PROTECTION FROM RADON IN ITALY: PAST, PRESENT AND PERSPECTIVES

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Received August 6, 2019

Abstract. In Italy, activities aimed to reduce risks attributable to radon exposure in dwellings and workplaces have been performed since the eighties, and their number sensibly increased after the start-up of the Italian National Radon Action Plan (INRAP) in the mid-00s. In the view of the forthcoming new regulation, these activities have been critically reviewed highlighting the lessons learnt which will be useful for the challenges of the new approach required by the 2013/59/Euratom Council Directive for the protection from radon.

Key words: radon activities, radon strategy, National Radon Archive, National Radon Action Plan.

1. INTRODUCTION

In Italy, the protection from risks attributable to indoor radon exposure has been regulating (in workplaces only) since 2000, but several activities started in the ’80s, including the first national survey on radon in dwellings. After the start-up of the Italian National Action Plan (INAP), in the mid-00s, the number of activities has increased and most of them have been coordinated at a national level. The information and data collected in the National Radon Archive [1] allow to review the Italian experience gained in these years which will be useful for the forthcoming transposition of the 2013/59/Euratom Directive.

2. ITALIAN REGULATION ON RADON

The present Italian regulation – which will be replaced by the forthcoming transposition of the 2013/59/Euratom Directive – deals only on the protection from radon in workplaces (including schools). In particular, radon measurements are required in fully underground workplaces and in other workplaces (with priority to those in basement and ground floor) only in radon prone areas declared by the Regions. Remedial actions are required if the measured radon level exceeds 500 Bq m^{-3} (value of the Italian action level) and if the annual effective dose for workers is higher than 3 mSv. The requirements on the effective dose do not apply.
to schools for which remedial actions are always mandatory if radon levels are higher than the action level.

Moreover, the employers should communicate the values of the measured radon concentration – and (if needed) the expected actions aimed to reduce it – only if the measured values exceed the action level.

However, a comprehensive national strategy for the reduction of radon-related risks, both in dwellings and workplaces, was delineated in a National Action Plan. This plan, even if not supported by a national regulation, has been partly implemented by national and regional projects.

2.1. ITALIAN NATIONAL ACTION PLAN (INRAP)

The Italian National Radon Action Plan (INRAP) was prepared in 2000–2002 by an ad-hoc working group of a commission on indoor air quality, set up by the Ministry of Health. The working group included experts from national and regional institutes and authorities related to the radon issue. In 2002, the Superior Council of Health and the Ministry of Health have approved the document The Italian National Radon Program (2002). In 2005, a support to the implementation of the INRAP was included in the projects of the Italian National Centre for Diseases Prevention and Control (CCM), which is the body that promote, under the coordination of the Ministry of Health and of the Regions, the activities in the field of monitoring and prevention of diseases.

The first project Start-up of the Italian National Radon Program to reduce the risk of lung cancer due to radon exposure in Italy carried out in the period 2006–2010 and contained some of the actions included in the full INRAP [2]. After this project, activities have been continued in the framework of other projects promoted by the Ministry of Health. Moreover, several regional projects were planned and carried out with reference to the INRAP.

Since radon activities are generally performed both by national and regional/local institutes, agencies and authorities, coordination is necessary in order to harmonize these activities. Since the beginning, the INRAP has been coordinated by the Italian National Institute of Health (ISS) with the support of the Radon National Coordination Group (RNCG), which now include representatives from all the 21 Italian Regions as well as representatives from public national institutes and ministries involved in radon issues (i.e. ISS, National Institute for Environmental Protection and Research (ISPRA), Italian National Workers Compensation Authority (INAIL), Ministry of Health, Ministry of Environment, etc.) [1].

The present INRAP will be updated in the forthcoming legislation considering the requirements of the 2013/59/Euratom Directive.

3. RADON ACTIVITIES

In Italy, most of the activities addressed to the protection from risks attributable to radon exposure started in the 80s. Initially, they were mainly based on research
issues, such as radon concentration measurement techniques (e.g. [3–7]), surveys on indoor radon concentration (e.g. [8–12]), studies on radon behavior of radon, thoron and their decay products in indoor air (e.g. [13, 14]), techniques to reduce radon concentration in existing buildings (e.g. [15, 16]). Afterwards, in the ‘90s, the first representative national survey on radon concentration in dwellings were carried out with the involvement of the Health Directorate of all the 21 Italian Regions (actually 19 Regions and 2 administratively independent Provinces) and the corresponding 21 Regional Reference Centers for the control of environmental radioactivity, under the coordination of the Italian National Institute of Health and of the National Agency on Environmental Protection [17–19]. Notably, this national survey allowed the development of know-how on radon concentration measurement techniques in all the Italian Regions. Therefore, it was the starting point to develop also other radon activities both at national and at a regional level.

