The KRISS Radon Chamber

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1. Introduction

As a part Radon and its progeny are the most important source of radiation exposures of general population. It is estimated that the annual effective dose by radon and radon progeny from the inhalation of air is about 50% of total public exposure dose rate and prolonged exposure to high levels of radon can cause lung cancer[1]. Since then, large varieties of detectors are thus used to measure the instantaneous, long term average or time variation of them. These diverse range of methodologies and measurement methods have led to the question of reliability. To fix up this problem, radon chambers in which the activity concentrations of radon and its progeny can be measured under well-defined conditions were designed to test and calibrate these instrumentations and to study effects of variations of environmental parameters on these measuring systems.

In this paper, we report on the general design and basic performance of the KRISS radon chamber.

2. Methods and Results

2.1 Description of the radon chamber

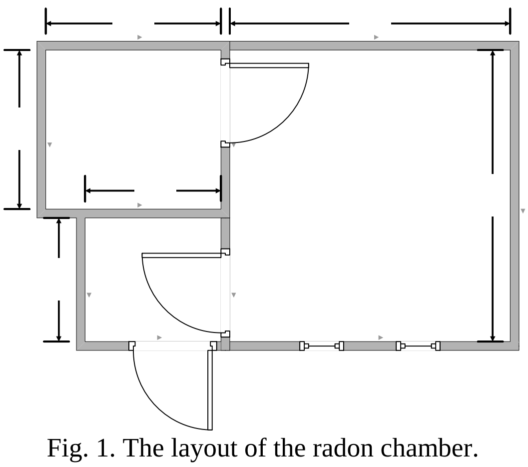

Fig. 1. The layout of the radon chamber.

A walk-in-type radon chamber with exterior dimensions of 5.5 m(W) x 3.5 m(D) x 2.6 m(H) was set up at the KRISS in Korea. It consists of three rooms, a machine room, a main exposure room, and an entry room to the main room. To reduce heat exchange with the surrounding, the walls of chamber were constructed aluminum-stainless steel panels filled with polyurethane foam in 100mm. The inner wall is polished and connected to ground to prevent attachment of Rn-progeny. The layout of the chamber is shown in Figure 1.

2.2 Rn concentration

The radon chamber is equipped with three flow-through type ^{222}Rn sources (Model RN-1025, 500kBq, 2110kBq and 3712kBq of ^{226}Ra from Pylon Electronic Development Co. Ltd.) which can be used independently or simultaneously. The achieved maximum concentration is about 250kBq/m^3 without air circulation. The radon concentration in the chamber is continuously monitored with two continuous scintillation cell monitors and two commercial monitors, an Alphaguard ionisation chamber[2] and an RAD7 solid state alpha detector[3], used as supplementary radon monitoring instruments. An example of the radon concentration at normal operation is given in Figure 2.

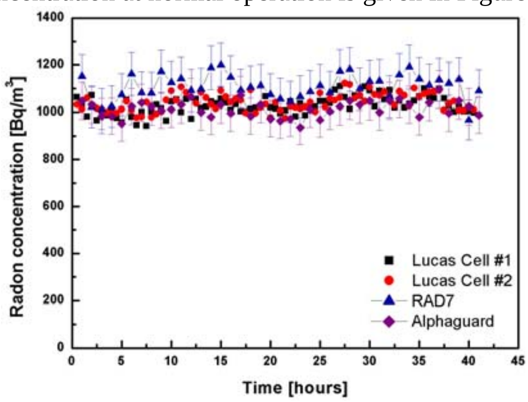

Fig. 2. The radon concentration of the radon chamber at normal operation.

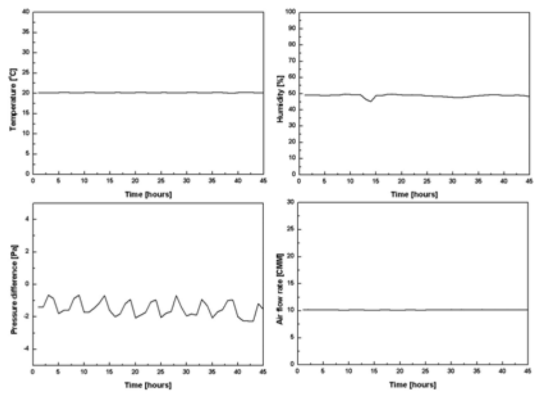

Fig. 3. The environmental condition of the radon chamber at normal operation.

2.3 Environmental control

The radon chamber is equipped with an environmental control unit which consists of refrigerator, heater, humidifier and dehumidifier. The temperature of the main room can be controlled from 10 ℃ to 40 ℃. The humidity is variable between 20% and 80%. The air in the chamber is circulated in 3 ~ 30 $m^3 \cdot min^{-1}$. In addition, these are used to create slight negative pressure. An example of the environmental condition at normal operation is given in Figure 3.

2.4 Distribution of the environmental parameters and radon concentration.

24 points in figure 4 were selected to investigate the distribution of in the radon chamber using two Alphaguard. The result is shown in figure 5. It is found in this figure that each parameter and radon concentration are distributed well in the radon chamber. r.

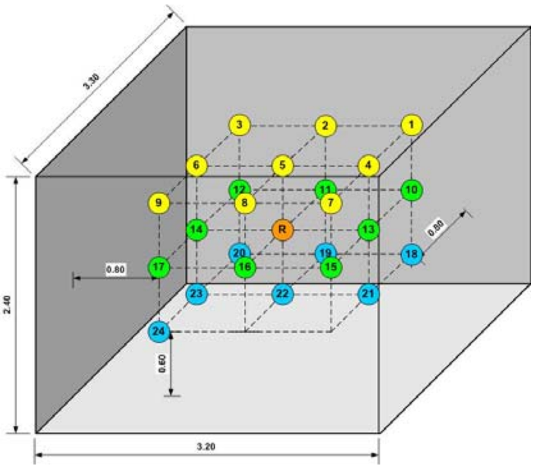

Fig. 4. The measurement points in the radon chamber.

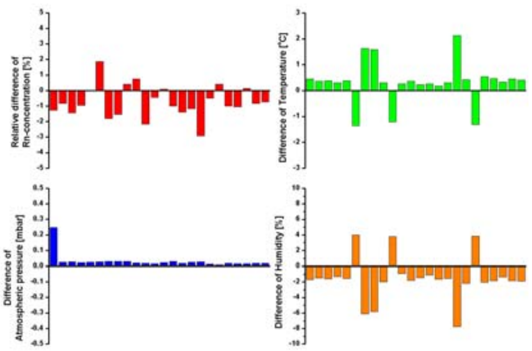

Fig. 5. The result of the distribution test.

3. Conclusion

The radon chamber of the KRISS was constructed to provide variable but stable atmospheric and radon-related conditions for the test and calibration of radon and radon progeny measuring instruments. Such conditions were achieved by the installation of an environmental control unit, three Ra-226 powder sources. The environ parameters and radon concentration are distributed well in the radon chamber.

Thus the radon reference chamber provide variable but stable environment for the test and calibration of radon and measurement systems, as well as well-defined environmental parameters to make exhaustive tests possible.

REFERENCES

[1] UNSCEAR, *Sources, Effects and Risks of Ionizing Radiations*, United Nations Scientific Committee on the Effects of Atomic Radiation 1988 report to the general Assembly, with Annexes. United Nations, New York(1988).

[2] Genitron Instruments, Heerstrabe 149, Germany. Model PQ2000PRO, Portable Radon Monitor, December 1998.

[3] Durridge Company, Massachusetts 01730, USA. Model RAD7, Electronic Radon Detector. December 1998.