

**NATIONAL STRATEGY FOR
REDUCTION
THE RISK OF RADON EXPOSURE
2018 - 2027**

LIST OF ABBREVIATIONS USED

NRA	Nuclear Regulatory Agency
NBCD	National Building Control Directorate
EC	European Commission
EU	European Union
SPA	Spatial Planning Act
EA BAS	Executive Agency “Bulgarian Accreditation Service”
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
MH	Ministry of Health
MOEW	Ministry of Environment and Water
MRDPW	Ministry of Regional Development and Public Works
MLSP	Ministry of Labour and Social Policy
MF	Ministry of Finance
SCSEAR	Scientific Committee for the Study of the Effects of Atomic Radiation
NCC	National Coordination Council
NCRRP	National Centre for Radiobiology and Radiation Protection
RCC	Regional Coordination Council
BNRP	Basic norms for radiation protection
AAEEC	Average annual equilibrium equivalent concentration
WHO	World Health Organization
SU	Sofia University
RB	Republic of Bulgaria

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I. INTRODUCTION

Radon is a natural source of ionizing radiation and is the largest contributor to the internal radiation exposure of the Earth's population. This exposure leads to an increased risk of developing lung cancer, with the risk being proportional to the average radon concentration and the time of exposure. The World Health Organization (WHO) identifies radon as the second most important factor causing lung cancer after smoking and the number one factor for people who have never smoked.

Reports of increased mortality from respiratory diseases among certain groups of underground miners in central Europe date back to the sixteenth century. Since 1990, national studies have been conducted in a number of countries in Europe, as well as in North America and China, looking at the relationship between radon concentrations in buildings and lung cancer in a population. Analysis has shown that in different countries between 3 and 14% of lung cancer cases are attributable to radon exposure. Data from national studies are the basis for the WHO strategy for lung cancer prevention. Based on these latest scientific data on the health risk of radon exposure, in 2009 the International Commission on Radiological Protection (ICRP) published that they indicate a 2-fold higher risk than previously thought.

In the new 2011 International Atomic Energy Agency (IAEA) Basic Standards for Radiation Protection (IAEA Safety Standards Series No. GSR Part 3), radon exposure in dwellings is included in the general radiation protection system for the general population. The specific requirements for protection from this exposure are set out in Requirement 50: "The government shall provide information on indoor radon levels and health risks, and develop and implement an action plan for the control of radon exposure of the public".

The requirements for the monitoring of radioactivity levels in the living environment, for the assessment of the exposure of the general population and the risk arising therefrom, are laid down in the Health Act, in conjunction with the Recommendation of the European Commission for the implementation of Art. 36 of the Euratom Treaty (2000/473/Euratom).

Council Directive 2013/59/EURATOM of 5 December 2013 laying down basic safety standards for the protection against the dangers arising from exposure to ionising radiation and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom (OB L13 of 17.01.2014) establishes uniform basic safety standards to *protect the health of professionals, the general public and patients*. It puts firmly in front of the brackets the *control of the living environment* related to the safety of the *population* as a whole and of groups at risk. For the first time, all radiation sources are brought together, including the control of natural Radionuclides (NORM), which includes the control of radon in residential and public buildings as well as in the workplace.

Due to all the above facts on identification of health risk and due to the complexity and scope of the problem, it is necessary to unite the efforts of all responsible institutions and their active involvement in the activities to reduce the risk of radon exposure to the population of the Republic of Bulgaria, which is expected to lead to a reduction in lung cancer morbidity and mortality.

Solving the problem requires the development of a National Strategy for the Identification and Management of the Risk of Radon Exposure in Buildings, with the combined efforts of the government, the non-governmental sector and the participation of all citizens.

The strategy aims to outline a coherent framework for setting priorities for action to reduce the risk of radon exposure and to support the implementation of measures to implement them at national, regional, municipal level and why not in every Bulgarian home, group and workplace.

The strategy will also help to identify and prioritise specific areas for collaboration and ensure that issues are addressed in a coordinated manner, with a view to developing the capacity to reduce the risk of radon exposure in the longer term.

The radon risk reduction strategy has a scope of action from 2018 to 2027.

Key Values

The strategy is based on the following key values: positive thinking, forward-looking, awareness, culture, responsibility, cooperation, continuity and political will.

