Cancer Association of South Africa (CANSA)

Fact Sheet and Position Statement on Radon as a Cause of Lung Cancer

Introduction

Radon gas is one of the most dangerous things individuals unknowingly expose themselves to every day. It forms from the natural decay of radioactive elements that exist in the earth (usually Uranium^{238}, Radium^{235}, or Radium^{234}) and the various deep under homes and workplaces. It has no colour, odour, or taste, so one cannot detect it without a measurement device.

[Picture Credit: Radon Picture]

Radium has 33 known isotopes, with mass numbers from 202 to 234. All of them are radioactive. Four of these: ^{223}Ra (half-life 11.4 days); ^{224}RA (half-life 3.64 days); 226Ra (half-life 1 600 years); and ^{228}Ra (half-life 5.75 years); occur naturally in the decay chains of primordial thorium-232, uranium-235, and uranium-238 (^{223}Ra from uranium-235, ^{226}Ra from uranium-238, and the other two from thorium-232).

Radon

Radon is a noble gas which is naturally radioactive. Isotope ^{222}Rn decays with a half-life of 3.8 days to a series of radioactive daughter products which exist as respirable (that can be inhaled) sized particles. The particulate daughter products are electrically charged and easily attaches to the surfaces of the respiratory organs where they decay by alpha particle emissions, importing intensively ionising radiation to the immediate surrounding tissue.

Alpha rays cannot penetrate the outer layer of one's skin and are, therefore, only a cause for concern if deposited inside the human body.

Eidy, M. & Tishkowski, K. 2020.

"Radon is one of the main causes of lung cancer in non-smokers. It is estimated to cause around 21,000 deaths annually. It is a radioactive gas that is tasteless, odorless, and colorless. Naturally occurring in the environment, it is the decay product of uranium-238 and radium-226. As an extremely dense and highly radioactive gas, it can damage the respiratory epithelium through the emission of alpha particles. It can be found in the soil, rocks, and ground throughout the world. It can exist in water supplies and can be entrapped in homes. It has a tendency to build-up in large quantities in areas with poor ventilation, and high levels can eventually cause health concerns. Recently, there has been a statistically significant linear relationship found with increased radon concentrations and an increased risk for lung cancer. Given that it is imperceptible by color, taste, or smell, and causes no obvious symptoms of irritation or exposure, measuring radon levels is the only way to know if there exists a high level of exposure."

Incidence of Lung Cancer Due to Exposure to Radon

The incidence of lung cancer in South Africa as a result of Radon exposure is not known, however, a recent study in Korea indicates the importance of radon as a cause of lung cancer and that mitigating radon exposure lessens the incidence of lung cancer due to radon exposure.

Lorenzo-Gonzalez, M., Ruano-Ravina, A., Torres-Duran, M., Kelsey, K.T., Provencio, M., Parente-Lamelas, I., Piñeiro-Lamas, M., Varela-Lema, L., Perez-Rios, M., Fernandez-Villar, A. & Barros-Dios, J.M. 2020.

Background: Through a pooled case-control study design, we have assessed the relationship between residential radon exposure and lung cancer risk. Other objectives of the study were to evaluate the different risk estimates for the non-small cell lung cancer histological types and to assess the effect modification of the radon exposure on lung cancer risk by tobacco consumption.

Methods: We collected individual data from various case-control studies performed in northwest Spain that investigated residential radon and lung cancer. Cases had a confirmed anatomopathological diagnosis of primary lung cancer and controls were selected because they were undergoing ambulatory evaluation or surgical procedures that were unrelated to tobacco use. Residential radon was measured using alpha track detectors. Results were analyzed using logistic regression.

Results: 3704 participants were enrrolled, 1842 cases and 1862 controls. Data show that lung cancer risk increases with radon exposure, finding a significant association of radon exposure with lung cancer at radon exposures above 50 Bq/m^3. The estimated adjusted OR for individuals exposed to concentrations >200 Bq/m^3 was 2.06 (95% CI: 1.61-2.64) compared with those exposed to ≤50 Bq/m^3. Within a smoking category, lung cancer risk increases markedly as radon concentration increases, reaching an OR of 29.3 (95% CI: 15.4-55.7) for heavy smokers exposed to more than 200 Bq/m.^{3}

CONCLUSIONS: This study confirms that residential radon exposure is a risk factor for lung cancer well below action levels established by international organizations. As expected, there is also an effect modification between radon exposure and tobacco consumption.

Kim, S.H., Koh, S.B., Lee, C.M., Kim, C. & Kang, D R. 2018.

