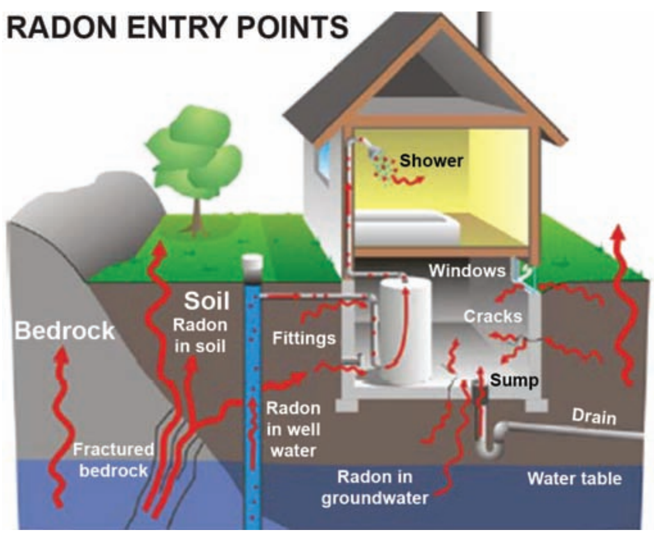
TECHNICAL BULLETIN
RADON

WHAT IS RADON?

Radon is a naturally occurring radioactive gas that is formed by the breakdown of uranium in soil, rock, and groundwater. It is a colorless and odorless gas and moves freely through the soil. In outdoor air, radon is typically not a health concern as it mixes with this outdoor air resulting in very low concentrations. However, in enclosed spaces, such as buildings, it can accumulate resulting in high concentrations. The source of radon is the soil on which the building is constructed and has the ability to enter the building through cracks in foundation walls and floors, and any gaps around pipes and cables. Just because a building doesn't have a basement doesn't mean radon cannot enter. Slab on grade buildings and buildings over crawl spaces are also susceptible. In addition, buildings can create vacuums that can draw radon in through natural causes, such as the stack effect, and also from mechanical causes that can include exhaust fans. Radon is heavier than air, resulting in higher



radon concentrations being detected at lower levels, however, as a result of these vacuums, it is possible that higher concentrations of radon can be detected at higher levels within a building.

HEALTH RISKS

The known health risk associated with radon exposure is an increased risk of developing lung cancer. Radon is the second leading cause of lung cancer behind smoking. It is a Group A carcinogen and 16% of all lung cancer deaths are attributed to radon exposure. As radon gas breaks down, it releases radon decay products (RDPs) which attach to lung tissue where they breakdown further, releasing alpha particles. These alpha particles are absorbed by this lung tissue resulting in lung cell death, or damage/ mutations leading to lung cancer.

In 2003, the EPA had updated estimations of lung cancer risks as a result of indoor exposure based on the Biological Effects of Ionizing Radiation (BEIR) VI Report (1999) report. The EPA worked with the Science Advisory Board (SAB) to review and incorporate the risk models in this report and the updated estimations of lung cancer deaths as a result of radon exposure is about 21,000 annually, which was consistent with this BEIR VI report. According to these estimates, about 2,900 of these deaths occur among people who have never smoked.

In 2005, the U.S. Surgeon General published a Health Advisory stating "Indoor radon gas is the second-leading cause of lung cancer in the United States and breathing it over prolonged periods can present a significant health risk to families all over the country. It's important to know that this

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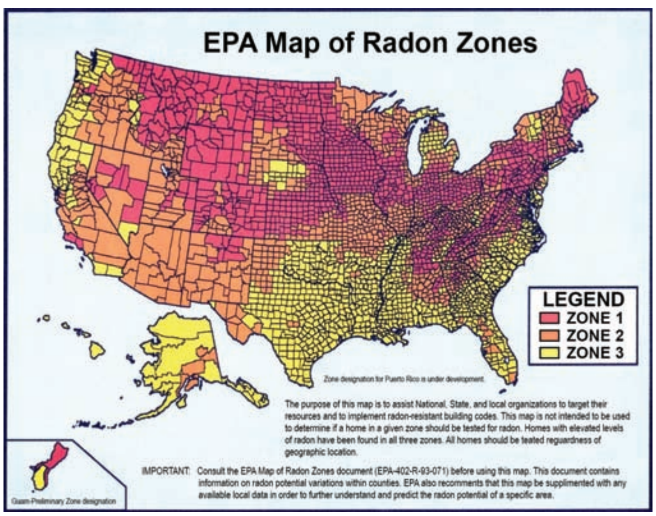
threat is completely preventable. Radon can be detected with a simple test and fixed through well-established venting techniques."