Positive thinking

Bulgarian society underestimates the importance of preventive activities, through which radon exposures can be not only expected but also manageable. The efforts of the responsible institutions are primarily focused on building the capacity to respond to the occurrence of increased radon exposure. A positive mindset needs to be formed in their management and expert staff regarding the possibility of managing the risk of radon exposure.

Perspectivity

The forward-looking approach overcomes the shortcomings of the purely planning approach, which relies on existing trends and possible forecasts, while allowing for a certain uncertainty and multivariate nature of the forecasts when organising the management. For this reason, sustainable development planning should be carried out by applying a forward-looking approach to the implementation of adequate, economically justified activities leading to a reduction in the risk of radon exposure.

Awareness

At the heart of reducing the risk of radon exposure is the collection and dissemination of best practice information in relation to the successful development of meaningful policies in this area. Awareness of the responsible institutions ensures that good practices can be easily used in the planning of preventive measures and activities, and awareness of the population facilitates their implementation. The first step in addressing the gaps in available information on radon risk is to carry out a risk assessment. The next step is to study good practices that help to reduce the risk of radon exposure and increase the responsible attitude of management institutions and the public towards radon exposure.

Culture

A factor in reducing the risk of radon exposure is the formation of a culture of radon exposure prevention and the correct behaviour of the whole society. Increased public awareness of the risk of radon exposure has a positive impact on decision-making processes, the development of regulations and the organisation of resources to reduce the risk of radon exposure. This will ensure effective policy to reduce radon exposure.

Responsibility

Reducing the risk of radon exposure is an expression of moral and societal responsibility at all levels of government. Both directly and indirectly, responsible leaders must believe and seek fulfilment in the humane cause in measures to reduce radon exposure. The serious public responsibility they assume by their participation in radon exposure risk management requires a strict public definition of responsibilities and a clear personalization of their performance.

Collaboration

Modern countries are not alone in facing the challenges of radon exposure situations. Their efforts to reduce radon exposure are supported by the combined action of countries within a coordinated regulatory framework. WHO, IAEA and EU documents are leading the way in managing the risk of radon exposure reduction.

Continuity

So far, activities have been implemented under the National Programme for the Reduction of Radon in Buildings on the Health of the Bulgarian Population 2013-2017. In the implementation of the activities of the work programme, certain successes have been achieved in the identification of the problem, the establishment of management structures, the training of experts and implementers of the set tasks, as well as an attempt to inform the Bulgarian population about the health risks of radon and the possibilities of measuring its concentration and the measures to be taken to reduce the risk of chronic exposure.

The continuation of these activities through this Strategy and its Action Plans will ensure long-term work on the issue.

Political will

The complexity of societal design and governance today requires a clear political will to enforce an integrated approach to managing the risk of radon exposure. The existence of political will is one of the main prerequisites for incorporating radon risk management into development planning for every sector of public life.

II. STATUS ANALYSIS

1. Radon - a national, social and medical problem

The natural radioactive element radon (radon-222), with atomic number 86 in the Mendeleev Table of Chemical Elements, is the largest contributor to the internal exposure of the Earth's population. The average annual effective dose to humans from inhalation of radon and its short-lived daughter products in ambient air is estimated at 1.2 mSv/year.

The global average annual effective dose from total external and internal exposure due to natural background radiation is equal to 2.4 mSv/year. Therefore, 50% of the natural exposure of the Earth's population is due to radon (radon-222). From the radiation protection point of view, radon is the dominant factor in human exposure from naturally occurring radioactive sources.

Radon, which has several isotopes, is a naturally occurring colourless and odourless radioactive noble gas. The longest-lived of the isotopes is radon-222 (²²²Rn) with a half-life of 3.826 days,

which will be referred to hereafter simply as "radon". Radon is a member of the uranium-radium family and is produced by the decay of radium-226 (^{226}Ra) with a half-life of 1,620 years. Radon, through alpha decay, forms daughter products which in turn decay to release alpha and beta particles. Polonium-218 and polonium-214 are alpha emitters, lead-214 and bismuth-214 are beta emitters (Fig. 1).

Radon is distributed all over the Earth - in soils, rocks, minerals, water and air. The permeability of the soil is important for its release, and its chemical inertness allows radon to migrate tens of metres by diffusion and convection. The concentration of radon in outdoor and indoor air depends on climatic conditions and varies widely from season to season.

