • All other considered relevant (e.g. Authority for Working Conditions).
Roles and responsibilities of APA:

• Develop and update a National Action Plan for radon within the next 3 years.

• From 02 April 2019 – Competent authority will start to take actions in what concerns to the RAP.
Identification of existing exposure situation:

- Past activities that have never been subject to regulatory control or have not been regulated in accordance with the requirements of this Decree-Law;
- Sources of natural radiation, including:
  - Radon and thoron exposure in workplaces, dwellings and other buildings with any public use factor;
  - Exposure to external radiation inside buildings due to construction materials;
Entity responsible for managing the existing exposure situation:

- The competent authority, in coordination with the relevant competent authorities, shall determine which entity is responsible for managing the existing exposure situation.
- Must be the holder or entity legally responsible for the area.
- Shall establish a protection strategy validated by the competent authority in coordination with other relevant government entities.
Entity responsible for managing the existing exposure situation:

- Preparation of a remedial action plan, supported by a radiological protection assessment and submitted to the competent authority for approval;
- Take into account the legal regime of environmental impact assessment;
- Choosing the optimized remediation option that:
  - The radiological impacts on people and the environment are considered together with non-radiological impacts on people and the environment, and with technical, societal and economic factors;
  - The establishment of an information mechanism for the public, and that stakeholders affected by the existing exposure situation are involved in the planning, implementation and verification of remediation actions, including any monitoring and surveillance after the end of the action;
Main highlights of the RAP: what are the elements and measurable targets

Art. N.º 150 - Decree-Law n.º 108/2018, 03 December 2018

1 - The competent authority elaborate a National Radon Plan

2 - ...shall compile existing data and studies on radon exposure and supplement them as necessary.

3 - ...shall draw up, within the framework of the strategic environmental assessment scheme, a national plan for radon, which shall be submitted within three years after the entry into force of this Decree-Law, for approval by resolution of the Council of Ministers.

4 - The national radon plan should be regularly updated.
1 - The competent authority elaborate a National Radon Plan which must contain:

a) **Assessment of the relevance of modifying reference levels** to radon activity in dwellings, other buildings with high occupancy factors by members of the public, and workplaces;

b) **Characterize at national level the areas most susceptible to radon exposure**;

c) **Identify the characteristics of the building** that can give rise to high concentrations of radon activity in the zones identified in the previous paragraph;

d) **Identify and require preventive measures for radon**, which can be **introduced into buildings to be built in the future at a relatively low cost**;
e) **Identify appropriate means and content to make available information** on indoor radon exposure and related health effects at local and national level, the importance of radon monitoring and the technical means to reduce concentrations;

f) **Strategy for conducting studies on indoor radon** concentrations or gas concentrations in soil for the purpose of estimating the distribution of radon concentrations within buildings, for the management of measurement data and for the definition of other relevant parameters, including soil and rock types, permeability and Ra-226 content in rock or soil;

g) **Approach, data and criteria used in delineating zones or defining other parameters** that can be used as specific indicators of situations with potentially high radon exposure;
h) **Identification of the types of workplaces and buildings** open to the public, such as schools, workplaces located **at ground level**, and those located in certain areas, where measurements are required, based on a **risk assessment** including, for example, hours of space occupation;

i) **Basis for the establishment of reference levels for dwellings and places of work** and, where appropriate, the **basis for establishing different reference levels for different uses of buildings**, including dwellings, buildings open to the public, places of work, as for existing and new buildings;

j) **Allocation of responsibilities, coordination mechanisms and resources available for the implementation of the action plan**;

k) **Strategy to reduce exposure to radon in homes** and with a view to giving priority to responding to the situations identified;
Main highlights of the RAP: elements and measurable targets

l) Strategies to facilitate post-construction corrective measures;

m) A strategy, including methods and tools, to prevent radon penetration into new buildings, including the identification of building materials with significant radon release;

n) Schedule review of the plan;

o) Communication strategy to raise public awareness and inform local decision-makers, employers and employees of the risks of radon, including in combination with tobacco;

p) Guidance on measurement methods and tools and corrective measures; consideration should also be given to criteria for accreditation of measurement and services responsible for implementing corrective measures;
q) Where appropriate, financial support measures for radon studies and corrective action, in particular in private households with very high radon concentrations;

r) Long-term objectives for reducing the risk of lung cancer attributable to exposure to radon, taking into account both smokers and non-smokers;

s) Where necessary, consideration of other related issues and related programs, such as programs on energy saving and indoor air quality.
Portugal background - radon

(The competent authority shall compile existing data and studies on radon exposure and supplement them as necessary).

