PROTECTING THE PUBLIC FROM CANCER CAUSED BY RADON

Office of Radiological Health

Virginia Department of Health

December 1, 2018

Executive Summary

The Virginia Department of Health's Office of Radiological Health was directed by the 2018 General Assembly in House Bill 1534 to determine the most effective means for protecting the public from cancer caused by radon, primarily by "determining any benefits of additional oversight for individuals performing radon testing and mitigation." House Bill 1534 reads as follows:

1. *§ 1. That the Department of Health shall review consumer complaints regarding radon testing and mitigation received since 2013 and the current certification requirements for individuals performing radon testing and mitigation and shall determine the benefits of any additional oversight for individuals performing radon testing and mitigation. The Department of Health shall report its findings and any recommendations to the House Committee on Health, Welfare and Institutions and the Senate Committee on Education and Health by December 1, 2018."*

This report communicates the Virginia Department of Health's findings and recommendations to the House Committee on Health, Welfare and Institutions and to the Senate Committee on Education and Health.

Introduction

The Virginia Department of Health was directed by the 2018 General Assembly to conduct a study for the purpose of "determining the most effective means of protecting the public from cancer caused by radon." This directive was promulgated by House Bill 1534 and was signed by Governor Northam on March 30, 2018.

The Virginia Department of Health, in conducting this study, collected background information on radon and its health effects; analyzed consumer complaints regarding radon testing and mitigation that were received by the Office of Radiological Health since 2013; examined Virginia's existing certification requirements for individuals performing radon testing and mitigation in the Commonwealth; conducted a literature review to identify best practices for radon reduction; examined radon statutes from other states; and solicited stakeholder input from radon testing and mitigation professionals.

Our research found that the most effective means to protect the public from the cancer-causing effects of radon exposure would likely be achieved through increased public awareness and education coupled with heightened enforcement authority. The public should be well informed about the possible adverse health effects of chronic exposure to high radon levels, radon testing options, selecting certified radon testing and mitigation professionals, and mitigation countermeasures. Enforcement authority is needed to help prevent radon testing and mitigation by uncertified individuals, improper testing, and sub-standard mitigation system installations. Additional oversight may provide some benefit to radon professionals but would likely require extensive revisions to the Code of Virginia and to the Virginia Department of Health's Radiation Protection Regulations.

Background

Radon-222 (hereafter called radon) is a colorless, odorless, tasteless, radioactive gas, produced naturally in rocks and soil by the decay of uranium-238 and subsequently radium-226. Radon, with a radioactive half-life of about four days, enters homes and other buildings through cracks and penetrations in the building foundation. Radon gas usually exists at lower concentrations outdoors, but radon is typically present at a higher concentration indoors. A high radon gas concentration in a home, school, or workplace increases the risk of radon-related lung cancer (American Cancer Society, 2016, para. 4). Radon has been known to be a Class A human carcinogen since the 1940's, is the number one cause of lung cancer among individuals who have never smoked, and the second leading cause of lung cancer overall (EPA, 2018, para. 3).

Radon is one of the most extensively studied environmental carcinogens, and the diversity and consistency of findings provide overwhelming evidence that protracted radon exposure is the leading environmental cause of cancer mortality in the United States. The National Academy of Science's National Research Council estimates that 66% of radon-induced lung cancers result from average exposures below the U.S. Environmental Protection Agency's radon action level of 4 picocuries per liter (pCi/L) of air (148 Bq/m3). In 1995, the Environmental Protection Agency estimated that protracted residential radon exposure to 1.3 pCi/L (48 Bq/m3), which is the United States mean residential radon concentration, results in about 21,000 radon-related lung cancer deaths each year, with an uncertainty range of 8,000 to 45,000 (EPA, 2003, p. 4). Additional deaths are likely as the result of exposure in schools, workplaces, and other non- residential buildings, plus increases since 1995 in population and the number of new homes with high levels of radon that were added to the housing inventory. Conversely, since smoking prevalence has decreased over the decades and because of the synergism between smoking and radon exposure, a corresponding decrease in radon-induced

lung cancers due to the changes in that risk factor has probably occurred. In some states, such as Iowa, test results from over 70% of all measured homes exceed the Environmental Protection Agency's radon action level. On an annual basis, if considered its own disease category, radon-induced lung cancer would be the eighth leading cause of cancer mortality in the United States (AARST-NRPP, 2015, p. 1).

