Exposure to radon in workplaces of several Spanish industries

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Extended abstract

Until the 1970's radon and its decay products were considered as a health hazard only in workplaces like uranium mines. After a huge amount of radon measurements in dwellings, mines other than uranium mines, and workplaces suspected of having high radon levels, the above consideration have changed. High indoor radon concentrations was recognised as a radiation health hazard, potentially causing an increase in the incidence of lung cancer. Bearing also in mind that radon supposes half of the total human exposure to radiation from natural sources, the IAEA pointed out the importance of controlling radon exposure in workplaces other than mines. There is a wide variety of workplaces which can present radon problems like spas, schools, factories, public buildings and offices.

Since 2001, Spanish law incorporated EURATOM basic standards for radiological protection, which include a request at the EC Member States to determine the working places on which exposure to natural radiation is significant. On Title VII (BOE 178/2001) radiation coming from natural sources has analogous role than radiation emitted from artificial ones used to.

In September 2003 a Specific Agreement for Collaboration between the Spanish Nuclear Safety Council and the University of Cantabria was signed in order to develop a research project focused on the assessment of the natural radiation doses received by people in workplaces of several Spanish industries. In the framework of this collaboration some major objectives were proposed:

- To analyse the different source-terms responsible of the dose received by the workers
- To get integrated radon measurements during a six month period
- To study the variations of radon concentrations
- To assess the total dose receive by workers from all natural sources of radiation measured.

Some of the workplaces studied within this research project are the following:

- *Tourist caves and speleological excavations*: All of them located in the region of Cantabria (Spain). High concentrations of radon exist in this kind of workplaces mainly because of the low ventilation rates existing at these enclosures
- *Fertilizing industries*: Atmospheric radon concentrations at these places may arise from the high uranium and radium content of the raw materials used (mainly phosphorite mineral, phosphoric acid and phosphogypsum generated as exhausted material)

- *Water treatment stations and spas*: High radon concentrations can arise to the workplaces by transport of the gas from underground springs or by high radium concentrations inside the water. Specially in water treatment facilities, radon can be released to the indoor air due to the continuous motion of the water.
- *Schools*: Mainly located in the high radon area of Salamanca (Spain), the concentrations of the gas can be elevated because of the high uranium and radium content on the soil under the building at these places.

Integrated measurements were made throughout the above mentioned places using CR-39 track-etched detectors, exposed for a 6 months period in order to evaluate average indoor radon concentrations. On the other hand, continuous radon monitoring was performed during 9 to 10 days by using the DOSEman radon dosimeter from SARAD GmbH. This system use semiconductor detector technology and is based upon the use of alpha spectrometry of the radon progeny (^{218}Po and ^{214}Po) present inside the detector chamber, and cover a measurement range of radon concentrations from 10 to 4 10^6 Bq m^{-3}. Radon concentration can be recorded each hour in a non volatile memory.

Main results are summarized in table I.

Workplace	Mean radon concentration (Bq m^{-3})	Range
Tourist caves	1200	50 – 3000
Fertilizing industries	500	40 – 800
Speleological excavations	300	100 – 700
Watering places: spas	1500	200 - 4000
Water treatment stations	700	40 – 3000
Schools	1800	40 - 5000

Table I: Mean radon concentrations measured in the different workplaces

In conclusion, when high radon concentrations are detected in a working enclosure, remedial actions must be taken in order to reduce indoor gas concentration as low as possible. After that, general criteria on radiological protection demand to get the worker’s exposure as low as reasonably achievable, the well known ALARA criteria (ICRP). The practical application of this criteria need to take into account factors like total exposure time and working time distribution.

References

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