Challenges, lessons learned and future good practices - radon
Population: 10 781 459
Area: 92 090 km²
Portugal is a country with a relevant risk in relation to natural radiation - many regions soil composed by granitic rocks - very high uranium and thorium content.

In these regions (North and Center), it is expected high indoor radon concentration.

Previous Reference Level 400 Bq/m³;
Actual (02 April 2019) Reference Level 300 Bq/m³
HIGH RADON LEVELS IN SCHOOLS AND KINDERGARTENS IN THE NORTHERN REGION OF THE COUNTRY

2017

Estudo avalia radão em Trás-os-Montes e Alto Douro e alerta para prevenção

A investigadora Lisa Maria Martins afirmou hoje, em comunicado emitido pela Universidade de Trás-os-Montes e Alto Douro-UTAD, que se trata de um trabalho "pioneiro em Portugal", porque estudou a "origem do radão".


2015

Governu manda LNEC avaliar níveis de gás radioativo em Bragança

Estudo da Universidade do Porto detetou níveis "preocupantes" de radão, um gás radioativo, em cemitérios e primárias do distrito.

2012

SCHOOL CLOSED DUE TO RADON LEVELS

Escola no Porto fechada por excesso de radão

Rui Sá/David Araújo/Virgílio Matos - RTP
25 Ago. 2012, 09:40 | País

A escola básica Ribeiro de Sousa, no centro do Porto, foi encerrada por causa de altos níveis de radiação.
Dwellings – Radon Related Studies

- MORE THAN 30 STUDIES INDOOR RADON MEASUREMENTS.
- MOSTLY ACADEMIC STUDIES AND RESEARCH PROJECTS.
Dwellings – Radon Related Studies

- Indoor Radon Measurements in 185 Dwellings (Alina Louro, 2009)
  - Range 75-7640 Bq/m³;
  - Average = 1078 Bq/m³;
  - Mode = 640 Bq/m³;
Radon in Drinking Water

- Radon in drinking water, Covilhã (tap water, fountains, well, etc.), 40 different supply points (Sandra Soares, UBI/LIP):
  - Range: 40-1457 Bq/m³
  - Average: 342 Bq/m³

Other studies in North/Center:
- RADON GAS ANALYSER DURRIDGE RAD7: 100 - 1690 Bq/L
- LIQUID SCINTILLATION QUANTULUS 1220 (PERKIN-ELMER): 10 - 7000 Bq/L
- ALPHAGUARD PQ2000PRO – GENITRON INSTRUMENTS: 100 - 1981 Bq/L
Risks Associated to the Construction Location: Geology Related Studies

- More than 20 Radon and Geology related studies;
- 1000 different sites disperses through the Beiras e Alto Alentejo.

Radon concentration in soils and rocks
Source: Alcides Pereira, FCTC
NUCLEAR TECHNOLOGICAL INSTITUTE (ITN) MEASUREMENTS IN 4200 BUILDINGS 1980, LR-115 – RADON RISK MAP