The 21,000 annual lung cancer deaths were projected from dated studies of underground miners exposed to radon. Other research included case-control studies of lung-cancer and radiation in the general population, and measured the effect of residential radon exposure on lung cancer risk by comparing radon levels in the homes of people who have lung cancer with radon in homes where no one has developed lung cancer. The findings of these case-control epidemiologic studies, which directly examined the risk of lung cancer in the residential setting, were in close agreement with the projections from miners.

Testing is the only way to know if a person's home, or another building such as a school or workplace, has elevated radon levels. Indoor radon levels are determined by the soil composition under and around the structure, the pathways through which radon and other soil gas may gain entry, and the characteristics and operation of the building that affect pressure differences driving outdoor air and soil gas into the home. Homes that are next door to each other can have different indoor radon levels, making a neighbor's test result an imprecise predictor of radon risk. Elevated indoor radon levels can be mitigated by a properly certified professional, and the risk of radon entry can be reduced when a homebuilder uses up-to-date consensus standards for radon-resistant new construction, approved by the American National Standards Institute.

The United States Environmental Protection Agency and the United States Surgeon General recommend taking action to reduce indoor radon levels in homes that have a radon level at or above 4 pCi/L, and the EPA advises that people should consider mitigation even when indoor radon falls in the range between 2 and 4 pCi/L. It is worthy to note that the radon concentration in most homes can be reduced to 2 pCi/L or below using accepted mitigation standards.

Data from a nationwide radon study performed by state radon programs and the Environmental Protection Agency over 25 years ago suggested that 1 in 15 homes in the United States have radon levels at or above the Environmental Protection Agency's action level, when based on annual average radon concentrations averaged over all living levels (EPA, 1992). More recent data indicates that in some states, the proportion of homes exceeding the Environmental Protection Agency's action level is much greater. (AARST-NRPP, 2017, pp. 1-2). In Virginia, radon testing data suggests that between 20 to 25% of all results are at or above the federal action level of 4 pCi/L.

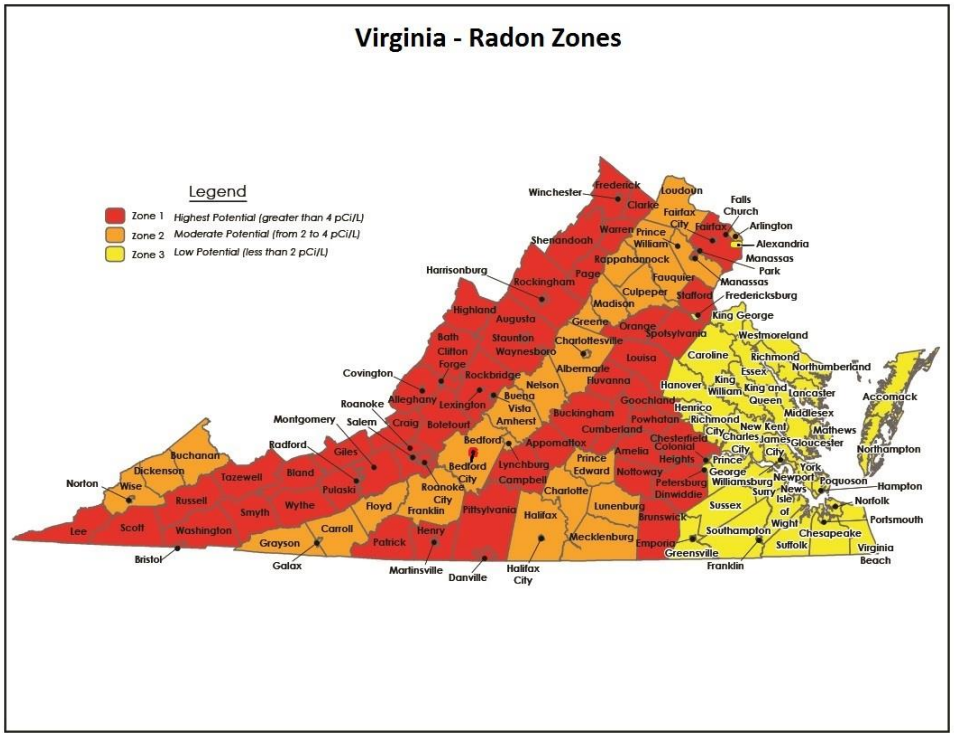
Clear evidence exists showing that chronic exposure to high levels of radon can cause lung cancer. The best solution to reducing radon's adverse health effects is to minimize chronic exposure to elevated levels; that is, to test and mitigate existing homes, and to build new homes using accepted radon resistant materials and practices. Lives can be saved by promoting radon reduction policies that include public education and awareness, radon-resistant new construction, radon testing, disclosure and notification, and the licensing and certification of radon professionals.

