IMPACT OF THE NEW BSS IN THE SPANISH RADON PROGRAM

Luis S. Quindos Poncela, Carlos Sainz Fernandez, Jose-Luis Gutierrez Villanueva, Ismael Fuente Merino

RADON Group, Faculty of Medicine, University of Cantabria, Avda Cardenal Herrera Oria s/n, 39011 Santander (Spain)

E-mail: quindosl@unican.es

Abstract

The new Basic Safety Standards (BSS) are under discussion at the European Council in order to issue a council directive. The Directive includes the exposure of members of the public to indoor radon. The Annex XVI of the document summarizes the list of items to be covered in the national action plan to manage risks from radon exposures.

In the case of Spain, the need for a Radon Program includes the existence of laboratories with radon measurement expertise. Therefore our group, in collaboration with ENUSA S.A. (Spanish National Uranium Company), has created the Laboratory on Natural Radiation (LNR). These facilities are located at an old uranium mine where radon concentrations are subjected to daily variations due to changes in environmental conditions.

We present the main results of several intercomparison exercises carried out at this laboratory. The results involve active and passive detectors covering a wide range of radon exposures.

Introduction

The new Basic Safety Standards (BSS, 2013) for protection against the dangers arising from exposure to ionizing radiation are under discussion at the level of European Council with the objective of issuing a proposed directive. The subject matter of the proposed directive is to establish a Community framework under the basic safety standards for the protection of human health. In particular, the Directive applies to the management of existing exposure situations, including the exposure of members of the public to indoor radon, external exposure from building materials and cases of lasting exposure resulting from the after-effects of an emergency or a past activity. The Annex XVI of the document summarizes the list of items to be covered in the national action plan to manage long-term risks from radon exposures: The list includes:

(1) Strategy for conducting surveys of indoor radon concentrations or soil gas concentrations for the purpose of estimating the distribution of indoor radon concentrations, and the management of measurement data and for the establishment of other relevant parameters (such as soil and rock types, permeability and radium-226 content of rock or soil).

(2) Methodology, data and criteria used for the delineation of areas or for the definition of other parameters that can be used as specific indicators of situations with potentially high exposure to radon.

(3) Based upon the risk assessment and other factors (e.g. duration of occupancy) identify types of workplaces and buildings with public access, such as schools, underground workplaces, and those in certain areas, where measurements would be required,

(4) The basis for the establishment of a reference action level for dwellings and workplaces. If applicable, the basis for the establishment of different reference levels for different uses of buildings (dwellings, buildings with public access, workplaces) as well as for existing and for new buildings.

(5) Assignment of responsibilities (governmental and non-governmental), including coordination mechanisms and available resources for implementation of the action plan.

(6) Strategy for reducing radon exposure in dwellings and for giving priority to addressing the situations identified under point 2.

(6a) Strategies for facilitating post construction remedial action.

(7) Strategy, including methods and tools, for preventing radon ingress into new buildings, including the identification of building materials with significant radon emanation.

(8) Schedules for reviews of the action plan.

(9) Strategy for radon and smoking risk communication to increase public awareness and inform local decision makers, employers and employees.

(10) Guidance on methods and tools for radon measurements and remedial measures. Criteria for the accreditation of measurement and remediation services shall also be considered.

(11) Where appropriate, provisions of financial support for radon surveys and for remedial measures, in particular for private dwellings with very high radon concentrations.

(12) Long-term goals in terms of reducing lung cancer risk attributable to radon exposure (for smokers and non-smokers).

(13) Where appropriate, consideration of other related issues and corresponding programmes such as programmes on energy saving and indoor air quality.

This European Directive will apply to all member states including those with radon programs in different stages of development. In the case of Spain, the need for a Radon Program covering the requests from the new BSS includes the creation of laboratories with expertise on radon measurement. Therefore our group, in collaboration with ENUSA S.A. (Spanish National Uranium Company), has created the Laboratory on Natural Radiation (LNR located at an old uranium mine in Saelices el Chico (Salamanca, Spain). At this moment, an on-going project is improving the resolution of the Spanish radon map by means of radon measurements in 10 km^2 squares in the whole country. Figure 1 shows the map available at this moment.

Figure (1): Radon map of Spain. The squares are 10km2 and they have been classified into four zones according to the geometric mean of radon values

In order to be ready for the moment when the new European Directive will come into force, our group is preparing a European project to deal with the harmonization of the different criteria already in use in Europe. They include different radon reference levels, action limits, different criteria to decide if using radon concentration or dose due to radon in the levels etc.. The main objective is to harmonize these standards to apply the requirements of the Annex XVI in all member countries.

