

## Final Results Regarding the Measurement of RN-222 in Indoor Air at Nimrd Constanta During 2018-2019

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### Legal framework

The national regulations (Law 63/2018; GD 256/2018; Com. Ord 752/3978/136/2018; CNCAN Ord. 185/2019) and the European Directive (2013/59/EURATOM) provide for the measurement of Radon in the indoor air of buildings with man activities (work and living) [1]. At NIMRD, the measurements were started in 2018 [2,3].

### Methods and Results

Active and passive methods have been applied [2]. The active method used an Airthings Wave detector, with continuous hourly measurement, located in the semi-basement (RadioecLab). In the passive method, a CR 39 plastic detector was used, exposure time 3 months, located on the second floor (Office; Fig.4). 8512 results from the period 01.01.2019-31.12.2019 and 2214 results from the period 07.05-07.08.2018 were discussed. At the same time, the temperature and humidity parameters were recorded (Fig.3).

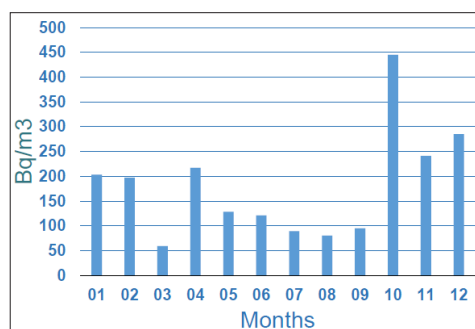


Figure 1: Rn222: monthly average concentration in 2019

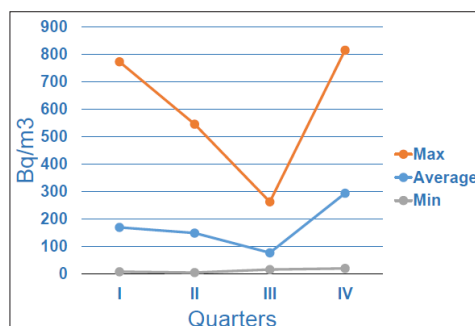


Figure 2: Rn222: Quarterly average concentration in 2019

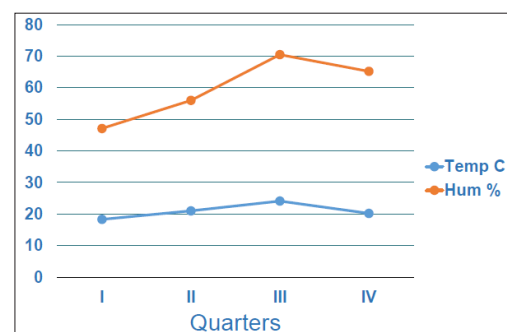


Figure 3: Quarterly averages temperature and humidity in 2019

### Discussions and Conclusions

Following the direct measurements, significant hourly, daily, monthly and quarterly variations (Fig 1; Fig 2) of the Rn222 concentration are found. These can be related to the degree of ventilation of the observed space, but also to the natural emanation of the radioactive isotope collected by the room. Ambient parameters (temperature, humidity) are anti-correlated with radon concentrations (Fig. 3). Maximum values of Rn222 can be drastically reduced by fresh air ventilation, so that no momentary concentration exceeds acceptable values. The annual average for 2019 was  $179 \pm 146$  Bq/m<sup>3</sup>, below the reference value of 300 Bq/m<sup>3</sup>. For comparison, the passive method was also used, placing a CR39 plastic detector in the same room as the active detector (RadioecLab, Annex Office) and another on a higher level (second floor, NIMRD Offices). Exposure through the passive method took place between 07.05-07.08.2018, leading to average results of  $140 \pm 30(2sd)$  Bq/m<sup>3</sup> on the semi-basement and  $88 \pm 18(2sd)$  Bq/m<sup>3</sup> on the second floor (Fig. 4, Accredited Laboratory). The vertical diffusion of Rn222 is influenced by mechanical barriers and losses by multiplying ventilation, which diminishes the emanation from the underground source.



Figure 4: Rn222: Three month average concentration in 2018

The average concentration of Rn222 measured directly in the period 07.05-07.08.2018 was  $109 \pm 79$  Bq/m<sup>3</sup> at semi-basement, which is comparable, within the limits of fluctuations, with the value of  $140 \pm 30(2sd)$  Bq/m<sup>3</sup> from the passive method. Continuing the direct measurements at semi-basement level, in 2019, during the same period, the value of  $88 \pm 51$  Bq/m<sup>3</sup> was obtained, close to that of the previous year ( $109$  Bq/m<sup>3</sup>). The average concentration decreases towards the end of the warm season, with a minimum in October, after which it increases in the cold season (Fig. 2). The accumulation of Rn222 in closed spaces is higher when the rooms are not ventilated (attention in the cold season). Mapping of Rn222 concentrations in the building remains a necessity, to establish a plan of measures, as appropriate.

## References

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3. Vasile Patrascu (2019) Preliminary annually results of Radon measurements in INCDM Constanța. International Symposium on Natural Radiation Sources – Challenges, Approaches and Opportunities, CNCAN, National Library Building, Bucharest.

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