Recent Experience with Radon Mitigation

I am sharing this information for those that may be interested in understanding what can be involved in mitigating radon gas in a residential home. It will give you an appreciation in the process for measuring and outlining one way of fixing problem. This is not a how-to guide and I am not a radon expert. There are lots of online resources and professionals that can consulted to help you determine if you have a problem and what could be done in your case to resolve it.

Background:
Recently my neighbour discovered they had a high level of Radon in their basement and decided to have a contractor come and rectify the situation.

This got me wondering what the Radon levels might be in my house, especially since I regularly use several rooms in the basement where levels are typically higher than upstairs.

Before going any further – what is radon? According to the Canada.ca site, radon is defined as:

> *Radon is a radioactive gas that occurs naturally when the uranium in soil and rock breaks down. It is invisible, odourless and tasteless. When radon is released from the ground into the outdoor air, it is diluted and is not a concern. However, in enclosed spaces like homes, it can accumulate to high levels. High radon levels can be a risk to the health of you and your family.*
> Radon gas: it's in your home - Canada.ca

Basically, exposure of high levels over time is cumulative and is the number one cause of lung cancer in non-smokers.

I took the initiative to look into this further and decided to purchase a radon measuring device to measure the levels in my house. There are options where you can buy a kit and gather samples that are sent to a lab for analysis. The drawback is that you cannot perform ongoing measurements on an ongoing basis.

Initially I purchased a device from a manufacture recommended by Health Canada that is about the size of a cell phone. It displays daily/weekly results as well as a cumulative average over a period of up to one year.

After measuring for a few weeks in my workshop where I have an exposed cement floor, I found that the radon levels were over **500 becquerels per cubic metre (Bq/m³)**. In my basement TV room, the levels were around 200-300 Bq/m³. This demonstrates that different areas of the basement or elsewhere in the house can have different levels of radon gas exposure. I also found that upstairs the level was around 100 Bq/m³. This was attributed to the fact that I had a cold air duct in the basement that was circulating the gas through the furnace vents as it was winter. I temporary sealed the vent up to reduce the draw from the basement.

What is a becquerel (Bq) you ask?

> *The International System unit of radioactivity, equal to one nuclear decay or other nuclear transformation per second.*

Health Canada recommends that if radon in indoor air for dwellings is above 200 becquerels (200 Bq/m^3) mitigation action should be taken. It should be noted that internationally the WHO recommends levels should be less than 100 Bq/m³. The frequency and duration of accumulative exposure impacts the potential health risks to an individual.

I purchased a second radon measuring device that records and stores data in the cloud so that you can analyze trends. The device I chose also measures numerous other parameters such as temperature, humidity, pressure etc.

First Level of Mitigation:
By researching the radon issue you will find that the basement in a house is typically the source of radon gas entering the living environment. The basement acts like a path of least resistance of the radon gas present in the ground to be released. Radon gas can come in from cracks in the walls or floor of your basement, around sump pits, pipe entrances etc.

In my case I purchased some concrete patch in a caulking tube and filled some cracks where the concrete floor was exposed. I used "Blue Skin" weather barrier to fill the larger gaps where the pipes for my sump pump protruded through the lid. After that I used removable caulking sealant around the gap in the sump lid and around the edges of where the Blue Skin was applied to fill any gaps. I found out that even sump lids with flexible gromets for the pipes and cords should be caulked with the temporary caulking.

The water pipe from the well is already sealed with closed foam insulation so there were no opportunities for gas ingress around it.

After taking these steps, the radon level in the workshop dropped from over 500 Bq/m³ to around 250-300 Bq/m³. Approximately a 50% drop.

Second level of Mitigation:
At that point I brought in a contractor certified in radon mitigation. I had already decided to go ahead with the mitigation before hiring him. During his first visit he came to assess my home layout and determine the most suitable place to install the suction fan to create sub-soil depressurization. Which simply means that a fan draws the radon gas out from under the basement floor and exhausts it outdoors where it safely dissipates rapidly in to the atmosphere. Note that the gas would have eventually and naturally seeped out of the ground if there wasn't a basement there in the first place. Another thing I learned is that even if you have an on-ground slab instead of a basement you may still be at risk of radon gas seeping into the building. Raised buildings such as cottages do not have a radon influx problem as the gas dissipates in the air under the floor of the building.