PURPOSE: Exposure to indoor radon is associated with lung cancer. This study aimed to estimate the number of lung cancer deaths attributable to indoor radon exposure, its burden of disease, and the effects of radon mitigation in Korea in 2010.

MATERIALS AND METHODS: Lung cancer deaths due to indoor radon exposure were estimated using exposure-response relations reported in previous studies. Years of life lost (YLLs) were calculated to quantify disease burden in relation to premature deaths. Mitigation effects were examined under scenarios in which all homes with indoor radon concentrations above a specified level were remediated below the level.

RESULTS: The estimated number of lung cancer deaths attributable to indoor radon exposure ranged from 1946 to 3863, accounting for 12.5-24.7% of 15623 total lung cancer deaths in 2010. YLLs due to premature deaths were estimated at 43140-101855 years (90-212 years per 100000 population). If all homes with radon levels above 148 Bq/m^3 are effectively remediated, 502-732 lung cancer deaths and 10972-18479 YLLs could be prevented.

CONCLUSION: These findings suggest that indoor radon exposure contributes considerably to lung cancer, and that reducing indoor radon concentration would be helpful for decreasing the disease burden from lung cancer deaths.

Hassfjell, C.S., Grimsrud, T.K., Standring, W.J.F. & Tretli, S. 2017.
BACKGROUND: Radioactive radon gas is generated from uranium and thorium in underlying rocks and seeps into buildings. The gas and its decay products emit carcinogenic radiation and are regarded as the second most important risk factor for lung cancer after active tobacco smoking. The average radon concentration in Norwegian homes is higher than in most other Western countries. From a health and cost perspective, it is important to be able to quantify the risk of lung cancer posed by radon exposure.
MATERIAL AND METHOD: We estimated the radon-related risk of lung cancer in Norway based on risk estimates from the largest pooled analysis of European case-control studies, combined with the hitherto largest set of data on radon concentration measurements in Norwegian homes.
RESULTS: Based on these estimates, we calculate that radon is a contributory factor in 12 % of all cases of lung cancer annually, assuming an average radon concentration of 88 Bq/m3 in Norwegian homes. For 2015, this accounted for 373 cases of lung cancer, with an approximate 95 % confidence interval of 145 – 682.
INTERPRETATION: Radon most likely contributes to a considerable number of cases of lung cancer. Since most cases of radon-associated lung cancer involve smokers or former smokers, a reduction of the radon concentration in homes could be a key measure to reduce the risk, especially for persons who are unable to quit smoking. The uncertainty in the estimated number of radon-associated cases can be reduced through a new national radon mapping study with an improved design.

Health Effects of Radon

When radon gas is inhaled, densely ionizing alpha particles emitted by deposited short-lived decay products or radon can interact with biological tissue in the lungs leading to DNA damage. The occurrence of cancer is generally thought to require at least one gene mutation, and proliferation of intermediate cells that have sustained some degree of DNA damage, which can greatly increase the pool of cells available for the development of cancer.

It is known that even a single alpha particle can cause major genetic damage to a cell. It is, therefore, possible that radon-related DNA damage can occur at any level of exposure and according to the World Health Organization, it is unlikely that there is a threshold concentration below which radon does not have the potential to cause lung cancer.

Radon is now recognised as the second most important cause of lung cancer, after smoking, in the general population.

Radon and tobacco smoke from cigarettes (and cigars and pipes) can damage your lungs. When they're combined, smoking and radon are more dangerous than either one on its own. Smokers who live in homes with high radon levels have a risk of lung cancer that's 10 times higher than non-smokers who live in homes with high radon levels (World Health Organization).

It is believed that the relationship between radon and risk of lung cancer is linear. In other words, doubling the exposure doubles the risk and halving the exposure halves the risk. Doubling of the risk means much more for a smoker, who is already at high risk of lung cancer, than for a non-smoker with a very small base line risk. Lung cancer risk from residential radon exposure is substantially lower since the exposure in homes is much lower than in mines, although the risk increases with radon concentration level and duration of exposure. For life-time exposure to radon of 20 Bq/m3 level at home the risk of lung cancer is estimated to be 0.3% (or 3 deaths in 1000 people). For comparison, risk of accidental death at home is 0.7% (or 7 in 1000).
(World Health Organization, 2002).

Key messages from the World Health Organization (2009 & 2016) include:

- Radon is a naturally occurring radioactive gas which may be found in indoor environments such as homes, schools, and workplaces, especially in areas where gold is/has been mined as well as areas where there are high concentrations of granite.

