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# FIRST MEASUREMENTS OF RADON AT NIMRD "GRIGORE ANTIPA"

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## ABSTRACT

Until other risks and distant dangers, there are some factors that can affect human health significantly. Therefore, concern about living and working conditions is legitimate. One of the factors that require special attention is Radon, a natural radioactive gas, that is present around us. Supervision of its level has become a current necessity for assessing health risks and establishing the most appropriate measures for protection, if the situation requires. The paper presents the first results of Radon measurements initiated at NIMRD "Grigore Antipa" headquarters, a building located in the Romanian Black Sea coastal zone. These were conducted between 07.05-07.08.2018. The values found were in the range of 10-429 $Bq/m^3$. These results will constitute a database in the field, with daily hourly measurements and monthly averages. Active and passive measurement methods have been applied. The investigation activity continues.
**Key-Words:** Radon, natural radioactivity, Black Sea, habitation

## AIMS AND BACKGROUND

Among the environmental conditions that accompany us over the course of life are natural radioactivity, more than half of the human exposure to natural radiation is due to Radon and its descendants (Chiosilă, 1998; Cosma, 2009; ***NRPC, 1989; ***UNSCEAR, 2000). This is a radioactive gas, from the family of noble gases. It is an element present in nature under several isotopic forms. Between these isotopes, are alpha emitters Rn-219, Rn-220 and Rn-222, derived from the disintegration of radionuclides Ra-223, Ra-224 and Ra-226, components of the U-235, Th-232 and U- 238 series (Cosma, 2009). However, only for Rn-220 (thoron) and Rn-222 (radon) isotopes should be given special attention, at the human exposure analysis, having half-lives of 55.6 s and 3.82 days respectively (Cosma, 2009;

***Order 752/2018).

The risk stems from alpha radiations emitted by radioactive descendants, these being transported by the inhaled air into the lungs where they can be retained increasing the incidence of cancer at relatively larger exposures, and general individual exposure (Cosma, 2009; ***Order 752/2018; ***UNSCEAR, 2000).

Precursor elements of the uranium and thorium radioactive series are present in the earth's crust, from which the radioactive gases can be released by free spaces at the surface, or can be entrained through groundwater or by extracting substances (minerals, hydrocarbons, gases and so on) (Cosma, 2009; Order 752/2018; ***UNSCEAR, 2000)).

Construction materials take up the radioactive components in the earth's crust, continuing exposure in houses (Cosma, 2009; ***UNSCEAR, 2000). Depending on the concentration of these elements in soil and building materials, natural irradiation may vary from one area to another, from one house to another (Cosma, 2009).

The introduction of Council Directive 2013/59 / EURATOM of 5 December 2013 laying down basic safety standards for the protection against the dangers of exposure to ionizing radiation (***Law 63/2018), which Romania also implements, requires the adoption of a National Action Plan to Radon (NAPR). The strategic directions of action of this plan (***Gov. Dec. 256/2018) can be important for institutions and citizens because:

• Establishes the regulatory framework and the responsibilities of the institutions involved in its application;

• The Radon mapping should be done inside the buildings throughout Romanian territory;

• will be identified workplaces and public buildings in areas with high levels of Radon;

• Actions are taken to prevent and control the penetration of Radon in the buildings to be built and remedial actions to the existing ones;

• There will be adopted an information, education and communication strategy to raise awareness and inform local decision-makers, employers and employees about the risks posed by Radon;

• It is looking for measures to reduce the risk of lung cancer attributed to Radon exposure are sought, correlated with the risks to smokers and non-smokers;

• There will be identified the formation, instruction and improvement needs of the professional categories that could be affected by radon exposure.

The National Commission for the Control of Nuclear Activities (CNCAN) has, through specific regulations (***Order 752/2018), imposed a maximum reference level of 300 $Bq/m^3$ for the annual average concentration of Radon activity in air inside buildings.

NIMRD "Grigore Antipa" Constanta, through the Radioecology Laboratory, has initiated a campaign for Radon level evaluation in its building, to verify the existing measurement methodologies and to know the degree of exposure of the staff. The experience and capabilities developed can be further used to expand the mapping of its locations, but also to the extensive application of NAPR in the coastal area.

## EXPERIMENTAL

An new Airthings Wave device have been installed in Radioecology Laboratory (Fig. 1), located at the basement of NIMRD ”Grigore Antipa” headquarters. Radon sampling is made with passive diffusion chamber. The measurements are made by alpha spectrometry. The accuracy of measurements is under 10% for long investigation (from 1 month upper). The information provided are radon concentration (Bq/m$^3$), humidity (relative) and temperature (Celsius degrees). The level of radon can be accessed in real time and have visible, when is activated, a colour code of air quality to take immediate decision. A mobile application gives an easy and user-friendly use (Fig. 2). The momentary values of Radon concentration, humidity and temperature can be viewed. Also, their evolution can be seen in graphs of the values of the last 48 hours, for the week and the month in progress, but also annually, with averages indication (Fig. 3). The colour code is displayed, depending on the range where the measured values is allocated. The data rows can be extracted from the provider central server.

For the average measurements is used a passive method with solid-state nuclear track detectors (CR-39). Alpha track technique is used. Detectors are Radtrak$^2$® type and consist of film elements located inside some cups made from antistatic plastic (Fig. 4). Radon enters by diffusion. The radiation interacts with detector material along observation time. At the end, after some preparation, the traces are read using an adequate image scanner and converted in concentration units, at the external specialized provider. The results are integrated in time and represent an average value over observation period (3 month). Exposure results are expressed as Bq/m$^3$ on considered period (month, year).


