# Evaluation of Effectiveness of Breathe EZ Air Cleaner in Reducing Risks Associated with Indoor Radon Gas

November 20, 2012

This report provides pertinent data gathered to date regarding our evaluation of the Breathe EZ Air Cleaner as a means of reducing radon decay products when added to a forced air furnace/air conditioning system operating in a continuous circulation mode.

## 1. Background and Purpose

It is well known that the primary health risk from the presence of indoor radon gas is due to inhalation of its short-lived decay products. Radon decay products, also known as radon progeny, are radioactive particles that release high energy alpha particles that can damage lung tissue if they radioactively decay between the times they are inhaled and when they are expelled from the lungs during normal clearing process.[1]

Typical methods for reducing indoor exposure to the radon decay products of radon is most commonly accomplished by reducing the entry of the parent radon gas through a homeôs foundation. This technique, referred to as Active Soil Depressurization (ASD) relies upon the ability to draw radon laden soil gas from beneath a lower level slab by connecting a pipe and fan to one or more holes cut through the slab or from beneath plastic sheeting installed upon earthen crawlspace areas with the sheeting sealed to foundation walls.

Although ASD techniques can be easy to install and economical to operate, their success is a function of the simplicity of the foundation. In cases of complex foundations, such as where additions have been made to a building, where multiple foundations are present, or in older homes where crawlspaces are inaccessible for the installation of the requisite membrane or are filled with heating and cooling ducts, ASD can be challenged or require expensive remodeling prior to its installation.

It has been these challenging situations as well as challenges offered in large buildings such as schools and office buildings for which researchers at the Progeny Group have looked at the application of air filters for the reduction of the risk-causing radon decay products as an alternative approach. This work over the last 10 years initially began with evaluating High Efficiency Particulate Air (HEPA) filters with excellent overall reduction of radon decay products when

1.) [1] National Research Council, Health Effects of Exposure to Radon, BEIR VI, 1999, Chapter 1, page 20

operated continuously. Subsequent investigation showed similar results with the use of less stringent filters including MERV 7 and 8 filters.

One of the challenges of installing a higher efficiency particulate air filter for radon decay product reduction has been the need to reconfigure the return air plenums of the buildingôs air handling system to contain the typically thicker filter media for this class of filters. However, the small configuration of the Breathe EZ device, with enhanced particulate reduction by the application of a maintained electrical charge interested us as a possible radon decay product reduction solution due to the simple insertion of the Breathe EZ filter into an existing furnace filter rack and provision of low voltage power from the existing thermostat power supply.

**2. Procedure**

To assess the ability of the Breathe EZ filters, they were installed on four houses located on the Front Range of Colorado where radon mitigation contractors had concluded that active soil depressurization was not economically feasible and referred the homeowners to us to assist in identifying alternative approaches. In each case the following procedures were employed:

- A licensed mechanical contractor replaced the standard furnace filter with the Breathe EZ filter and connected its 24 volt power supply to the low voltage circuit within the Forced Air Units (FAU) cabinet.
- The mechanical contractor also revised the FAU controls such that the blower operated at its lowest speed during periods when heating or cooling was not called for, but resumed to its higher, design speed when the thermostat called for heating or cooling. By doing so, interior air was constantly recirculated through the filter allowing for particulate reduction at all times.
- Radon and radon decay products were measured utilizing an Electret Radon Progeny Integrating Sampling Unit (RPISU)[2] over a minimum two day period as follows:

| Condition | Filter | FAU Blower Operation |
|---|---|---|
| Pre-Installation | Existing 1 inch pleated filter | **Auto**<br>Blower turned on only when heating or cooling called for |
| Post-Installation | Breathe EZ Filter | **Constant**<br>Heating Cooling not called for: Lowest air circulation rate<br>Heating Cooling called for: Normal design air flow rate |

- Radon progeny sampling devices were deployed and retrieved by an individual certified for its use under the National Environmental Health Associationôs National Radon Proficiency Program[3]

