TerranearPMC Safety Share

Week of January 30, 2017 – Radon

January is Radon Awareness Month.

It was back in December 14, 1984, at the then new Limerick nuclear power plant in Montgomery County, Pennsylvania, where, as the story goes, a construction engineer was on his way to work and set off the facility's radiation monitoring alarms. Because the plant was still under construction (the plant went "critical" a few days later) there was no nuclear fuel at the plant. This information coupled with the fact that he was entering the facility, confused plant personnel as to why the alarms had been triggered. The monitoring equipment was checked and found to be operating within specifications. This resulted in an investigation of the engineer's home where his house was found to have massive amounts of radon in it. Obviously, the engineer left his house and went to work, completely unaware that he was contaminated. This single event opened the eyes of health organizations across the country to examine the extent of radon-related health problems.

The U.S. Environmental Protection Agency (US EPA) and the Surgeon General's Office have estimated that as many as 20,000 lung cancer deaths are caused each year by radon. Radon is the second leading cause of lung cancer (behind tobacco smoke). Radon-induced lung cancer costs the United States over $2 billion dollars per year in both direct and indirect health care costs.

According to the US EPA, nearly 1 in 3 homes checked in seven states and on three Indian lands had screening levels over 4 picoCuries per Liter (pCi/L) which is the EPA's recommended action level for radon exposure (Note: after the incident at the Limerick Power Plant, the engineer's home was measured to have over 2700 pCi/L).

Radon is a gas that is created through the radioactive decay of radium (ra-226), which, in turn, is formed from a complex series of decay processes that initiate from the elements of uranium and thorium, found in rock formations and soils throughout the world. Because radon is a gas, it has the ability to travel through soil void spaces and cracks in rock formations; thereby entering into the atmosphere or underground mines and basements. Because radon is a gas, it can become easily airborne, causing people to inhale this material. Therefore, without adequate ventilation, radon can accumulate, causing elevated airborne concentrations and increasing the risk of lung cancer.

Radon's chemical symbol is Rn and has an atomic number 86. It is also a noble gas, meaning it is extremely stable, thus not prone to react with other materials. It has a half-life of 3.8 days and since its materials-of-origination, thorium and uranium, are two of the most common radioactive elements on Earth, while having very long half-lives (on the order of billions of years), radon will be present long into the future.

Radon is an alpha emitter and while alpha particles can be stopped by human tissue, because it is a gas, it can be inhaled and thus, enter into our respiratory system where damage can occur. Radon has numerous progeny, such as polonium-218, lead-214, bismuth-214 and polonium-214. All are radioactive isotopes and have half-lives that are much less than that of radon. This means that these

materials, once in the lungs (due to radon's airborne ability), will decay releasing energy that is known to damage cell tissue and internal cell functions.

Radon was discovered, in 1899 by Ernest Rutherford and Robert B. Owens. In 1900 Friedrich Ernst Dorn reported some experiments in which he noticed that radium compounds emanate a radioactive gas which he named *Radium Emanation* (*Ra Em*).

In 1923, the International Committee for Chemical Elements and International Union of Pure and Applied Chemistry (IUPAC) chose the name radon (Rn) for this airborne radium progeny. Yet even as late as the 1960s, the element was referred to simply as *emanation*.

Although, radon was not known in the 1500s, severe respiratory health effects were observed in the metal mines of Europe. Through modern monitoring technology, it has been determined that radon was the cause for these illnesses where airborne radon exposure concentrations reached 1,000,000 Bq/m^3. In 1530, the noted physician, Paracelsus described a wasting disease of miners, the *mala metallorum*, and Georg Agricola (another 16^{th} century physician who was dedicated to diseases in the mining industry) recommended ventilation in mines to avoid this mountain sickness (*Bergsucht*). In 1879, these respiratory ailments were identified as lung cancer (by Herting and Hesse in their investigation of miners from Schneeberg, Germany). In the US, serious health effects of uranium miners in the Southwest United States employed during the early years of the Cold War were identified; and only after decades of compiled evidence, were health standards implemented (1971).

The US EPA has detailed locations throughout the country where radon represents a considerable concern. Counties that have been identified with elevated radon levels generally exist in the Mid-west and Northeast; however other locations may be prone.

To protect your family from potential radon exposure, the EPA recommends testing your home. Testing is easy and inexpensive. There are many test kits available, such as charcoal canisters which can be purchased online. Most short term tests take 2-7 days. They need to be placed in the lowest structural area of the home, such as a basement and should be allowed to sample the area for a minimum of 48 hours. Each canister comes with instructions for sending to a laboratory for analysis. If results indicate radon concentrations greater than 4 pCi/L, you may need to consider consulting with an organization that specializes in radon problems.

If a radon problem has been identified in a home or building, there are certain methods that can be employed which have been quite successful to mitigate the problem. They include placement of a gas permeable layer and/or plastic sheeting beneath a slab (this can only be performed during construction as a preventative measure), or sealing and caulking below-grade openings in the concrete foundation floor so as to reduce soil gas entry into the home. Another method to control radon gas is placement of a 3- or 4-inch gas-tight PVC pipe (or other gas-tight pipe) that runs from the gas permeable layer through the house to the roof to safely vent radon and other soil gases above the house. Lots of information is available on the EPA website at https://www.epa.gov/radon.

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You can't be brave if you've only had wonderful things happen to you

Mary Tyler Moore (1936 – 2017)