Description of the Laboratory on Natural Radiation (LNR)

This laboratory is located at a site (old uranium mine) where sources of natural radioactivity are readably available. This allows for the testing of instruments and detectors under temperature and atmospheric pressure conditions typically found in homes and work places. The site, shut down in 2004, has been undergoing restoration. The building selected for the laboratory (Figure 2) was formerly used for the treatment of uranium mineral and had to be converted to a natural radiation calibration facility. This task was performed by the Radon Group, in collaboration with ENUSA. At the site, Radon concentrations and external gamma radiation are subjected to daily variations due to changes in environmental conditions. Thus, the laboratory of natural radiation is the perfect place for the performance of experiments devoted to the analysis of environmental radioactivity as well as a location for testing instruments specialized on the measurement of natural radiation. In May 2011, the lab conducted its first intercomparison exercise under field conditions (Figure (2)).

Figure (2): View of the Laboratory on Natural Radiation located at the facilities of an old uranium mine (Saelices el Chico, Spain)

The building is a 2-story house with four rooms on the ground floor. Two of the rooms play the role of radon chambers and one of them has an artificial ventilation system installed. The biggest room on the ground floor (working area) has area available for up to 30 working spaces. Room 4 is employed for the measurement of radon in water. Figure (3) shows the radon in water standard used for performing the experiments. The barrel is totally filled with water with soil containing high uranium concentrations lying at the bottom. The radon is dissolved uniformly in the water reaching a concentration of approximately 450 Bq l^{-1}.

Figure (3): Radon in water standard sample located on the ground floor of LNR

The upper floor of the building is composed of a conference room, and a third radon chamber where the concentrations are low (100 – 200 Bq m^{-3}). In addition, this room also has installed an artificial ventilation system to reduce the radon levels.

Intercomparison exercise on external gamma dose rate

Outside the main building there are two sites assigned for the determination of external gamma dose as shown in Figure (4). The two sites have values of absorbed doses between 110 and 1800 nGy h^{-1}.

The first intercomparison on natural radioactivity under field conditions was held in the old uranium mine of ENUSA in the municipality of Saelices el Chico (Salamanca, Spain) from 23 to 27 of May 2011 (Gutierrez-Villanueva et al., 2012). The meeting was organised by the Radon group of University of Cantabria (Spain). The main objective of this event was to test different instruments and detectors for the measurement of radon gas and external gamma radiation (dose rate) in real conditions at a location where the levels of natural radiation were quite high.

Figure (4): Site located outside the main building of LNR with a known gamma dose rate values

A total number of 11 laboratories participated in the exercise. They reported the results in terms of the mean value obtained individually at different points of the test site. The ambient conditions such as temperature were monitored during the exercise. Therefore it was demonstrated the effect of this parameter when determining the external gamma dose rate by means of kerma values. Figure (5) and Figure (6) shows the results for the sites with a reference value of 110 ± 2 nGy h^{-1} and 1870 ± 50 nGy h^{-1}.

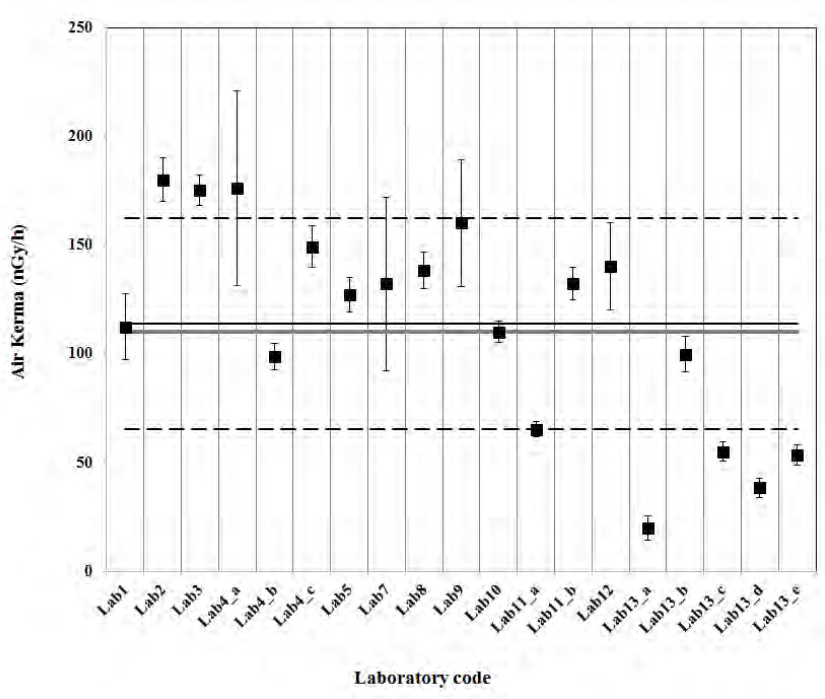

Figure (5) Results of external gamma dose rate in a reference site 110 nGy h^{-1}

The results of this were recently published (Gutierrez-Villanueva et al., 2013). They indicate that the measurements of most of the laboratories agree within 25 % at the two sites tested. If the effect of temperature in some of the detectors used in the intercomparison were taken into account, the results could be improved. For example one improvement could be reached by correcting the photon energy response to the calibration technique.