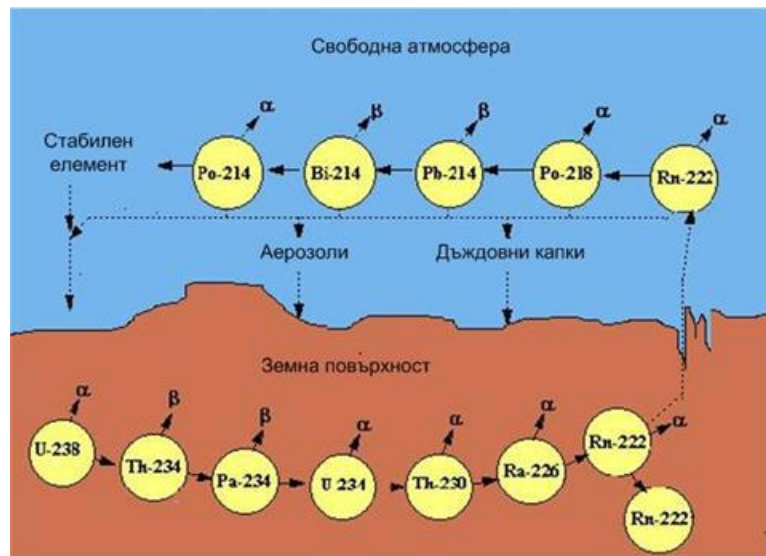


Fig 1. Natural radioactive decay of uranium-238 (^{238}U) to the stable end product lead-206 (^{206}Pb) (after <http://www.geologiefranken.de/strahlenschutz/radon.html>)

The unit of activity of a radionuclide in the International System of Units (SI) is the becquerel (Bq) and corresponds to one radioactive decay per second, and the concentration of radon in a unit volume of air is measured in becquerels per cubic metre (Bq/m^3).

Exposure of the public to radon in buildings is considerably greater than exposure outdoors because it penetrates freely through defects in the outer skin and small cracks in the foundation. The main source of radon in the air of a building is the soil and rock beneath it and the building materials of which it is constructed. Other sources of radon are building materials and drinking water from water supply systems. In individual cases, one of these sources may predominate. For example, in areas with uranium mining, dwellings may be found for which materials including waste materials with high radium content are used as building materials, making them the main source of radon. Water may be a major source for settlements near mineral water deposits with high radon content. Atmospheric ambient air may contribute in very rare cases - for example near uranium mines (such as in the village of Eleshnitsa, municipality of Razlog) or in places that are very specific geologically, topographically and climatically.

The entry of radon into buildings is a complex process and is influenced by many factors, such as changes in atmospheric pressure, wind speed and precipitation, etc. As a consequence of these atmospheric influences, in addition to diurnal and seasonal variations, indoor radon

concentrations exhibit significant annual variability. For this reason, long-term (three months to one year) indoor radon measurements are necessary to make a reliable assessment of radon risk.

2. Risk factors and health effects

The main route of exposure from radon and its daughter products is by inhalation (inhalation). Short-lived radon decay by-products are deposited on aerosol particles and dust in the air or on indoor surfaces. In confined spaces, the equilibrium between radon and its short-lived daughter products depends mainly on the aerosol concentration, the ratio between room volume and air exchange, etc. When inhaled, these particles attach to the airways and lead to irradiation of sensitive cells in the lung tissue by alpha and beta particles, which creates a risk for the development of radon-induced lung cancer.

Lung cancer is the most common malignancy in men worldwide and one of the most common in women. According to the statistics for Bulgaria lung cancer accounted for 19.3% of all cancer cases in men and 5.3% of cancer cases in women in 2013 according to the National Cancer Registry. This makes it the most common type of cancer in men and the 5th most common in women. On average, there are 3,624 deaths from lung cancer in a year, of which 81.6% are men. It is one of the leading causes of death in the country, and each year in Bulgaria the trends in lung cancer incidence and mortality are increasing in both sexes. The incidence and mortality rates of lung cancer in men in Bulgaria are higher than the European average. The 5-year survival rate from lung cancer in Bulgaria is very low - 5.9% for men, 10.4% for women and 6.5% overall for both sexes. It is lower than the European average of 12.6%.

The occurrence of diseases affects not only the individual, but also their loved ones and has major economic consequences for any society in terms of loss of income and resources for health care. Therefore, having a national strategy to reduce the risk of radon exposure, including national surveys, monitoring and appropriate methods and guidelines and recommendations to reduce radon concentrations, with optimal use of available resources, will be of great societal importance. Such strategies have been developed in EU Member States and their aim is: to effectively reduce radon-induced lung cancer by reducing the exposure of the population based on monitoring and implementing measures to reduce radon levels in new and existing buildings.