Indoor radon concentrations in OECD countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Arithmetic mean</th>
<th>Geometric mean</th>
<th>Geometric standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>OECD countries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>11</td>
<td>8</td>
<td>2.1</td>
</tr>
<tr>
<td>Austria</td>
<td>99</td>
<td>15</td>
<td>NA</td>
</tr>
<tr>
<td>Belgium</td>
<td>48</td>
<td>38</td>
<td>2</td>
</tr>
<tr>
<td>Canada</td>
<td>28</td>
<td>11</td>
<td>3.9</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>140</td>
<td>44</td>
<td>2.1</td>
</tr>
<tr>
<td>Denmark</td>
<td>59</td>
<td>39</td>
<td>2.2</td>
</tr>
<tr>
<td>Finland</td>
<td>120</td>
<td>84</td>
<td>2.1</td>
</tr>
<tr>
<td>France</td>
<td>89</td>
<td>52</td>
<td>2.0</td>
</tr>
<tr>
<td>Germany</td>
<td>49</td>
<td>37</td>
<td>2.0</td>
</tr>
<tr>
<td>Greece</td>
<td>55</td>
<td>44</td>
<td>2.4</td>
</tr>
<tr>
<td>Hungary</td>
<td>82</td>
<td>62</td>
<td>2.1</td>
</tr>
<tr>
<td>Iceland</td>
<td>10</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Ireland</td>
<td>89</td>
<td>57</td>
<td>2.4</td>
</tr>
<tr>
<td>Italy</td>
<td>70</td>
<td>52</td>
<td>2.1</td>
</tr>
<tr>
<td>Japan</td>
<td>16</td>
<td>13</td>
<td>1.8</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>110</td>
<td>70</td>
<td>2</td>
</tr>
<tr>
<td>Mexico</td>
<td>140</td>
<td>90</td>
<td>NA</td>
</tr>
<tr>
<td>Netherlands</td>
<td>23</td>
<td>18</td>
<td>1.6</td>
</tr>
<tr>
<td>New Zealand</td>
<td>22</td>
<td>20</td>
<td>NA</td>
</tr>
<tr>
<td>Norway</td>
<td>89</td>
<td>40</td>
<td>NA</td>
</tr>
<tr>
<td>Poland</td>
<td>49</td>
<td>31</td>
<td>2.3</td>
</tr>
<tr>
<td>Portugal</td>
<td>62</td>
<td>45</td>
<td>2.2</td>
</tr>
<tr>
<td>Republic of Korea</td>
<td>53</td>
<td>43</td>
<td>1.8</td>
</tr>
<tr>
<td>Slovakia</td>
<td>87</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Spain</td>
<td>90</td>
<td>46</td>
<td>2.9</td>
</tr>
<tr>
<td>Sweden</td>
<td>108</td>
<td>56</td>
<td>NA</td>
</tr>
<tr>
<td>Switzerland</td>
<td>78</td>
<td>51</td>
<td>1.8</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>20</td>
<td>14</td>
<td>3.2</td>
</tr>
<tr>
<td>USA</td>
<td>46</td>
<td>25</td>
<td>3.1</td>
</tr>
</tbody>
</table>

Worldwide average: 39

European Radon Indoor Radon Map

Portugal
Indoor Radon AM: 50 - 500 Bq/m³
SCOPE:
A GLOBAL PROJECT, WITH KEY INTERNATIONAL AND NATIONAL PARTNERS

OVERALL AIM:
TO REDUCE THE POPULATION DISEASE BURDEN DUE TO RADON IN HOMES

INITIAL PROJECT TIME FRAME:
2005-2008

IRP MEMBERS:

<table>
<thead>
<tr>
<th>Country</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albania</td>
<td>Italy</td>
</tr>
<tr>
<td>Argentina</td>
<td>Japan</td>
</tr>
<tr>
<td>Austria</td>
<td>Lithuania</td>
</tr>
<tr>
<td>Belgium</td>
<td>Luxembourg</td>
</tr>
<tr>
<td>Brazil</td>
<td>Norway</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>Poland</td>
</tr>
<tr>
<td>Canada</td>
<td>Romania</td>
</tr>
<tr>
<td>China</td>
<td>Russian Federation</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>Serbia &amp; Montenegro</td>
</tr>
<tr>
<td>Finland</td>
<td>Slovenia</td>
</tr>
<tr>
<td>France</td>
<td>Spain</td>
</tr>
<tr>
<td>Georgia</td>
<td>Sweden</td>
</tr>
<tr>
<td>Germany</td>
<td>Switzerland</td>
</tr>
<tr>
<td>Greece</td>
<td>Turkey</td>
</tr>
<tr>
<td>Hungary</td>
<td>USA</td>
</tr>
<tr>
<td>India</td>
<td>Ukraine</td>
</tr>
<tr>
<td>Ireland</td>
<td>United Kingdom</td>
</tr>
</tbody>
</table>

The WHO International Radon Project (IRP)

Objectives:
- Identify effective strategies for reducing the health impact of radon
- Promote sound policy options, prevention and mitigation programmes (incl. monitoring & evaluation of programmes)
- Raise public, political and economical awareness about the consequences of exposure to radon (incl. financial institutions as target group)
- Estimate the global health impact of exposure to residential radon using available data on radon worldwide

Key partner agencies from over 35 Member States.