- Epidemiological studies confirm that radon in homes increases the risk of lung cancer in the general population. Other health effects of radon have not been demonstrated.

- The proportion of all lung cancers linked to radon, is estimated to be between 3% and 14%, depending on the average radon concentration in the country and on the method of calculation.

- The lower the radon concentration in a home, school, or workplace, the lower the risk of lung cancer, however, there is no known threshold below which radon exposure carries no risk.

- Well-tested, durable and cost-efficient methods exist for preventing radon in new houses and reducing radon in existing dwellings.

- Radon is much more likely to cause lung cancer in people who smoke, or who have smoked in the past, than in lifelong non-smokers. However, it is the primary cause of lung cancer among people who have never smoked. Smokers are estimated to be 25 times more at risk of lung cancer from radon than non-smokers. To date, no other lung cancer risks have been established.

- There is no known threshold concentration below which radon exposure presents no health risk. Even low concentrations of radon can result in an increase in the risk of lung cancer.

- The majority of radon-induced lung cancers are caused by low and moderate radon concentrations rather than by high radon concentrations, because in general, less people are exposed to high indoor radon concentrations.

- The risk of lung cancer increases by 16% per 100 Bq/m^3 increase in long time average radon concentration. The dose-response relation is linear – for example, the risk of lung cancer increases proportionally with increasing radon exposure.

Gaskin, J., Coyle, D., Whyte, J. & Krewksi, D. 2018.
BACKGROUND: Radon is the second most important cause of lung cancer, ranked by the World Health Organization as the fifth leading cause of mortality in 2010. An updated database of national radon exposures for 66 countries allows the global burden of lung cancer mortality attributable to radon to be estimated.
OBJECTIVE: Our goal was to estimate the global population attributable burden of lung cancer mortality in 2012 from residential radon.
METHODS: Estimates of the population attributable risk (PAR) of lung cancer mortality from radon were determined using the attributable fraction approach, using three models for excess relative risk of lung cancer from radon.
RESULTS: The estimates of the median PAR of lung cancer mortality from residential radon in 2012 for the 66 countries having representative national radon surveys were consistent, as 16.5%, 14.4%, and 13.6% for the exposure-age-concentration (EAC) model (BEIR VI), the Hunter model, and the Kreuzer model, respectively. The mean PAR using the EAC model ranged from 4.2% (95% CI: 0.9, 11.7) for Japan, to 29.3% (95% CI: 22.9,

35.7) for Armenia, with a median for the 66 countries of 16.5%. Radon-attributable lung cancer deaths for all 66 countries totaled 226,057 in 2012 and represent a median of 3.0% of total cancer deaths.
CONCLUSIONS: Consistent findings between the three models used to estimate excess relative risks of lung cancer from radon, and between the attributable fraction methodology and the life table analysis, confirm that residential radon is responsible for a substantial proportion of lung cancer mortality worldwide. https://doi.org/10.1289/EHP2503.

Radon Measurements

Safe levels of radon have not been established. In homes where there are smokers present and smoking indoors (instead of outside), the risk of developing lung cancer will be much higher.

Radioactivity of a radionuclide, for instance radon, is reported in Becquerels, Bq. 1 Becquerel (1 Bq) = 1 disintegration of atom per second. Radon concentrations in the air are measured as the amount of radioactivity (Bq) in a cubic metre of air (Bq/m^3).

The WHO Handbook on Indoor Radon: A Public Health Perspective indicates that radon exposure is a major and growing public health threat in homes and recommends that countries adopt reference levels of the gas of 100 Bq/m^3.

Outdoor, radon usually quickly dilutes to low concentrations and is generally not a major health problem. The average outdoor radon level usually varies between 5-15 Bq/m^3. However, indoors, radon concentrations are much higher, with the highest levels found in places like mines, water treatment facilities and buildings built on areas where underground radon is found. In buildings such as homes, schools, offices, and other workplaces, radon levels may range from 10Bq/m^3 to more than 10 000 Bq/m^3 depending on the amount of environmental radon.

Key messages from the World Health Organization (2009):

- Radon measurements in homes are easy to perform, but need to be based on standardised, national, protocols to ensure accurate and consistent measurements for each country.
- Long-term integrated radon measurements are preferred for assessing the annual average radon concentration within a dwelling or building.
- The presence of high temporal variation of indoor radon makes short-term measurements unreliable for most applications.
- The type of radon detector should be carefully selected since it influences the cost of measurement per dwelling and, therefore, the cost of a radon programme on a national level.
- Quality assurance and quality control measures are strongly recommended to assure the reliability of radon measurements.