3. Regulatory requirements

Directive 2013/59/Euratom requires Member States to establish national reference levels for indoor radon concentrations not exceeding 300 Bq/m³. This requirement must be transposed into national law by 6 February 2018.

The implementation of Directive 2013/59/Euratom in national legislation will set a reference level for annual average airborne volumetric activity of 300 Bq/m³ for members of the public and workers.

Where buildings and workplaces are identified where reference levels are exceeded, measures need to be taken to:

1. Reduce radon concentrations in the air of public buildings and workplaces in accordance with the optimisation principle;

2. informing and encouraging occupants of existing buildings to take action to reduce the radon concentration in the air of their premises (by improving ventilation, limiting radon intrusion, etc.);
3. Systematic monitoring of radon concentrations in buildings and workplaces with elevated radon in the air.

4. Radon mitigation policy in buildings - an international review

World Health Organization (WHO)

The World Health Organization launched the International Radon Project in 2005 with experts from about 40 countries. The result of the project work is the WHO Handbook on Indoor Radon: A Public Health Perspective, published in 2009. It lists radon exposure as the second most important cause of lung cancer after smoking, and the number one cause for people who have never smoked. In the US, for example, about 21,000 lung cancer deaths a year can be attributed to this factor. Significant attention is paid to the need to develop national programmes, the main priorities of which are as follows:

- to reduce the risk to the general population as well as the individual risk to people living under high radon concentrations;
- establish a national reference level of 100 Bq.m⁻³ and, if this is not possible, select a level not exceeding 300 Bq.m⁻³;
- Develop and adopt technical rules and standards to regulate protective and remedial (restorative) measures to protect against radon intrusion in new and existing buildings;
- Develop a national measurement guide to ensure quality and consistency of results.

International Commission on Radiological Protection (ICRP)

Following a study of the latest scientific data on the health risk of radon exposure, the ICRP stated in 2009 that it indicated a 2-fold greater risk than previously thought and changed the reference level for radon in dwellings from the previously recommended 600 Bq.m⁻³ to 300 Bq.m⁻³. This recommendation was included in the 2014 adopted ICRP Publication 126, Radiological Protection from Radon Exposure. The measurement should be representative of the average annual radon concentration in a building. Given that different individuals should be protected to the same extent regardless of the use of the building and the length of time they are in it, the committee recommends that the same value of 300 Bq.m⁻³ be used for mixed-use buildings (accessible to both workers and the public).

International Atomic Energy Agency (IAEA)

In revising the International Basic Standards for Radiation Protection adopted 15 years ago, the IAEA took full account of the latest WHO and ICRP recommendations on protection from radon exposure. In the new 2014 International Basic Standards for Radiation Protection (IAEA

Safety Standards Series No. GSR Part 3), radon exposure in housing is included in the general system of radiation protection of the population. Specific requirements for protection from this exposure are specified in Requirement 50: “The government shall provide information on indoor radon levels and health risks, and develop and implement an action plan to control radon exposure to the public.” To this end, the Government should provide:

- information on volumetric concentrations of radon in dwellings and other buildings with a high population use (kindergartens, schools, hospitals, etc.) by conducting representative surveys/measurements;
- presenting information to the public on radon exposure and the associated health risks, including increased risk from smoking;
- development of a coordinated action plan to reduce radon levels in existing and newly constructed buildings, providing for:
 - ✓ Determination of the reference level for radon in dwellings and other buildings with high population use (taking into account existing socio-economic conditions) not exceeding 300 Bq/m³ ;
 - ✓ reducing radon levels and corresponding irradiation to optimise protection;
 - ✓ taking protective measures according to priorities and the effectiveness of the measures applied;
 - ✓ elaboration setting rules and standards c purpose preventing radon from entering homes.
- competent authority for:
 - ✓ Development and implementation of an action plan for the control of radon exposure of the general public in confined spaces;
 - ✓ identifying circumstances in which radon mitigation measures should be mandatory, taking into account regulatory requirements and existing socio-economic conditions.

With regard to worker exposure, there is a requirement for the regulatory authority to establish an appropriate reference level for workplaces not exceeding 1000 Bq.m-3.