3.1. RADON SURVEYS

After the first national survey in dwellings several regional surveys were carried out in kindergartens and primary schools (e.g. [20–23]), as well as further surveys were conducted in dwellings of some Regions [24, 25], and in one Region (Tuscany), dwellings, workplaces and schools were sampled and monitored [26]. These surveys were generally aimed to characterize the radon distribution in indoor air, but also to identify some radon-prone areas (e.g. [27–29]) as required by the legislation.

Some national surveys were conducted in specific types of workplaces, such as banks [30] and underground inspection rooms and offices of a telephone company [31]. Some local but extensive surveys were conducted in other specific workplaces, e.g. in buildings of research institutes [32]. Moreover, another national survey in dwellings has been designed and carried out involving dwellings inhabited by workers of a telephone company, in order to obtain information on the distribution of radon concentration in dwellings in all the 110 Italian Provinces by means of affordable methods [33].

Up to now, a total of more than 50 000 among dwellings, schools and workplaces have been measured in the framework of radon concentration surveys at national, regional or sub-regional level carried out by national or regional public institutions involved with protection from radon exposure (Table 1).

Before the INRAP, radon surveys were generally carried out using different sampling designs. For example, for several regions, radon surveys gave rise to different radon maps generated with different criteria and, in turn, with different information contents.

Therefore, in the framework of the INRAP, a methodology was developed with the aim to harmonize survey design and data analysis and it was adopted for several regional radon surveys.
Table 1

<table>
<thead>
<tr>
<th>Italian macro area</th>
<th>Dwellings</th>
<th></th>
<th>Workplaces</th>
<th></th>
<th>Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>National</td>
<td>Regional or sub regional</td>
<td>National</td>
<td>Regional or sub regional</td>
<td>Regional or sub regional</td>
</tr>
<tr>
<td>North-East</td>
<td>2 354</td>
<td>10 987</td>
<td>559</td>
<td>1 178</td>
<td>5 326</td>
</tr>
<tr>
<td>North-West</td>
<td>2 794</td>
<td>4 901</td>
<td>848</td>
<td>1 692</td>
<td>1 327</td>
</tr>
<tr>
<td>Center</td>
<td>2 045</td>
<td>9 471</td>
<td>557</td>
<td>1 258</td>
<td>903</td>
</tr>
<tr>
<td>South and islands</td>
<td>3 669</td>
<td>2 407</td>
<td>1 199</td>
<td>129</td>
<td>1 349</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10 862</strong></td>
<td><strong>27 766</strong></td>
<td><strong>3 163</strong></td>
<td><strong>4 257</strong></td>
<td><strong>8 905</strong></td>
</tr>
</tbody>
</table>

Source: National Radon Archive.

Such a methodology takes into account international recommendations [34, 35] and deals with two main objectives, such as the estimate of radon distribution representative of the population (or worker) exposure, and the identification of radon-prone areas.

Representative estimates of indoor radon concentration distribution, including estimates of the number of dwellings (and workplaces) with radon concentration above possible reference levels, are necessary for several purposes, such as the unbiased evaluation of population exposure and risk, and the optimized choice of national reference levels. Whereas the identification of radon-prone areas is useful to prioritize the search of dwellings and workplaces exceeding reference levels.

3.2. RADON MITIGATION IN EXISTING BUILDINGS AND PREVENTION IN NEW BUILDING

Regarding radon mitigation, in these years, only few Regional Agencies for Environmental Protection have developed expertise (including detailed guidelines) on reducing radon entry in existing buildings with high radon concentration. According to the National Radon Archive [1], more than 300 buildings have been “remediated” by the agencies and institute institutionally involved in the protection from radon. The majority of remedial actions were carried in schools, for which Italian legislation requires remedial action in case of radon concentration higher than an action level of 500 Bq m⁻³.