Radon Concentrations in Some Areas of South Africa

According to the Atomic Energy Corporation of South Africa, Ltd., (**Leuschner**, *et al*., 2002), the following figures represent the average Radon levels and maximum indoor Radon Measurements (in Bq/m^3) recorded in various areas in South Africa during 2002:

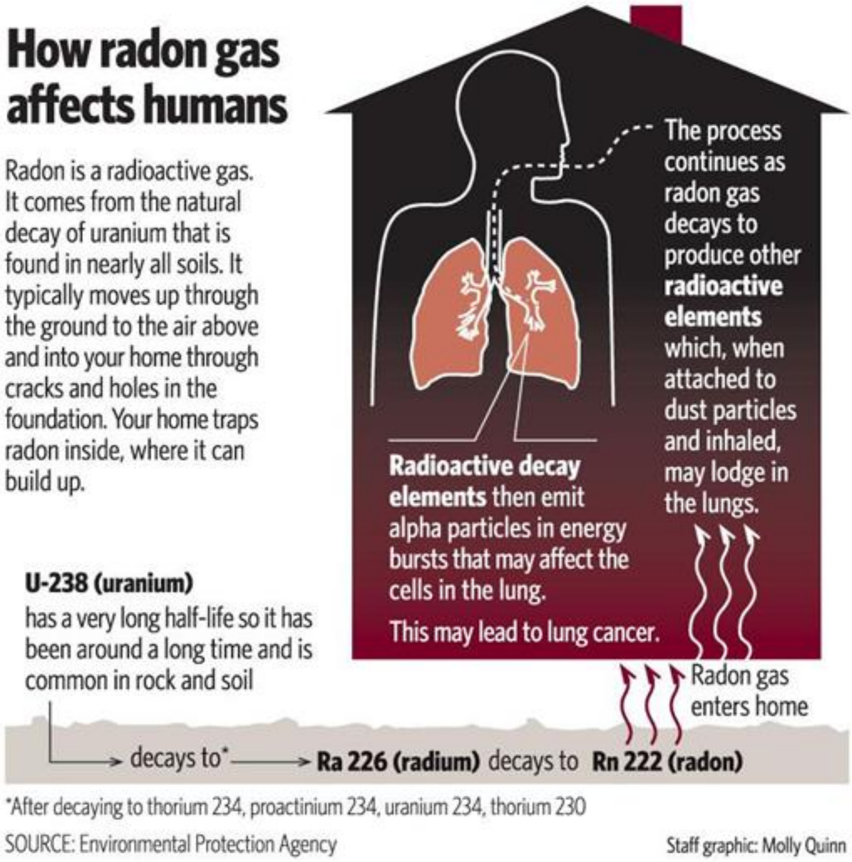
TOWN	**Sample Size Bq/m³**	**Average Radon Level Bq/m³**	**Maximum Radon Level Bq/m³**
Paarl	60	85	842
Parys	44	66	595
Randburg	13	122	440
Nababeep	88	87	393
Springbok	67	78	340
Germiston	143	116	297
Krugersdorp	53	77	273
Boksburg	116	66	212
Pretoria	148	66	197
Johannesburg	284	49	197
Randfontein	45	92	185
Beaufort West	62	79	184
Malmesbury	59	42	150
Hartbeespoort	28	59	145
George	91	64	143
Verwoerdburg (Centurion)	29	61	136
Stilfontein	72	62	131
Soweto	150	56	131
Roodepoort	6	61	130
Richards Bay	76	38	120
Brits	30	42	119
Sandton	16	50	106
Akasia	7	57	97
Phalaborwa	8	61	79
Bedfordview	23	20	72
Cape Town	134	13	52
Rustenburg	10	33	48

N.B. The above data reflects radon readings taken during 1988 and 1989. Changes due to mining and topographical restructuring of the environment since 1989 may result in totally different indoor radon readings.

How Radon Enters the Body

[Picture Credit: How Radon Affects Humans]

Breathing radon in indoor air can cause lung cancer. Radon gas decays into radioactive particles that can get trapped in one's lungs when one breathes it. As they break down further, these particles release small bursts of energy. This can damage lung tissue and increase one's chances of developing lung cancer over the course of a lifetime. People who smoke have an even greater risk. Not everyone exposed to high levels of radon will develop lung cancer, however, radon in indoor air is the second leading cause of lung cancer.