European Commission

In 2013. In 2013, the European Commission adopted Directive 2013/59/Euratom on basic standards for radiation protection. Annex XVIII of the Directive also provides an indicative list of elements to be included in the national action plan for the management of long-term risks from radon exposure.

Basic requirements for construction works are laid down in Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive

89/106/EEC (OJ L 88, 04.04.2011). Construction works as a whole and individual parts thereof must be fit for their intended use, taking particular account of the health and safety of persons involved throughout the life cycle of the works. Subject to normal maintenance, the works must meet these essential requirements for an economically reasonable period of use.

Structures must be designed and constructed in such a way that throughout their life cycle they do not pose a threat to the health and safety of workers, occupants or neighbours, nor have an unreasonably high impact on the quality of the environment or the climate during construction, use and demolition. Specific factors identified include possible causes of the above harmful effects, emission of hazardous emissions and release of toxic gas. These requirements of the regulation have been in force since 01.07.2013.

5. Radon propagation studies in Bulgaria

So far, measurements of radon concentrations and radon daughter products have been carried out in buildings by the National Centre for Radiobiology and Radiation Protection - MoH, the Executive Environmental Agency - MoEW and SU "Sv. Kliment Ohridski" in the European Union. The measurements cover some larger towns with an increased incidence of lung cancer (e.g. Rakovski), as well as settlements affected by the former uranium mining industry. The studies are not systematic and do not show the overall picture of exposure of the Bulgarian population. It can only be achieved by conducting national surveys. In a large number of countries in the world, national surveys began to be carried out as early as the 1980s and they have become the basis for the development of the lung cancer prevention strategy. In Bulgaria, a national survey on radon concentration in dwellings has been conducted so far within the framework of the National Programme for the Reduction of the Impact of Radon in Buildings on the Health of the Bulgarian Population 2013-2017, adopted by Decision No. 537 of the Council of Ministers of 12.09.2013.

Measurements in objects with increased radiation risk. Industrial uranium mining in Bulgaria began after 1945 in the town of. Buhovo. At first, uranium was mined using the so-called classical method. In 1970, geotechnical extraction of uranium with sulphuric acid solutions by drilling began in the Thracian Lowlands. Under RCM No 163 of 1992, the sector was restructured and uranium mining ceased. Figure 2 shows the locations of the former uranium mining sites in Bulgaria.

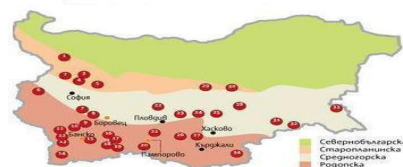


Fig. 2. Location of former uranium mining sites and the amount of uranium deposits remaining

It is assumed that buildings with airborne radon concentrations higher than the WHO recommended level of 300 Bq/m³ for existing buildings may be located near these sites. Passive (cumulative) measurements over an extended period of time in randomly selected residential buildings were made by the National Centre for Radiobiology and Radiation Protection - MH and SU "Sv. Kliment Ohridski" in the settlements. Eleshnitsa, town of St.

Rakovski, Sliven-ville zone, village of. Bachkovo. The maximum recorded value is up to 4500 Bq/m³ (Bachkovo village). The results confirm the assumption that a significant part of residential buildings in areas with increased radiation risk may have radon concentrations in air around or above the recommended levels.

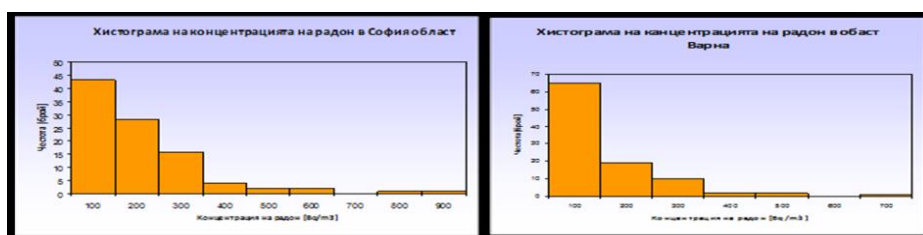
Measurements in larger cities in Bulgaria. Cumulative (passive) measurements of radon concentrations in residential buildings have been carried out by the National Centre for Radiobiology and Radiation Protection in Bulgaria. The results of the survey were carried out by the National Radiation Protection and Radiation Laboratory in Sofia. The measurements were made with short-term SST electrets and cameras for a period of 10 days. The areas covered were the Central, Northwest and Southeast regions, as well as different types of construction in these areas. No values approaching the recommended levels were found for existing construction (pre-1990). For new construction, brick is the predominant building material for residential buildings. For this, the concentration varies over a wider range and higher than typical average levels can be expected. The results are summarised in the table:

Year of construction	Concentration [Bq/m] ³
before 1990	60 ÷ 200
after 1990	100 ÷ 600

A 2010 measurement of radon concentrations in kindergartens in Sofia by the NCRRP showed that in 82% of cases the results were below the reference levels. Only 7% of the measurements showed high values in the buildings.

