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Measurement of radioactivity in the environment — Air: radon-222 —

Part 8: Methodologies for initial and additional investigations in buildings

Mesurage de la radioactivité dans l'environnement — Air: radon 222 —

Partie 8: Méthodologies appliquées aux investigations initiales et complémentaires dans les bâtiments

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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ISO 11665-8 was prepared by Technical Committee ISO/TC 85, *Nuclear energy, nuclear technologies, and radiological protection*, Subcommittee SC 2, *Radiological protection*.

ISO 11665 consists of the following parts, under the general title *Measurement of radioactivity in the environment — Air: radon-222*:

— *Part 1: Origins of radon and its short-lived decay products and associated measurement methods*

— *Part 2: Integrated measurement method for determining average potential alpha energy concentration of its short-lived decay products*

— *Part 3: Spot measurement method of the potential alpha energy concentration of its short-lived decay products*

— *Part 4: Integrated measurement method for determining average activity concentration using passive sampling and delayed analysis*

— *Part 5: Continuous measurement method of the activity concentration*

— *Part 6: Spot measurement method of the activity concentration*

— *Part 7: Accumulation method for estimating surface exhalation rate*

— *Part 8: Methodologies for initial and additional investigations in buildings*

The following parts are under preparation:

— *Part 9: Method for determining exhalation rate of dense building materials*

— *Part 10: Determination of diffusion coefficient in waterproof materials using activity concentration measurement*

— *Part 11: Test method for soil gas*

Introduction

Radon isotopes 222 and 220 are radioactive gases produced by the disintegration of radium isotopes 226, and 224, which are decay products of uranium-238 and thorium-232 respectively, and are all found in the earth's crust. Solid elements, also radioactive, followed by stable lead are produced by radon disintegration [1].

Radon is today considered to be the main source of human exposure to natural radiation. The UNSCEAR (2008) report [2] suggests that, at the worldwide level, radon accounts for around 52 % of global average exposure to natural radiation. The radiological impact of isotope 222 (48 %) is far more significant than isotope 220 (4 %), while isotope 219 is considered negligible.

The International Cancer Research Centre (ICRC) of the World Health Organization (WHO) has recognized radon as a lung carcinogen in humans since 1987.

In this part of ISO 11665, the term radon refers to its isotope 222.

Radon activity concentration can vary from one to multiple orders of magnitude over time and space. Exposure to radon and its decay products varies tremendously from one area to another, as it depends on the amount of radon emitted by the soil, on the weather conditions, and on the degree of containment in the areas where individuals are exposed [3].

Radon activity concentration is usually higher in buildings than in the outside atmosphere due to the lower air renewal rates. The more the ventilation is reduced, the greater the accumulation of radon in buildings. The underlying soil is usually the dominant source of radon in buildings. Building materials, outside air, tap water and even city gas can also contribute to increasing radon activity concentration.

Radon enters buildings mainly via a convection mechanism, the so-called "stack effect" that is due to a difference in air temperature between the inside and the outside of the building, which generates a difference in pressure between the air in the building and the air contained in the underlying soil. The radon activity concentration depends on the architecture, equipment (chimney, mechanical ventilation systems, etc.) and the environmental parameters of the building (temperature, pressure, etc.) and on the occupants' lifestyle.

Radon activity concentrations vary inside buildings by several tens of becquerels per cubic metre to several hundreds of becquerels per cubic metre [4]. Activity concentration can be as high as several thousands of becquerels per cubic metre in very confined spaces.

The assessment of the radon activity concentration of the atmosphere in a building is based on a step-by-step procedure with two measuring stages: the initial investigation, to estimate the annual average value of the radon activity concentration in the building, and, when needed, additional investigations.

When it is decided that the radon activity concentration in a building has to be reduced, mitigation techniques will be adapted to each individual case [5][6][7]. The impact of the mitigation will be assessed using new radon measurements in the building.

NOTE The origin of radon-222 and its short-lived decay products in the atmospheric environment are described generally in ISO 11665-1 together with measurement methods.