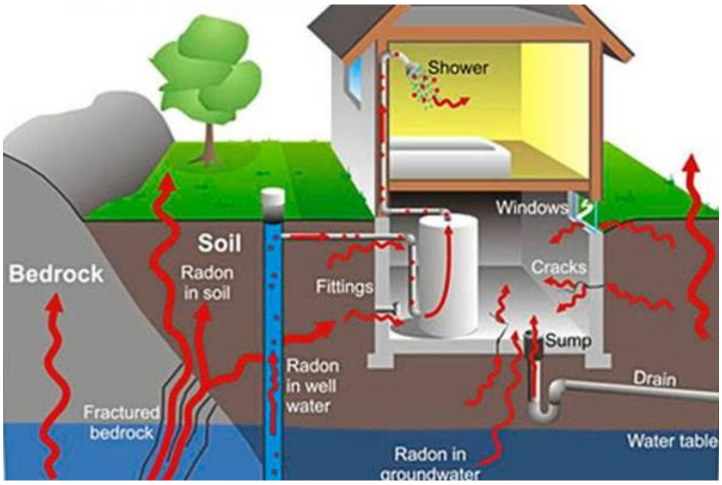
When an individual spends time in an atmosphere that contains radon and its decay products, the part of the body that receives the highest dose of ionizing radiation is the bronchial epithelium, although the extra-thoracic airways and the skin may also receive appreciable doses. In addition, other organs, including the kidney and the bone marrow, may receive low doses (Kendall & Smith, 2002). If an individual drinks water in which radon is dissolved, the stomach will also be exposed.

The evidence for radon-related increase in mortality from cancers other than lung cancer has been examined, and no strong evidence was found that radon was causing cancers other than lung cancer. There are, however, ongoing studies in this regard.

How Radon Enters Homes

The list below indicates the ways in which radon enters the house and will subsequently aid in the explanation of the resistance techniques implemented (Environmental Protection Agency, 2006):

- Cracks in solid floors;
- Construction joints;
- Cracks in walls;
- Gaps in suspended floors;
- Gaps around service pipes;
- Cavities inside walls; and
- The water supply



[Picture Credit: How Radon Enters Homes]

It is important to keep in mind that radon dissipates in the air and if the ground floor is kept ventilated, it will decrease, almost to nothing.

Radon in Drinking Water
Only about 1-2 percent of radon in the air comes from drinking water. However, breathing radon increases the risk of lung cancer over the course of one's lifetime. Some radon stays in the water; drinking water containing radon also presents a risk of developing internal organ cancers, primarily stomach cancer. However, this risk is smaller than the risk of developing lung cancer from radon released to air from tap water.
Based on a National Academy of Science report, the United States Environmental Protection Agency (EPA) estimates that radon in drinking water causes about 168 cancer deaths per year: 89% from lung cancer caused by breathing radon released to the indoor air from water and 11% from stomach cancer caused by consuming water containing radon.

Messier, K.P. & Serre, M.L. 2017.
BACKGROUND: The risk of indoor air radon for lung cancer is well studied, but the risks of groundwater radon for both lung and stomach cancer are much less studied, and with mixed results.
METHODS: Geomasked and geocoded stomach and lung cancer cases in North Carolina from 1999 to 2009 were obtained from the North Carolina Central Cancer Registry. Models for the association with groundwater radon and multiple confounders were implemented at two scales: (i) an ecological model estimating cancer incidence rates at the census tract level; and (ii) a case-only logistic model estimating the odds that individual cancer cases are members of local cancer clusters.
RESULTS: For the lung cancer incidence rate model, groundwater radon is associated with an incidence rate ratio of 1.03 [95% confidence interval (CI) = 1.01, 1.06] for every 100 Bq/l increase in census tract averaged concentration. For the cluster membership models, groundwater radon exposure results in an odds ratio for lung cancer of 1.13 (95% CI = 1.04, 1.23) and for stomach cancer of 1.24 (95% CI = 1.03, 1.49), which means groundwater radon, after controlling for multiple confounders and spatial auto-correlation, increases the odds that lung and stomach cancer cases are members of their respective cancer clusters.
CONCLUSION: Our study provides epidemiological evidence of a positive association between groundwater radon exposure and lung cancer incidence rates. The cluster membership model results find groundwater radon increases the odds that both lung and stomach cancer cases occur within their

respective cancer clusters. The results corroborate previous biokinetic and mortality studies that groundwater radon is associated with increased risk for lung and stomach cancer.

Radon in Primary, Secondary and Tertiary Institutions

Children and others spend several hours in venues and facilities in primary, secondary and tertiary institutions where learning and education takes place. Radon is a leading cause of lung cancer and may pose a significant long-term risk of individuals in such premises.