In the period October 2011 - May 2012, a pilot study of radon concentration in dwellings in four districts, Sofia-city, Sofia, Plovdiv and Varna, was conducted by the NCRRP under an IAEA project. Radon concentrations between 20 and 3560 Bq/m were detected³ Figures 3 presents the results of the frequency distribution of radon concentration by districts.

The geometric mean value determined in this study is: for Plovdiv - 137 Bq/m³; for Sofia - 78 Bq/m³ ; for Sofia region - 111 Bq/m³ and for Varna - 80 Bq/m³ . It is important to note that the results of this study show not a high percentage of dwellings above the reference level of 300 Bq/m³ (Sofia - 3%; Sofia region - 9%; Plovdiv - 14%; Varna - 5%).



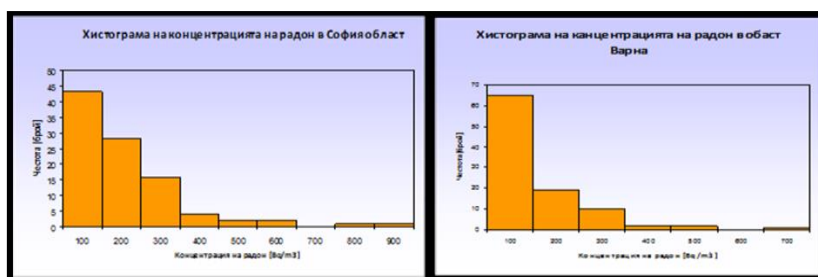


Fig 3: The results for the frequency distribution of radon concentration in Plovdiv, Sofia-city, Sofia-district and Varna

The data demonstrate the need for centralized measures to limit radon exposure in buildings, which can be achieved through an integrated multidisciplinary approach to the problem, as well as health promotion activities and specialized training on the issue for builders, occupational physicians, and the public to achieve real results in lung cancer prevention and population health protection.

6. Existing situation

The lack of a strategic framework to reduce the risk of radon exposure is one of the main challenges. Actions currently lack a strategic focus as their approach is mainly based on the development of projects and programmes that are often uncoordinated and inappropriate. Currently available data on radon concentrations are scattered, limited and difficult to compare - different methods and instruments are used to make measurements. Data on the concentrations found and the economic consequences of radon exposure are at best indicative.

Changes in national legislation reflecting new requirements related to the presence of radon.

Studies carried out in recent years on the risk assessment of radon exposure have led international organisations such as the World Health Organisation, the International Commission on Radiological Protection, the International Atomic Energy Agency and the European Commission to revise the recommended radon concentration levels. The process of change must also be implemented in our legislation.

Insufficient public awareness of the risk of exposure to radon, and of the actions and measures that can be taken to reduce exposure, is also a serious challenge. Measures implemented so far are inconsistent and limited in scope, and the issue of resourcing is underestimated.

The coordination between the responsible institutions is not at the required level and the frequent change of the regulatory framework in the sector, the lack of effective coordination, consistency and continuity of the responsible structures negatively affects the reduction of the risk of radon exposure.

To be an effective national strategy requires the involvement of a range of agencies, as well as coordinating activities and ensuring links with tobacco control and other health programmes, communication with the population and with professional groups involved.

The strategy should also set a legislative framework by involving different groups of experts, including architects, civil engineers, occupational health doctors, etc., in the process of drafting regulations.

Following the definition of consensus strategic goals and policies, it is necessary to develop a national action plan (with optimal implementation periods and a 5-year evaluation of achievements) that defines the action plan of the concerned agencies, which should include specific tasks and activities related to the development of criteria and professional standards, guidelines, training, including the publication and dissemination of information materials on health risk reduction, along with the conduct of systematic national surveys on

7. Rationale for the adoption of a National Strategy for the Reduction of Radon Exposure Risk

✓ Radon is the main source of radiation exposure for the general population, but there are a number of cost-effective measures available both to prevent the problem in new buildings and to remediate existing buildings. The development and implementation of government policy in this area will be able to achieve significant public health benefits and reduce the risk to the population.