Mitigation process:
The following steps provide an overview of the assessment and installation process of the fan and vent installed by my contractor. Note this is not a DIY project and someone certified to do the work should be hired. The overview of the steps will give you an appreciation of the scope of the work to be done. This is by no means a how-to guide.

After successful completion of the installation, my contractor registered the installation with Health Canada who tracks this information. Having a Radon Mitigation system installed in a home may be a selling factor to a potential buyer of your home in the future.

Step 1:

- A suitable location to install the vent fan is determined
- The fan is typically installed in the furnace/utility room where the 4" pipe can be vented outside

- External venting has to be located specified minimum distances from natural gas meters, air circulation intakes etc. to meet building code requirements
- The fan plugs into a standard outlet

Step 2:

- Approx. 1" diameter hole is drilled in the concrete floor where the vent pipe will eventually be installed
- A hose from a shop vac with a known draw in CFM is inserted into the hole
- At the "opposite end" of the basement, a small (~1/4") hole is drilled down through the concrete floor
- A hose connected to a vacuum gauge is inserted in the hole
- With the shop vac running a reading is taken
- The value measured (typically in pascals) is used by the contractor to determine what size (draw power) vent fan will be required to ensure adequate sub-concrete subfloor venting.

Step 3:

- In my case the draw was excellent so the smallest fan size was chosen
- A 5-inch hole was drilled through the concrete floor where the original 1-inch hole had been made
- A similar 5-inch hole is drilled to the outside, often through the joist header

Step 4:

- A 4-inch (inside diameter) pipe is inserted in the hole and the fan is mounted using flexible couplings to reduce vibration noise and simplify removal of the fan should there be need for replacement or repair
- The pipe plumbing and length will vary depending the location of the outside vent hole relative to fan location
- The pipes and couplings are glued
- The external vent pipe has a screen to prevent small animals from getting in.

Step 5:

- Once the fan is plugged in a measurement is taken at the far test hole to ensure there is adequate draw
- The test hole is filled with caulking and the gap around the pipe is packed and sealed with caulking to ensure no leaks
- Any insulation etc. is replaced around the vent pipe egress point
- A U-tube Manometer is installed on the intake side of the fan to provide a quick at-a-glance indication that the fan is drawing properly

The fan runs continuously at a relatively quiet noise level.

Results:

The results in my case are significant. In just over 24 hours the levels had dropped to less than 10 Bq/m^3.

	Day of Installation	2 days After Installation
Workshop	220 Bq/m^3	5 Bq/m^3
TV Room	132 Bq/m^3	3 Bq/m^3