Gordon, K., Terry, P.D., Liu, X., Harris, T., Vowell, D., Yard, B. & Chen, J. 2018.

"Exposure to Radon, a colorless, naturally occurring radioactive gas, is one of leading causes of lung cancer, and may pose a significant long-term risk for school age children. We examined the regulations and statutes in each US state related to radon in schools to delineate key features of policies and discrepancies among states that may have public health implications. Search terms such as "radon", "school", "mitigation", "certification", "licensing", and "radon resistant new construction" were used to scan current statutes from each state legislature's website and regulations from official state government websites for relevant regulatory and statutory requirements concerning radon in schools. State regulations related to the testing, mitigation, and public dissemination of radon levels in schools are inconsistent and the lack of nationwide indoor radon policy for schools may result in unacceptably high radon exposure levels in some US schools. We highlight the features and discrepancies of state laws and regulations concerning radon in schools, and offer several constructive means to reduce risks associated with radon exposure in school children."

Reducing Radon in Homes and Other Buildings

There are different techniques that may be employed to reduce the risk of radon exposure in homes (Karam & Venter, 2007). These techniques include:

<u>Resistance Techniques to Aid in the Dissipation of the radon gas</u> - In order to stop radon from entering into a dwelling unit, there are resistance techniques that may be utilised. The first is a gas permeable layer which allows the free flow of the gas beneath the home. It comprises of a 10cm layer of clean gravel and is utilised in basement or ground level homes. Plastic sheeting is then placed on top of the gas permeable layer on ground floor units and acts as a blanket preventing the gas in the soil from entering the house.

The second technique is sealing the cracks and other openings in the slab or foundation. Sealing these cracks limits the flow of radon gas into the house thereby lowering the possibility of cancer development. However this technique should not be used in isolation and must incorporate other reduction and resistance techniques such as active or passive sub-slab suction.

Sealing has the advantage of allowing more cost efficiency as well as effective dissipation of radon.

Natural ventilation exists in all homes through windows, doors and vents. This forms the third technique, although not the most effective, of alleviating the build up of radon. This technique should be regarded as a temporary solution because once these openings have been closed the radon levels will return to normal within 12 hours. Accordingly, it is important to monitor the levels of radon in the units to ensure it does not rise to dangerous levels and stays within the required approved limits.

Preventing the build-up of the gas is important in new and existing homes and allows for people to live far healthier lifestyles. However, this only forms a component of the construction of the housing. The designs proposed, with the exception of ground level housing, all have elements that are there to dissipate the gas without the need to solely rely on preventative and reductionist techniques.

The following is a list of the proposed designs:
• Normal single-stand ground floor house;
• Normal single stand house with a crawl space;
• Commercial use on the ground floor with housing above it;
• Cluster developments with parking on the ground floor;
• Town houses with parking on the ground floor; and
• Single stand development with parking on the ground floor.

Commercial or parking use on the ground floor with residential above - Commercial use on contaminated land is not new in Johannesburg. It has been developed successfully on several sites south of the CBD, such as City Deep. It is an economically attractive form of development because the cost of development may be recovered through rent and other commercial activity.

Parking on the ground floor with residential above - The fourth design typology utilises the ground floor as parking and the floors above it as residential. The proposal is that the building go no higher than the third floor or that it be mixed density however these are subject to the requirements of the private developers as well as what the market is able to bare. This design may take various forms as is illustrated in the following figures however it still retains the basic design elements.

Recommendations
From previous research, the following are recommendations for a shared responsibility between government, developers, in some cases banks, and possibly the NNR.

• There is a need to educate the public as well as developers on the risks of developing and living on contaminated land. This education has to be in simple non-technical terms and widely available. The demand for development of the sites is currently, not high but as the city expands it is likely to become increasingly attractive. Therefore, the education process can begin so that a gradual shift of perceptions is achievable.

• The negative perception associated with contamination may prevent any form of development occurring. However, with the improved education, advocated in the above point, as well as the promotion and marketing of the former mine dumps as an investment, this can be overcome.

• It is important that the sites are developed for residential purposes and not solely for commercial or industrial applications. At present any affected city has a tremendous population living on the periphery, which makes it difficult for them to access jobs and basic amenities, such as water and sewerage. By allowing people the opportunity to live and work in the city they have a better quality and standard of life. There is enough commercial space in the inner city to satisfy demand and in order to allow the creation of job opportunities. If the former mine tailings were also developed for these purposes, there would be a tremendous oversupply.