✓ International experience has shown that effective prevention of population health and reduction of radon exposure involves a wide range of actions including: effective prevention in new buildings, identification of existing homes and workplaces with high radon levels, remediation of existing buildings, awareness raising and training. These actions require the involvement of a range of institutions, agencies and other stakeholders and coordination between them, which would be achieved by developing and preparing a national level strategy.

✓ New regulatory requirements, harmonised with international European recommendations for the control of radon exposure in buildings, to provide a sound basis for the distribution of responsibilities and the interaction between institutions and between institutions and NGOs need to be implemented.

✓ The development and implementation of the strategy will take an integrated approach to ensuring and safeguarding the health of society as a whole and of the individual by identifying health hazards from the adverse effects of environmental factors. The strategy is based on the notion that good health is an asset and a source of economic and social stability.

✓ The strategy will contribute to national surveys of radon levels in buildings and to the preparation of a radon map of Bulgaria, based on an established a national database of radon measurements, which will improve public awareness and implementation of effective prevention measures for new buildings.

✓ Every citizen in Bulgaria has the right to healthy and safe working conditions, and children should grow up in buildings with proven air quality. Achieving a single approach of measuring radon in workplaces, as well as organising a survey of kindergartens and schools could be achieved with a common national strategy to reduce the risk of radon exposure involving a range of agencies and institutions.

III. OBJECTIVES

Strategic objective

Reducing the collective and individual risk to the Bulgarian population from radon exposure in buildings by implementing a long-term policy to provide a stable legal and institutional framework and support the implementation of measures to reduce radon exposure.

Operational objectives

1. Conduct an integrated and systematic national policy aimed at reducing radon exposure to prevent health risks.
2. Establish a framework for the management and implementation of national action plans with a clear structure, priorities, responsibilities, and sequential steps, for the long-term reduction of radon exposure
3. Collect and systematize information on radon exposure in residential, public buildings and workplaces by conducting national surveys and other systematic measurements
4. Introduction of technical rules and regulations for the practical application of adequate preventive (protective) measures in the construction of new buildings and remedial (restorative) measures in existing buildings in operation.
5. Improve public awareness of the health risks of radon and the opportunities for mitigation.
6. Establish a system for monitoring radon concentrations in public buildings and workplaces.

IV. TARGET GROUPS

- Citizens
- Construction specialists
- Occupational Medicine Specialists
- Employers
- Education professionals
- Medical professionals
- Print and electronic media

V. PRIORITIES - MILESTONES FOR STRATEGY IMPLEMENTATION

Under operational objective: 1. Conduct an integrated and systematic national policy aimed at reducing the impact of radon in order to prevent health risks.

The following priorities have been identified under this operational objective:

- 1.1. Development of a national action plan with specific activities with a duration of 5 years.

1.2. Introduction and implementation of European and international norms, rules and recommendations in Bulgarian legislation, as well as new scientific achievements in the field of radiation protection.

Under operational objective: 2. Establish a framework for the management and implementation of national action plans with a clear structure, priorities, responsibilities, and consistent steps, for the long-term reduction of radon exposure.

2.1 Establishment of a National Coordination Council with the participation of all relevant agencies with responsibilities for the implementation of the radon mitigation policy.

2.2 Establish regional coordination councils to manage and coordinate the implementation of radon mitigation policy at regional level, involving all stakeholders.

2.3 Integrate as far as possible with other health risk prevention strategies (e.g. smoking, air quality, energy conservation, etc.)

2.4 Developing and implementing adequate methods for periodic evaluation of the effectiveness of the National Action Plans including: performance evaluation; cost-effectiveness analysis and updating of evaluation criteria where necessary.

Under operational objective: 3. Collect and systematize information on radon exposure in residential, public buildings and workplaces by conducting national surveys and other systematic measurements.

3.1 Development of a methodology for the development and maintenance of a national database for measurements of radon concentration indoors or in soil gas, etc. Improve and keep up-to-date the data by expanding the systematic database of measurements.

3.2 Use specific indicators to identify areas with potentially high radon concentrations based on existing maps, databases or information systems.

3.3 Organizing and conducting national surveys (measurements) of radon concentrations in buildings with emphasis on measurements conducted in homes, schools, public buildings, etc.