Regarding preventive measures, in 2008 a specific recommendation of the Radon National Coordination Group of the INRAP, regarding preventive measures in all new buildings, was published [36]. It recommends that preventive measures should be introduced in all the new buildings, and not only in selected areas (i.e. radon priority areas). In the text, it is specified that preventive measures should be not expensive and easy to be applied (i.e. not requiring training or specific knowledge on radon). This will make this approach feasible in a large number of buildings. Moreover, this recommendation advises that preventive measures should
be introduced also in case of considerable building renewals involving soil-building interface.

Few Italian Regions and Municipalities have already adopted this recommendation. To obtain a uniform adoption in all the Country, it is intended that this recommendation will be formally implemented in all the regional and local building regulations and codes.

3.3. RADON TRAINING AND AWARENESS

Training of public (environmental and health) agencies personnel is an important goal in order to correctly implement all the measures that a national plan requires (radon measurements, remedial actions, information on radon issues). According to the National Radon Archive, different national institutions have organized in the past and are still organizing training courses and most of them are an overview of the different radon issues. Also, regional public institutions have organized during the years different training courses: specific on radon issues or within the framework of a more general training course on radioprotection. In the NRA information about more than 20 training courses organized by regional public agencies are collected, most of them dedicated to general radon issues, whereas only a few of them were dedicated to radon remedial actions. With the aim of harmonizing the Italian activity also in this area, standardized training courses on different topics have been designed for the training of the radon professionals throughout the national territory.

Information of the public, stakeholders, decision-makers and (local) authorities on radon issues are fundamental steps and basis for all radon activities and measures. Several public institutions, including the Italian National Institute of Health [37], have webpages dedicated to radon. In the framework of the INRAP, harmonization of the messages included in these webpages has been carried out. For example, in case of radon maps, messages have been added alerting readers that: i) maps do not allow to know the radon level in individual dwellings; ii) there are dwellings with high radon levels also in areas not identified as radon prone; iii) the only way to know radon concentration in a house is to measure it with cheap devices available in the market.

4. LESSON LEARNT FROM THE PAST ITALIAN EXPERIENCE AND PERSPECTIVE

Information collected in the National Radon Archive, briefly described above, allows to find out some issues regarding the past Italian experience.

The low number of dwellings and workplaces remediated as compared to the numbers of surveyed ones shows that probably too much attention was paid on
performing radon surveys and, on the contrary, too small attention was paid to implement an effective strategy and tools for radon remediations in existing buildings. For examples, in most cases, a lot of work was done producing very detailed radon maps, which are often considered as a goal instead of a tool for the reduction of radon-related risks.

Regarding the regulation on radon in workplaces, it resulted that it was only partially implemented considering that only one region (out of 21) declared radon prone areas in its territory and, for this reason, radon measurements were generally performed only in underground workplaces. Moreover, it was not possible to verify the fulfillment of the notification, since the regulation required it only for those workplaces with radon levels higher than 500 Bq m⁻³.

The small number of remediated dwellings is probably due to the fact that there is no national regulation on radon in dwellings as well as to the fact that in Italy the recommendations are probably not effective. In fact, it is worth noting that since the present National Radon Action Plan was not supported by regulation, only a part of the planned activities started in a fraction of its territory.

The past experience has allowed us to acquire some elements for solve the above-mentioned issues in the on-going transposition of the 2013/59/Euratom Directive [38]. In particular, it will be taken into account the new concept of reference level (RL) and the need to optimize the protection from radon-related risks not only above this level, but also below it [39].

This new challenging approach could be applied, for example, choosing two different reference levels for future and existing buildings, with a lower RL for the future ones. In addition, some actions could also be promoted for radon levels lower than RL (e.g., recommendations for levels higher than half of RL and obligations for levels above RL). It could be considered also a compulsory approach (instead of a recommendatory one), at least for some situations (e.g. rented houses).

Finally, for the evaluation of the effectiveness of the future policy – it is also required by the 2013/59/Euratom Directive – the definition of ad-hoc indicators is necessary in order to avoid the issues arisen from the present regulation on radon in workplaces. Therefore, the structure of the present National Radon Archive will be modified in order to allow to populate the above-mentioned indicators with relevant information and collected data. These indicators will be defined considering the final goals of a national radon strategy which are the reduction of both individual and collective risks, i.e. the reduction of the number of lung cancers attributable to radon exposure in dwellings and workplaces.

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