World Health Organization Recommendations

The World Health Organization (WHO) makes the following recommendations regarding reduction of rodon in homes:

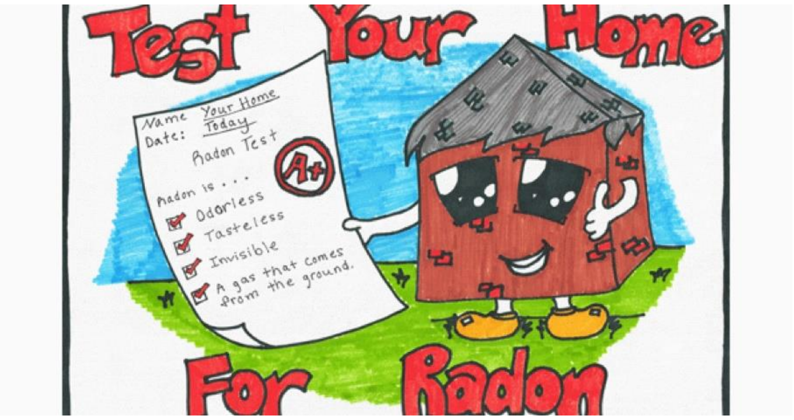
- Increasing under-floor ventilation
- Installing a radon sump system in the basement or under a solid floor
- Avoiding the passage of radon from the basement into living rooms
- Sealing floor and walls
- Improving the ventilation of the house.

The World Health Organization provides options for reducing health risks from residential radon exposure through:

- Providing information to the general public on levels of radon indoors and the associated health risks
- Implementation of a National Radon Programme aimed at reducing both the overall population risk and the individual risk for people living with high radon concentrations
- Establishing a National Annual Average Concentration Reference Level of 100Bq/m^3, but if this level cannot be reached under the prevailing country-specific conditions, the reference level should not exceed 300Bq/m^3
- Implementing radon prevention in building codes to reduce radon levels in homes under construction, and radon programmes to ensure that the levels are below national reference levels
- Developing radon measurement protocols to help ensure quality and consistency in radon testing.

How One can Test for the Presence of Radon in Homes and Other Structures

Testing for radon in South African homes is currently not done. All homes in radon contaminated areas in South Africa should be tested for radon, especially before renting or buying a property situated in a known radon contaminated area.



[Picture Credit: Test for Radon]

In order to do this, reference will be made of current practice in the United States of America where the United States or America Congress, in October 1988, enacted the “Indoor Radon Abatement Act”.

The Act established a long-term goal of indoor air as radon-free as the ambient, outside air. United States legislation makes provision for funding of radon-related activities at the state and federal levels to:

- Establish state programmes and providing technical assistance
- Conduct radon surveys of schools and federal buildings
- Establish training centres and a proficiency programme for forms offering radon services
- Develop a citizen’s guide to radon, and
- Develop model construction standards.

The following schedule of testing and resulting remedial action can go a long way towards creating a safe radon-free living and working environment:

Test the home with a short-term test:

Testing a home for radon is easy and does not cost very much. One can test for radon oneself or hire a professional to do it. If renting a home, ask the landlord to get it tested. There are 2 main types of radon test kits.

- Short-term tests take between 2 and 90 days.
- Long-term tests take more than 90 days.

Start with a short-term test.

Test for radon should commence in the lowest level of the home where people spend time. If the house has a basement which is mainly used for storage, test the first floor. Avoid testing in places that are damp – like the kitchen, bathroom, or laundry room.

If any area of the house has a radon level between 50 and 100Bq/m^3, it is time to take action. There is no safe level of radon.

Test the home again if the radon level is higher that 100Bq/m^3

The radon level in the home can change. A long-term test is the best way to know what the radon level is over time.

- If the radon level was very high, use another short-term test.
- If the level was higher than 100Bq/m^3, use a long-term test.
- It is also a good idea to test your home again after remodelling your home — or if one made changes to heating, ventilation, or air conditioning systems.

If the home has a radon level reading of higher than 300Bq/m^3, have the house fixed by an expert.

If 2 radon test kits show that the radon level in the home is higher than 300Bq/m^3 (the highest recommended reading as per the World Health Organization recommendation), make a plan to have the home fixed by making use of the services of a qualified radon contractor. One may also want to take action even if the radon level is between 200Bq/m^3 and 300Bq/m^3.

One must be sure to use of the services of a contractor who is qualified and experienced in dealing with indoor radon. The contractor should make the necessary alterations to the dwelling or premises that will assist in keeping radon from getting inside the building as well as facilitating the quickest dispersal of radon gas from the building. It is always a good idea to get more than one quotation.