3.4 Conduct a radon survey at workplaces where radon concentrations are likely to have high levels.

3.5 Other studies, such as radon in soil gas, radon in water, building products that can affect the concentration of radon in buildings.

3.6 Epidemiological studies to assess the incidence of disease in an area and their ability to be used as a guide for subsequent analysis of the results of implementing radon concentration reduction programmes.

Under operational objective: 4. Introduction of technical rules and regulations for the design and implementation of protective technical measures for the construction of new buildings and corrective (remedial) technical measures for existing buildings.

4.1 Training of professionals in the construction industry involved in the process of building construction: turnkey.

4.2 Establishing a working mechanism for implementing corrective actions in buildings, evaluating best practices for efficiently and economically reducing radon levels in buildings, including a control system including pre-control of building material inputs.

4.3 A mechanism for effective corrective action in public buildings including schools, kindergartens, hospitals, nursing homes, etc. where high indoor radon concentrations have been found.

4.4 Mechanism for financial support for radon concentration studies and remedial measures where appropriate; for example: private residential buildings with particularly high indoor radon concentrations.

4.5 Establish a system to provide detectors to evaluate the effectiveness of corrective actions to reduce radon concentration

Under operational objective: 5. Improve public awareness of the health risk of radon and opportunities to reduce it.

Risk communication and dissemination of radon prevention messages pose serious challenges. Information about radon is not widely known now and is difficult to perceive as a public health risk. Training of different target groups is envisaged, e.g. in the form of workshops, development, publication and distribution of information materials on reducing the risk of prolonged exposure to high radon concentrations. Effective communication requires cooperation between different organisations, clear and coordinated messages, and the involvement of collaborators trusted by the public.

5.1 Identify the purpose and key messages of the communication strategy aimed at different target groups.

5.2 Identify stakeholders and develop appropriate communication channels for each of them

5.3 Form and train communication teams.

5.4 Planning national and regional communication programmes.

5.5 Evaluation of the achievements of the implemented communication strategy.

Under operational objective: 6. Establish a system for monitoring radon concentration in public buildings and workplaces

With regard to occupational exposure, the Euratom Basic Standards Directive 2013/59 requires the regulatory authority to establish an appropriate reference level for workplaces not exceeding 1000 Bq/m³. In this sense, the strategy requires the identification of workplaces where doses requiring the categorisation of workers as occupationally exposed are likely to be realised.

6.1 Develop a mechanism to measure radon in workplaces and identify those where high levels of radon concentration are likely to be detected and workers would need to be classified as occupationally exposed

6.2 Classification of workplaces according to their specificity (where a control system needs to be set up; places with likely high radon concentration values where the population

also has access; public buildings that can be treated as dwellings, i.e. the reference concentration should be 300 Bq/m³, etc.)

6.3 Determine appropriate exposure reduction measures in workplaces where workers are not classified as occupationally exposed but where high radon concentrations are likely to be detected.

VI. EXPECTED RESULTS

A key element in the implementation of the strategy's objectives is the involvement of state, municipal, non-governmental and business institutions, as well as society as a whole. In this regard, it is necessary to achieve:

Consensus among state, municipal, non-governmental and business institutions and civil society at national, regional and local levels on the need to pursue an active policy to reduce radon levels in residential and public buildings.

Involvement and direct participation of the executive and local authorities, the health and education systems, NGOs and businesses, national and local media.

Declaration of political will by parliament, government, local authorities and civil society to implement the programme.

The implementation of the strategy will contribute to reducing the impact of the risk factor radon. Together with smoking reduction, the prevention of lung cancer will be improved. Its results can be reported through epidemiological studies on the prevalence of lung cancer.

As results of the implementation of the Strategy and its Action Plans the following should be expected:

1. Comprehensive harmonisation of legislation on radiation protection, construction and occupational health and safety;
2. Conducting national surveys of radon levels in Bulgaria;
3. Implement anti-radon measures in at least 5% of public buildings where concentrations above 300 Bq/m have been detected³ ;
4. Continuously increase the number of measurements in order to produce a radon map with appropriate statistical reliability.
5. At least 30% of the construction experts involved in the issue should have knowledge of the application of technical requirements for radon protection in the construction of new buildings and the reconstruction of old ones;
6. Achieve media coverage reaching 30% of the Bulgarian population;
7. At least 10% of occupational health services to be trained in relation to the introduction of radon measurement as a factor of the working environment.