Operation Maintenance and Monitoring Plans for Radon Control Systems in Multi-Family Structures

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Public Health Radon Reduction Roadmap (PHR3)

Introduction

Many multi-family buildings have either had radon reduction systems installed during their construction or retrofitted into them after a radon survey indicated concerns. Regardless of when the systems were installed, they need to continue to function properly to control radon. That is where a proper operation and maintenance plan combined with periodic retesting comes into play.

In other words, radon reduction systems are not a one-and-done-affair like asbestos abatement or any type of source removal remediation project. Rather, these radon entry control systems need to operate for the life of the building.

Radon comes from the underlying geology and is constantly being generated and presented to structures above that geology. It is derived from natural deposits of Uranium with a half-life of 4 billion years. So, the potential for elevated indoor radon will continue to exist.

Regardless of what methods were utilized to reduce radon, either ventilation repairs, active soil depressurization systems or passive depressurization systems; they are mechanical systems that can deteriorate and eventually will fail. There can also be changes to building systems or foundations that can cause units previously determined to not be elevated in radon to become elevated.

Think of radon as a bubbling cauldron of noxious, but undetectable vapors, from the bowels of the earth that rise up, and the systems installed on a building intercept these vapors and divert them to the outside. That is good, but at some point, the systems will fail, or other pathways can open.

There are two components of a control plan to assure continued control of these vapors.

- Routine inspections of radon reduction systems and equipment and its mechanical performance.
- Periodic retesting of indoor radon levels of occupied units within the multi-family complex.

This bulletin supplements other bulletins and the primary technical guidance document that can be found listed in the Resource section of this bulletin.

Concept of Radon Reduction Systems

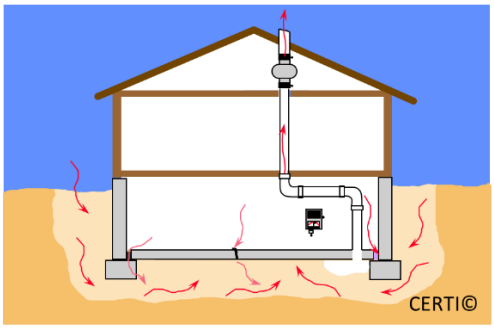
To understand a maintenance program, one needs to understand how the system operates.

Radon is a soil gas created under a building's foundation in geology beneath it. It is constantly being generated and there is nothing that can be done to stop it. It is a natural phenomenon.

Fortunately, much of the radon that is created enters the outside air where it is diluted and naturally decays away. However, buildings constructed over this geology can have very slight, imperceptible vacuums within them that draw radon containing soil gasses in through minute (or large) openings in the foundation.

Radon control systems are designed to create a vacuum under the foundation to preferentially collect soil gases and vent them to the atmosphere where they can be diluted and decay as if they had reached the atmosphere naturally. In essence, a radon control system diverts the radon around the house on its journey to the air.

To accomplish this, a system would have been installed that creates a vacuum under the foundation that is slightly greater in strength than the vacuum applied on the soil by the building. This under-foundation vacuum would have been accomplished with a fan system that needs to operate continuously to intercept or "control" the continuously generated radon laden soil gas beneath the building. So, maintaining the under-foundation vacuum is key.



An Active Soil Depressurization System Draws Radon Laden Soil Gases from Beneath the Foundation and Exhausts them to Safe Location Outside

System Performance Checks

Since maintaining the vacuum under the foundation is critical, mechanical performance indicators are installed as part of the system.

These are typically not radon measurement devices, although there are some radon monitoring devices emerging, the most common devices are those that indicate continued vacuum or air flow that existed at the time the systems were installed that successfully reduced radon, as demonstrated by post-mitigation radon testing.

There are two basic approaches being taken:

System Pressure Measurement Performance Indicators

The first is a pressure/vacuum device that measures the vacuum in the soil gas extraction pipe at a location below the radon fan. A light showing power to the fan is not sufficient as other things can impede the vacuum such as blockages in the system from ice or varmints.

These are often simple U-Tube monitors mounted on the side of the vent pipe. They can also be remote mounted for easier viewing by maintenance personnel without having to enter occupied spaces or climbing through attic spaces.

U-tube Mounted on Radon Vent Pipe

Remote Monitor Mounted Outside of in Hallway for Easy Viewing

Pressure style indicators can also be electronic devices that send a remote measurement of pressure or deviation from design pressure. These can be located where they can easily be checked by maintenance personnel such as outside or in a hallway or even in the maintenance office. Systems are also becoming available where they can send data to a cloud based monitoring program.

In interpreting the performance indicator, the key is not what the pressure is, but rather if it has changed from the original pressure observed when the system was installed and achieved sufficient reductions in indoor radon levels. Deviations or no pressure at all indicate a problem. Here are a few conditions that may occur:

Increase in Vacuum:

- Something is blocking air flow in the portion of the vent system below the radon fan.
    - Rising water table -- check building drainage system

Drop in Vacuum:

- Something is restricting air flow on discharge of radon fan:
    - Ice in discharge
        - Temporary condition
    - Bird nest or critter in fan (an open mesh screen should have been installed over the discharge pipe to prevent this)
    - Fan has deteriorated but not failed completely
    - Fan discharge piping has broken
- **No Vacuum**
    - Fan is not operating, or power is OFF

Air Flow Style Performance Indicators

Since the system extracts air from the soil, another method is to ensure the soil gas extraction rate remains the same as it was when the system was originally installed.