Visit the URL below for additional information on advice provided by the United States Environmental Protection Agency (EPA) regarding how and when radon testing should take place in the event of either buying or selling a property:

https://www.epa.gov/sites/production/files/2015-05/documents/hmbuygud.pdf

According to the United States Environmental Protection Agency (EPA) the most common residential codes and standards that address radon-resistant building techniques are:

- International Code Council Codes & Standards: (Available for purchase from ICC.)
  - International Green Construction Code (IgCC): Chapter 8 – Indoor Environmental Quality and Chapter 10 – Construction and Plans for Operation.
  - International Code Council (ICC-700): National Green Residential Standard • Extensive radon provisions will be included in 2020.
  - International Residential Code (IRC): Appendix F of the 2006 International Residential Code (IRC): Radon Control Methods
- The National Fire Protection Association: Building Construction and Safety CodeSection 49.2.5 of NFPA 5000TM: Radon Control Methods (Available for purchase from NFPA.)
- American National Standards Addressing Radon in New Construction: (Available for purchase from AARST.)
  - CCAH: Reducing Radon in New Construction of 1 & 2 Family Dwellings & Townhouses (Homes).
  - CC-1000: Soil Gas Control Systems in New Construction of Buildings (Schools & Large Buildings).

Position of the Cancer Association of South Africa (CANSA)

The Cancer Association of South Africa (CANSA) recognises and supports the view of the World Health Organization that Radon, a silent killer gas, is a Group 1 carcinogen declared as such by the International Agency for Research on Cancer (IARC) in 1988.

The Cancer Association of South Africa, (CANSA):

Recommends that a definition of $Radon^{222}$, a decay product of Radium (Ra atomic number 8) which is a known Group 1 Cancer Causing Agent according to the International Agency for Research on Cancer (IARC) which is the second leading cause of lung cancer after tobacco use be taken up in the National Nuclear Regulator Act, 1999 (Act No 47 of 1999).

CANSA requests that:

- The National Nuclear Regulator (NNR) publicly recognise $Radon^{222}$, the decay product of Radium as a Group 1 cancer causing agent
- The NNR issue regulations under the National Nuclear Regulator Act, 199 (Act No 47 of 1999) relating to the public management of $Radon^{222}$ within South Africa
- The NNR identify and map $Radon^{222}$ contaminated areas of South Africa
- The NNR undertake a $Radon^{222}$ screening exercise covering the environment, homes, schools and workplaces where $Radon^{222}$ has been found to be a contaminant across South Africa
- The NNR provide and publish guidelines as to the acceptable levels of radon (measured in Bq/m^3) for the environment, mines, homes, workplaces, schools and other places as a matter of urgency
- The Minister of Minerals and Energy, in the NNR's Annual Public Report (in terms of 7(1)(j) of the National Nuclear Regulator Act, 1999 (Act No 47 of 1999) include a section covering management and control of $Radon^{222}$ in all contaminated parts of South Africa by the NNR
- The National Nuclear Regulator (NNR) issue regulations in terms of the National Nuclear Regulator Act, 1999 (Act No 47 of 1999) regarding compulsory building regulations applicable to all areas where $Radon^{222}$ contamination has been identified

- Building regulations should make provision for screening, certification, mitigation and control of Radon^{222} for new buildings as well as whenever a property is newly built, sold or bought
- The NNR issue regulations in terms of the National Nuclear Regulator Act, 1999 (Act No 47 of 1999) regarding compulsory Radon^{222} Clearance Certificate contaminated areas within South Africa:
  - Radon^{222} Clearance Certificate for Schools and Work Places – every 2 years
  - Radon^{222} Clearance Certificates whenever selling/purchasing a home in any urban, suburban, or farm area as well as for any place of employment within identified Radon^{222} contaminated areas

Medical Disclaimer

This Fact Sheet is intended to provide general information only and, as such, should not be considered as a substitute for advice, medically or otherwise, covering any specific situation. Users should seek appropriate advice before taking or refraining from taking any action in reliance on any information contained in this Fact Sheet. So far as permissible by law, the Cancer Association of South Africa (CANSA) does not accept any liability to any person (or his/her dependants/estate/heirs) relating to the use of any information contained in this Fact Sheet.

Whilst the Cancer Association of South Africa (CANSA) has taken every precaution in compiling this Fact Sheet, neither it, nor any contributor(s) to this Fact Sheet can be held responsible for any action (or the lack thereof) taken by any person or organisation wherever they shall be based, as a result, direct or otherwise, of information contained in, or accessed through, this Fact Sheet.

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