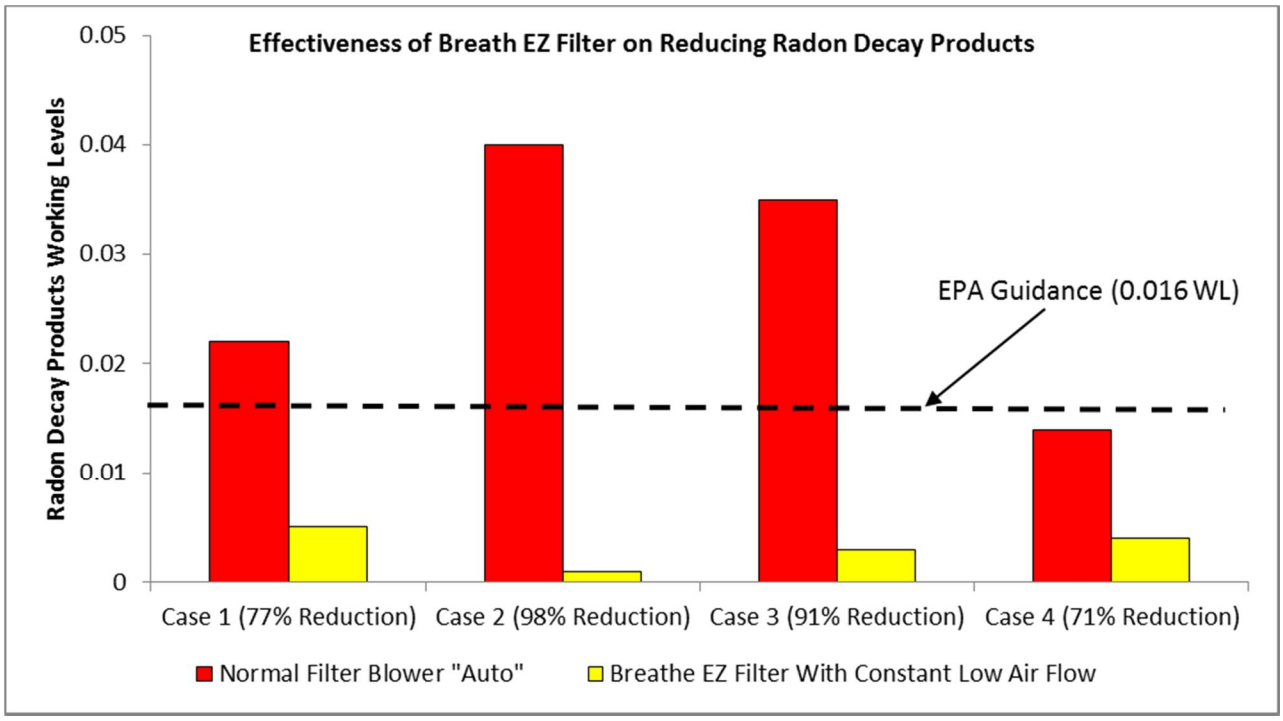
[2] US EPA / NEHA-NRPP Device Code 8228, Group 25
[3] Colorado Vintage Companies, Inc./Progeny Group LLC NEHA-NRPP Analytical Lab: #102911AL,

- Tests were conducted immediately before and after the Breathe EZ filters were activated to reduce weather variables that could affect the activity levels of the parent radon.
- Measurements were conducted on the lowest occupiable portion of the home in accordance with US EPA protocols[4].

## 3. Summary of Results

Before and After, integrated radon decay product measurements for each case are presented in the graph below with a comparison to the US EPA Guidance of 0.020 Working Levels (WL) for radon decay products[5]. Note that recently US EPA unofficially lowered its guidance to a more conservative 0.160 WL[6] which is shown on the graph as a comparative guidance.

**Figure 1: Two-Day RDP Measurements Before and After Installation of Breathe EZ Filters**




[4] US EPA, Protocols for Measuring Radon and Radon Decay Products in Homes, EPA 402-R-92-003, July 1993
[5] US EPA, Protocols for Measuring Radon and Radon Decay Products in Homes, EPA 402-R-92-003, July 1993
[6] 2003

**Description of Cases**

**Case 1**

This house was originally constructed in the early 1900s with several additions since then. The complicating factors that made active soil depressurization difficult was the presence of three separate crawlspaces, two of which could not be accessed without removal of forced air ductwork as well as two distinct and separated basements. Estimates to rework ductwork to allow access to install a typical ASD approach and install ASD multiple systems to treat separate foundation areas was in excess of $20,000.

The installation of the Breathe EZ filter was accomplished in approximately 1 hour by a qualified mechanical contractor.

**Case 2**

This was a loft residence constructed over retail space. The normal application of active soil depressurization approaches would have required the installation of the system in the lower level retail space owned by a separate entity than the subject loft unit. Due to complications of access to another ownerôs property for installation and future maintenance of the system, an approach for addressing the indoor radon decay products was opted for.

**Case 3:**

This house is an older home constructed in the foothills of the Rocky Mountains where granite boulders were incorporated into the interior design of the structure (See photo). Due to concern of radon emanation from interior granitic boulders and poor communication beneath the slab due to slab poured directly on rock, local mitigation contractors were unable to make normal ASD approaches work.

**Case 4:**

This was an older home located near the foothills in southern Colorado and constructed over multiple crawlspaces, areas of which had head room of less than 12 inches. Subsequently, the degree of difficulty of installing a polyethylene membrane in these tight spaces led to estimates by local mitigators in excess of $3,500.00 which was a cost that was beyond reach by owners who lived on a fixed, retirement income.

**Summary**

From the trials conducted, it appears the Breathe EZ Air Cleaner filter, when utilized in conjunction with modifications to a forced air heating/cooling system where the forced air blower runs continuously at a minimum speed, can significantly reduce airborne radon decay products that represent the primary risk from elevated indoor radon.

The ease of installation also makes it a viable approach when traditional active soil depressurization systems are not feasible, especially for low income or fixed income families living in older, difficult to mitigate homes.

We are very interested in continuing research on the applicability of the approach provided by the Breathe EZ Air Cleaner filter as it can fill the much needed niche of mitigation of difficult houses, provided they have existing, ducted forced air heating/cooling systems that can accommodate the easily installed filter.

Please note when pursuing this application further it is imperative that verification of reductions be performed utilizing measurement devices that are specifically sampling radon decay products, such as the Radelec Electret Radon Progeny Sampling Unit or Continuous Working Level monitors.

We appreciate you providing the filters utilized in this study as do the homeowners who felt as though they would not be able to benefit form a healthier environment due to the complexity of their homes and limited financial resources. Further confirmation and applicability will provide a much needed alternative for consumers and tool for the professional radon mitigation contractor.

Sincerely,
Douglas L. Kladder
President