Although air flow transmitters could have been installed, a simple method employs an ammeter that measures the current the radon fan is drawing. Since the current is proportional to the air flow extracted by the fan, a change in current flow will indicate a change in air flow. These are convenient as it allows for the ammeter indicator to be located away from the fan as long as the power to the fan is routed through the ammeter.

Ammeter Style Performance Indicator that indirectly measures air flow by showing change in current draw for radon fan.

To interpret the ammeter style meters, they typically have easy to read meter faces with “GOOD” zones and “BAD” zones. Here are some conditions that may occur:

- **Needle Movement to the Right (higher air flow)**
    - A portion of the vent pipe has been broken allowing interior air to be extracted rather than soil air
- **Needle Movement to the Left (lower air flow)**
    - Suction piping has a restriction such as rising water table -- check building drainage system.
    - Blockage in discharge such as ice or a critter.

Frequency of Checking Performance Indicators

Radon systems have proven to be very durable, but they will eventually fail.

It is recommended the performance indicators be checked at least monthly. Recent standards are now recommending an audible alarm, or a signal be sent to a monitoring system if the vacuum or air flow changes.

Regardless of the method used, periodic measurements of the vacuum should be recorded, and if there are deviations, an inspection of the system should be conducted by maintenance staff or the radon contractor who installed the system.

Radon Monitoring Plan

Mechanical performance indicators are good for periodic validation of the radon system. However, they are surrogate indicators of performance. The only way to know if the systems are truly controlling radon is to conduct radon measurements of the indoor air.

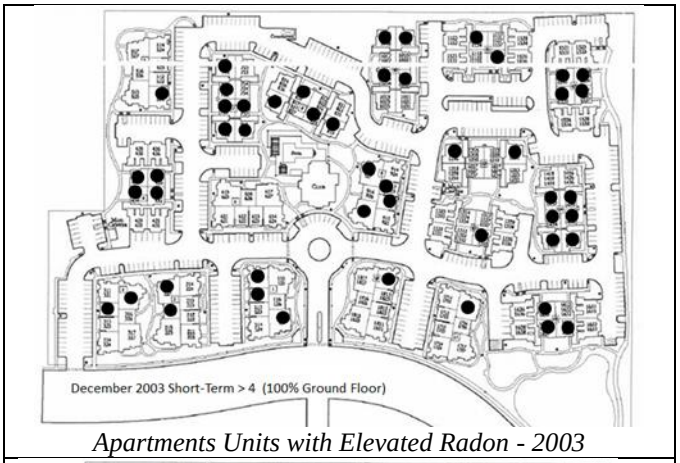
It is recommended that after a building has exhibited elevated radon levels that led to the installation of radon mitigation systems, or HVAC repairs, that a re-test of radon levels occurs every two years. It is also recommended that a retest be done after major modifications to a building are made such as an addition or revamp of the HVAC system.

One has the same options in how the re-survey is done as were available in the initial survey. The retest could be short-term or long-term. However, unless time is of the essence, using a long-term test with a duration of 90 days or more has the advantage of not requiring closed unit conditions which can be inconvenient to occupants.

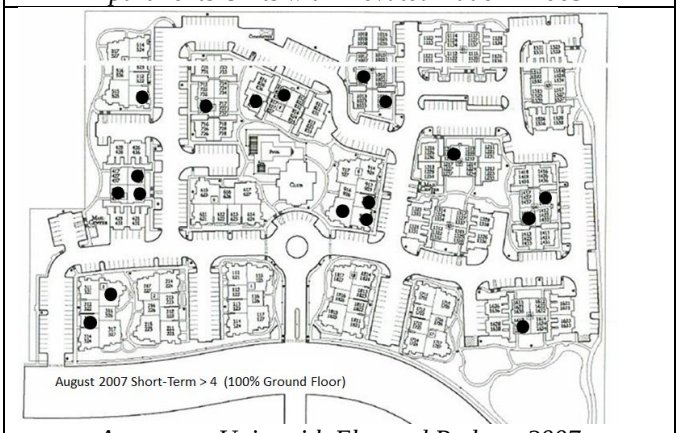
Where to Re-Test

Certainly, those units which previously were the focus of mitigation efforts should be re-tested as part of the monitoring plan. However, the other ground floor units that previously were not elevated should be included in the monitoring plan. That is because those units have the same geological potential for elevated indoor radon and conditions may have changed in the units from those that existed two years previously to where now there is a radon concern.

In other words, radon concerns can move around. The next illustration shows the results of two radon surveys performed on the same apartment complex 4 years apart. The dots indicate those units that were found to be elevated from their respective surveys.



Apartments Units with Elevated Radon - 2003



Apartment Units with Elevated Radon - 2007

Certainly, some of the same units were elevated in both surveys but several were different. Because of this, it is recommended all ground floor units be included in the periodic retesting program rather than just those specific units identified in the original survey and mitigation efforts.

Resources

Resources available at Colorado Department of Public Health and Environment (CDPHE) website www.coloradorado.info:

Technical Manual:
Measuring and Mitigating Radon in Colorado, Colorado Department of Public Health and Environment, 2018

Videos:
Installing Radon Systems in New Home Construction
Installing Radon Systems in Multi-Family Buildings

ANSI/AARST Standards for Multi-Family Buildings
https://standards.aarst.org/