Working groups collect and analyse information on radon risk, radon policies, radon mitigation and prevention as well as radon risk communication.

The key elements of the International Radon Project included:
- Developing evidence-based public health guidance for MS to formulate policy and advocacy strategy including the establishment of radon levels;
- Provision of guidance on methods for radon measurements and mitigation;
- Development of approaches for radon risk communication.
The WHO International Radon Project (IRP)

SOME CONCLUSIONS FROM IRP:

• Experience of several countries - reducing radon levels in homes as sustained action on radon is a challenging goal, in particular as the benefit in terms of reducing lung cancer risk can only be demonstrated after a longer time period.

• In addition, the effect of smoking, the main lung cancer risk factor, needs to be considered in risk assessments and in risk communication aimed to inform the public about ways to reduce lung cancer risk.

• Many challenges remain with respect to radon data comparability, approaches to measurements, voluntary or compulsory mitigation and other issues. This should be seen as an important resource for MS in their efforts to effectively reduce lung cancer risk due to radon.

• Strong international cooperation can be one of the core steps to lower the radon-associated health burden worldwide.
Workplaces – Radon Related Studies

THE ONLY STUDY ADDRESSING SPECIFICALLY OCCUPATIONAL EXPOSURE – HYDROTHERAPY TREATMENTS (17 THERMAL SPAS)
Porto University / Coimbra University / Ministry of Health

Participants
- C. Falguerias
- C. Monteigas
- C. Rainha
- C. Saúde
- C. Tapas
- T. Akafoche
- T. Caidelas
- T. Cró
- T. De Entre-os-Rios
- T. Longroiva
- T. Luso
- T. Marinha
- T. Mongão
- T. Sangordin
- T. Unhais da Serra
- T.S. Lourenço
- T.S. Pedro do Sul

Workplaces – Radon Related Studies

• Several published papers (A.S. Silva, M.L. Dinis);
• 40 technical reports on radon in workplaces from several Thermal Spas (TS) and Worker’s Dwellings (WD) (Silva & Dinis, 2012-2018).

- Radon thermal water $\approx 7000$ Bq/L;
- Indoor Radon TS $\approx 5000$ Bq/m$^3$;
- Indoor Radon in WD $\approx 4000$ Bq/m$^3$. 
Passive detectors - Radon

RADON MEASUREMENTS:
• Passive detectors: CR-39
• LR-115 Radon Monitor Canary Pro
• RM-80 detector
• Radon Monitor 1029, SUNNUCLEAR CORP

Source: Alcides Pereira (CITEUC)

• INFORMATION IS NOT COMPILED OR ORGANIZED IN A SITE OR IN A DATABASE.
• VERY GOOD STUDIES BUT THE INFORMATION IS DISPERSED.
• DIFFERENT METHODS AND TECHNIQUES.
Passive detectors - Radon

Source: Mario Reis (IST/CTN)
First Stage of “Start Taking Actions” to Develop a National Radon Action Plan:

1. **CHALLENGES (Data management - existent and future)**
   - Compile and harmonize the existent studies - information is not compiled or organized on a site or database.
   - Different methods and techniques were used - how to harmonize all these data?
   - Complement existing measurements (with others studies whenever necessary).

   **In some cases studies, values are contradictory** (e.g.):
   - High values in water but no in the indoor air;
   - High values in the indoor air, but not in the water;
   - Geology dominated by granites but low values in water and/or in indoor air;
   - ...
First Stage of “Start Taking Actions” to Develop a National Radon Action Plan:

2. LESSONS LEARNED (Measurement campaigns, risk management)

- Existence of very good studies but the information is dispersed - information should be gathered by one institution – the competent authority (?);
- Standardize measurement methods, techniques and tools for new measurements;
- Validate protocols for new measurements;
- ....
First Stage of “Start Taking Actions” to Develop a National Radon Action Plan:

3. GOOD PRACTICES (Public awareness and communication)

- Involve the different organizations who have been developing several studies ("avoid ownership conflicts");
- Learn from the other countries that are already developing and/or implementing the RAP.
  - Approach through different pillars (e.g. Belgium):
    1. Risk management;
    2. Measurement campaigns;
    3. Regulations;
    4. Public awareness and communication;
    5. Data Management.
Thank You!