RADON GUIDELINES

The U.S. Environmental Protection Agency has maintained a radon action level of 4 picocuries/litre (pCi/L) since the 1980s. This is equivalent to approximately 148 Bq/m3. The EPA notes that concentrations of radon below this level still pose a risk and recommends Americans consider mitigation if radon levels are above 2 pCi/L. In comparison to other guidelines around the world, Canada has a higher allowed exposure guideline of 200 Bq/m3 which is equal to 5.4 pCi/L, and globally, the World Health Organization recommends 100 Bq/m3 (2.7 pCi/L).



Zone 1:	Counties with predicted average indoor radon screening levels greater than 4 pCi/L
Zone 2:	Counties with predicted average indoor radon screening levels from 2 to 4 pCi/L
Zone 3:	Counties with predicted average indoor radon screening levels less than 2

TESTING

This can be done by purchasing a do-it-yourself radon test kit, or it can be performed by a radon measurement professional, certified under the National Radon Proficiency Program (NRPP).

To provide a realistic estimate of the radon concentrations, the measurements should be made in the normal occupancy area of the lowest lived-in level of the house. This is defined as an area occupied by an individual for more than 4 hours a day and can include spaces such as living rooms or bedrooms.

The two most common types of radon detectors used for testing buildings are short term and long term detectors. The short term detectors are used for a period of 2-7 days, the long term detectors can be used for a period of 1 to 12 months. Since the radon concentration inside a building can vary over time, a longer period of testing will give a more accurate level of radon concentration. Health Canada recommends a test period of 3 months minimum. It also recommends that the ideal time of the year is between September and April when windows and doors are typically kept closed.

MIGRATION TECHNIQUES

Radon Resistant Construction Techniques

As building codes and standards continue to develop to establish minimum construction standards for radon resistant construction, techniques have currently been established for existing and new construction to provide protection against radon gas infiltration.

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There are two types of depressurization systems that have been deemed effective, passive and active. A passive system is one where the installed pipe is used along with the natural ventilation to allow movement of the radon to the outside of the building. If this is not effective in reduction below the guideline, then an active system is required to be installed.

EXISITING CONSTRUCTION

In an exisiting structure, if the radon levels are found to be in excess of the guideline, the most common method for radon reduction is active soil depressurisation (ASD). This involves the drilling of a hole in the concrete floor slab, installation of a pipe with a fan that will draw the radon gas from under the building and force it outside. The installation of this system is typically performed by a contractor certifed by NRPP.

NEW CONSTRUCTION

Use a clean coarse granular material below the floor slab to allow the gases to move freely underneath the building. Granular material shall be a minimum of 4 inches thick and shall consist of material that will pass through a 2-inch sieve and be retained by a 1/4-inch sieve. Alternatively, a uniform layer of sand can be used, a minimum of 4 inches thick, overlain by a layer or strips of geotextile drainage matting designed to allow the lateral flow of soil gases.

Seal all openings, penetrations, and cracks in the concrete foundation floor (including the perimeter), and walls with sealant to prevent radon from entering the building.

Install a soil gas/vapor retarder membrane on top of the gravel to prevent soil gases from entering the building. It is imperative that this material be of sufficient strength to resist puncture and maintain the integrity of the soil gas barrier. Seal all overlap, joints, and terminations of this membrane to provide a continuous barrier.

Run a 3” minimum PVC pipe vertically from the gravel layer under the floor slab, vertically through the concrete floor slab, and terminate at least 12 inches above the surface of the roof, in a location at least 10 feet away from any window or other opening into the conditioned spaces of the building that is less than 2 feet below the exhaust point, and 10 feet from any adjoining or adjacent buildings.

To facilitate installation of an active sub-slab depressurization system, electrical junction boxes shall be installed during construction in proximity to the anticipated locations of vent pipe fans and system failure alarms.

Building is to be positively pressurized (especially areas adjacent to walls, floors and roofs in contact with the soil) when all ventilation and exhaust systems are operational.

Long term testing of building is needed, and if the radon concentration levels exceed the guideline, installation of a full active soil depressurization system would be required.

The above information has been developed to provide an overview of radon, the effects that it has on our population, as well as the current techniques being used to measure the radon concentration and construction methods to be able to control the exposure to radon within in a building. Radon mitigation systems require a soil gas barrier and current new construction requirements do allow a polyethylene sheet to be used. It has been shown that standard polyethylene can have a relatively low puncture resistance, as well as having the potential to degrade when in contact with the soil, both characteristics causing the gas barrier to be discontinuous. W. R. MEADOWS manufactures PERMINATOR® and PRECON underslab barriers that have superior puncture resistance and have been designed and tested to meet the industry standards for underslab construction. In addition, these products have been tested for radon resistance and can be part of an effective radon mitigation system. For information on how W. R. MEADOWS can contribute to a radon mitigation system, please visit our website at www.wrmeadows.com, or contact your local technical representative.