In addition, an evaluation of the results provided by all laboratories using the evaluation criteria provided by IAEA in its intercomparisons (IAEA, 2011) revealed that only 25 % of the labs passed the test.. Hence, the calibration of radiation detectors in a laboratory, although a necessary condition, is never enough to attain good results in real world measurements.

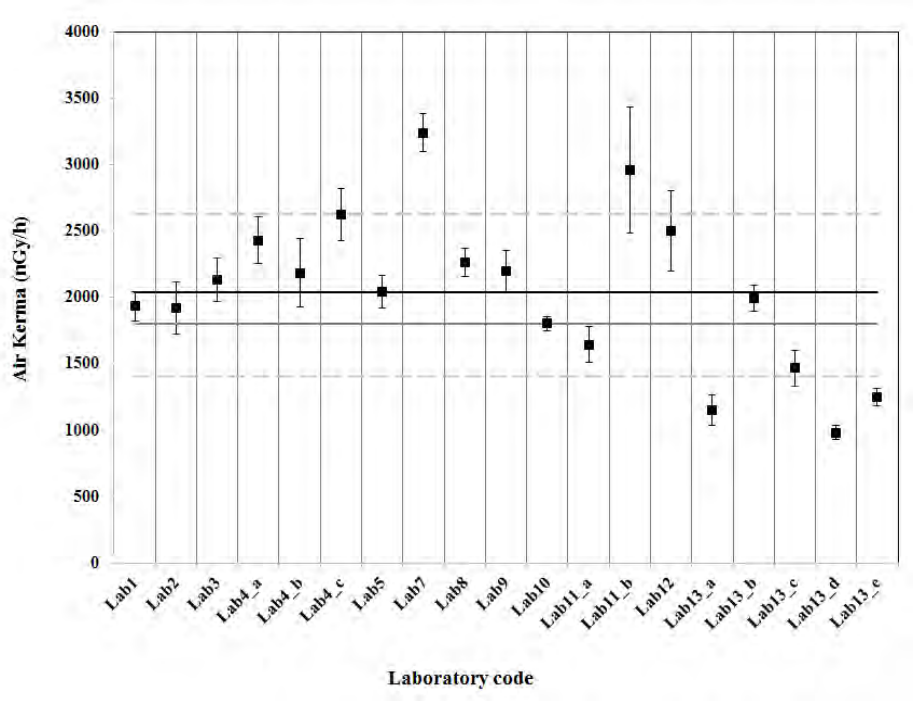

Figure (6): Results of the test in the reference point with high levels of external gamma dose

Conclusions

The Laboratory of Natural Radiation located at Saelices el Chico (Spain) is a natural radioactivity facility available for the entire research community. This unique laboratory provides the opportunity to verify the behaviour of external gamma radiation and radon gas measurement equipment at different temperature, humidity and barometric pressure under actual field conditions. To have such a service is very important in order to fulfil the requirements from the new European Basic Safety Standards that will come into effect in the next few months.

References

1. Basic safety standards for protection against the dangers arising from exposure to ionising radiation. Council Directive 2013.

2. Jose Luis Gutierrez-Villanueva, Carlos Sainz Fernandez, Ismael Fuente Merino, Luis Quindos Lopez, Jorge Quindos Lopez, Alicia Fernandez Villar, Sara Eva Casal Ordas, David Lopez Abascal, Diego Arteche Laso, Enrique Fernandez Lopez, Luis Santiago Quindos Poncela. International intercomparison Exercise on natural radiation under field conditions. PUbliCan, Ediciones de la Universidad de Cantabria. ISBN 978-84-86116-64-4, 2012

3. J.L. Gutierrez-Villanueva, C. Sainz, I. Fuente, J.C. Sáez-Vergara, E. Correa, L.S. Quindos. Poncela. Intercomparison exercise on external gamma dose rate under field conditions at the laboratory of natural radiation (Saelices el Chico, Spain). Radiation Protection Dosimetry 155 (4), 459-466, August 2013

4. Worldwide Open Proficiency Test: Determination of Natural and Artificial Radionuclides in Moss-Soil and Water IAEA-CU-2009-03, 2011.