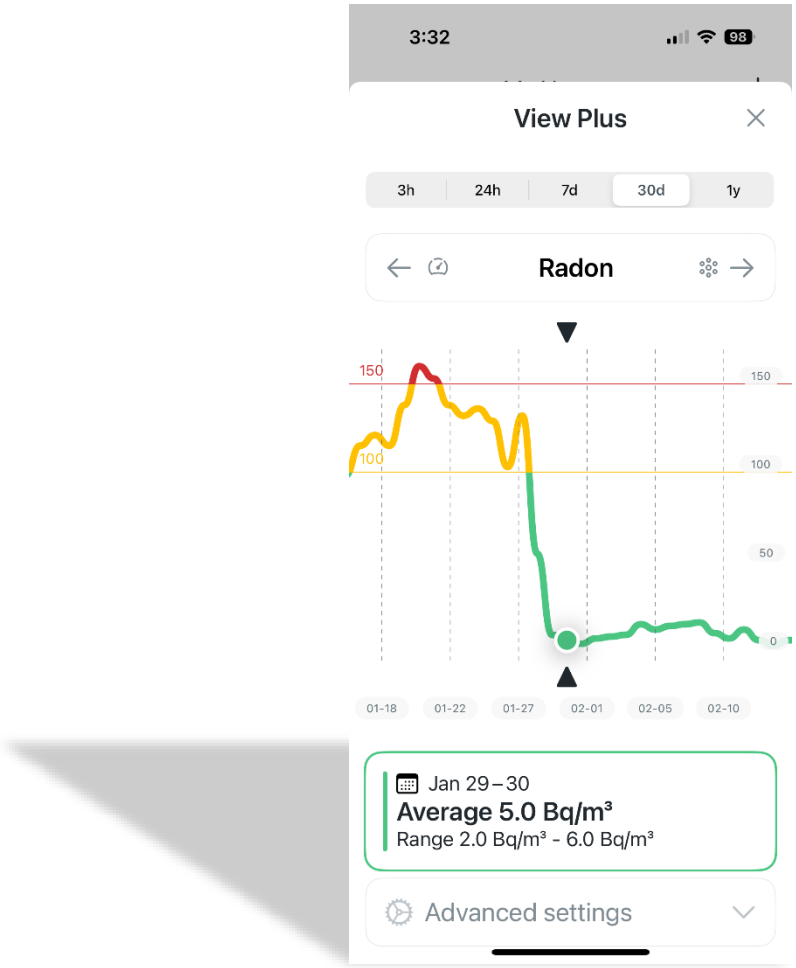
The values fluctuate on a daily basis. This can be attributed to the atmospheric pressure changes, number of times doors and windows are left open, frequency of furnace cycles and so on.

Over the course of January to March the levels varied between near zero to just under 20 Bq/m³ in the workshop which originally had the highest levels of over 500 Bq/m³ before any steps were taken to reduce the levels.

In discussions with the contractor, I learned a few interesting facts.

1. Radon can still be a problem when the house is built on a concrete slab (no basement).
2. House foundations built on bedrock may have higher concentrations of radon gas that is forced up though cracks in the rock..

Now the radon levels in my house are well below the recommended level. The graph shows the results in the TV room. Note the dramatic drop in radon levels within 48 hours of installing the mitigation on Jan 28th.



Radon Measurement Devices: (That I use)
Over a period of two months, I bought two devices accepted by Health Canada for consumer measurements of radon. There are other brands and models available.

AIRTHINGS Corentium Home, Radon Gas Detector

- First device I purchased
- Provides radon level measurements, accumulative average over up to 1-year, weekly/daily average
- There is NO external storage of data or transmission to a phone

https://www.canadiantire.ca/en/pdp/airthings-corentium-battery-operated-home-radon-detector-with-lcd-display-black-0460389p.html?rq=radon+detector

Airthings Corentium Battery Powered Digital Home Radon Detector | The Home Depot Canada

Sometimes on sale at Amazon.
AIRTHINGS Corentium Home , Radon Gas Detector, Canadian Version in Bq/m, grey : Amazon.ca: Home

AIRTHINGS 2960 View Plus

- Measures Radon as well as other parameters such as air quality, pressure, humidity, etc.
- Good device to measure ongoing home air quality
- Uses wi-fi and stores data in the cloud and graphically slows longer term trends
- Considerably more expensive than the other model

Airthings View Plus Air Quality Monitor | The Home Depot Canada

Airthings 2960 View Plus - Radon & Air Quality Monitor (PM, CO2, VOC, Humidity, Temp, Pressure) : Amazon.ca: Tools & Home Improvement

Online searches may show other devices that may be of interest.
Some Online Radon Resources:
This is a sampling of some of the online resources I found while researching this topic.

Mike Holmes on Radon - This video addresses the health issues and outlines the whole installation process similar to what I experienced.
Mike Holmes on Radon - YouTube

Canada.ca Health Site
This site provides a good introductory overview of radon gas, its effects, home testing etc
Radon gas: it's in your home - Canada.ca

Radon: Resources
Radon: Resources - Canada.ca

Radon - Reduction Guide for Canadians
https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/radiation/radon-reduction-guide-canadians-health-canada.html