**Fig. 1.** Wave detector.


**Fig. 2.** Mobile screenshot-1.

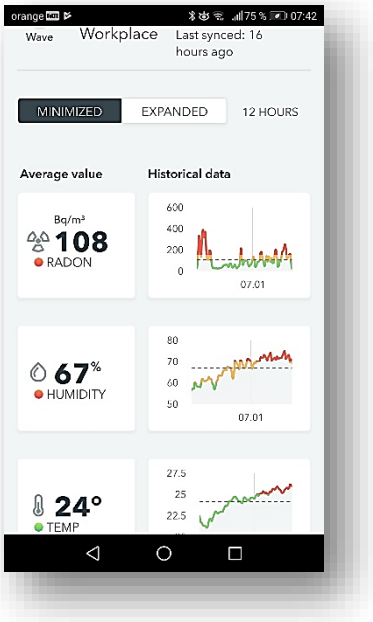


**Fig. 3.** Mobile screenshot-2.

**Fig. 4.** Radtrak$^2$® detectors.

Two such detectors (Fig. 4) were installed, one in the Radioecology Laboratory (near the Wave device, Fig. 1) and another at the upper floor, on the same vertical line with the above mentioned laboratory.

## RESULTS AND DISCUSSION

The paper presents the results of a campaign launched on 7 May 2018. All results included until August 7 (3 months) were considered, but the campaign continued. A total of more than 2,000 daily measurement points was obtained. These are presented in increments of one month (Fig. 5, 6 and 7).

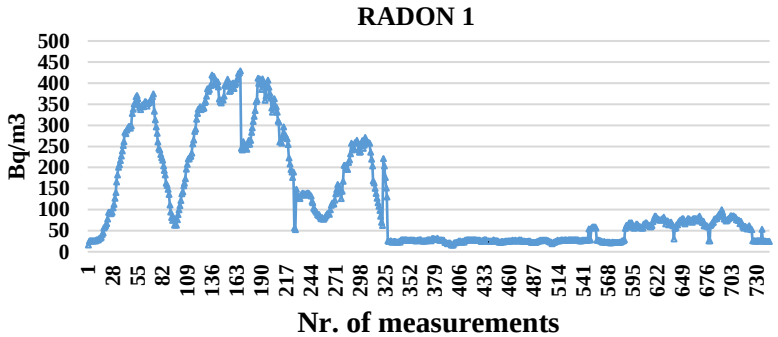


**Fig. 5.** Radon concentration between 7 May - 6 June 2018.

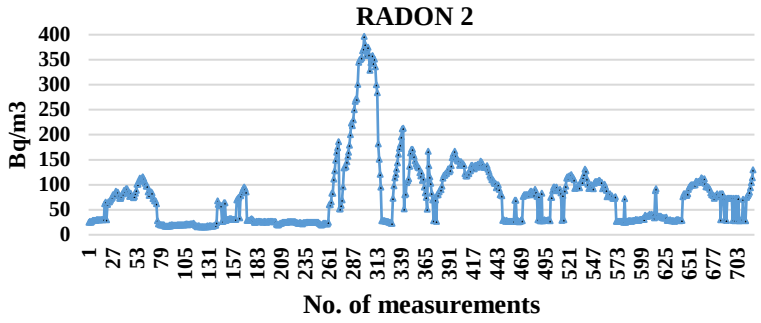


**Fig. 6.** Radon concentration between 7 June - 6 July 2018.

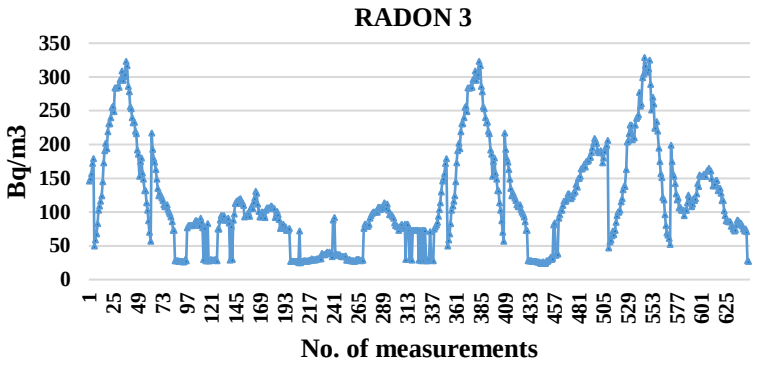


**Fig. 7.** Radon concentration between 7 July - 6 August 2018.

The results of integrated Radon content are not yet available at the time of writing this article.

The average concentration calculated over the entire investigation period is 105.2 Bq/m$^3$. In the first month of observations (May-June 2018), an average of 122.4 Bq/m$^3$ was obtained. In the second month (June-July 2018), the average was 72.8 Bq/m$^3$. Finally, in the third interval (July-August 2018) it was 117.3 Bq/m$^3$.

The fluctuation of measured values is in the range of 10-429 Bq/m$^3$, the maximum being in the first part (May). The accumulation of Radon was not uniform, depending on local factors (atmospheric pressure, ventilation of the room, and so on). When these factors oscillate, peaks of accumulation appear. Continuing the study will highlight this, because it will customize the behaviour of Radon in the given case (Patrascu et al., *in press*).

The monthly average of Radon concentration does not exceed the maximum allowed limit, but brief periods of intense accumulation may be known. Identifying the causes that lead to these increases will also guide the choice of appropriate mitigation measures.

## CONCLUSIONS

- It was possible to measure Radon in the building of NIMRD "Grigore Antipa".
- Optimal methods and means of measurement have been identified and are easy to use.
- A working basis has been established for the future development of the concern for indoor exposure to ionizing radiation.
- Health is important for the employer and the employee, and this is maintained through everyday attention of everyone.

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