How Does Radon Enter the Home?

Radon may be present at much higher concentrations indoors. The magnitude of indoor radon concentration depends on many factors including the strength and proximity of radon

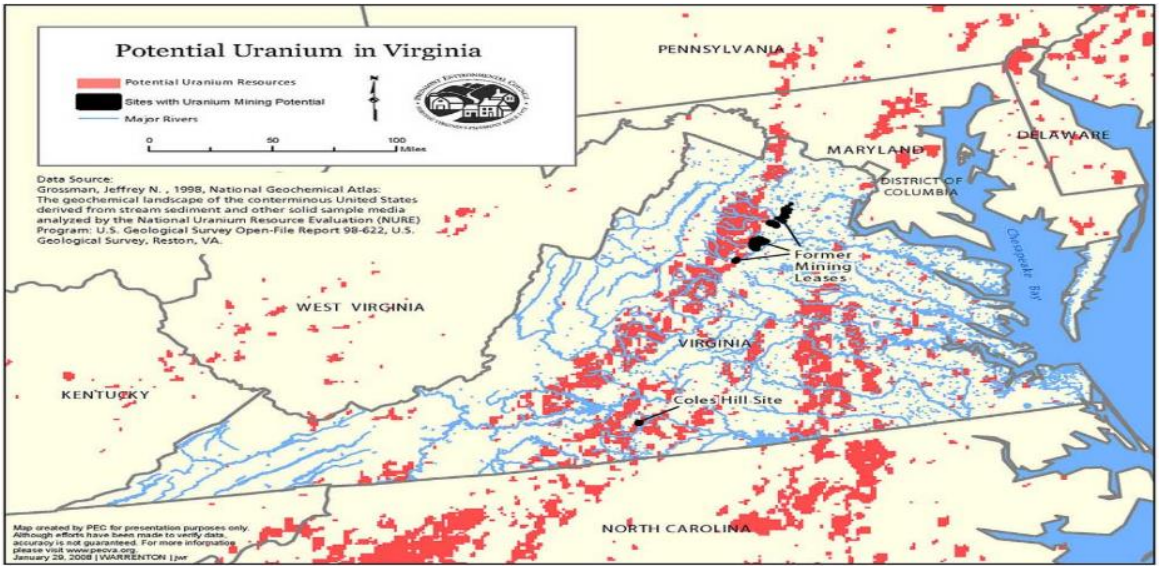
source material under the home, construction techniques and even the lifestyle habits of the occupants. Radon gas can enter a home through various openings in the foundation walls and floor. These openings may include cracks and holes, floor drains, sump pits, construction joints, gaps around pipe penetrations, unsealed hollow block walls and microscopic pores in what appears to be solid concrete. The highest radon concentrations are usually found in basements and other sections of the home that are in direct contact with the ground such as living areas above crawl spaces. Radon may also be found in well water and it will be released into the indoor air when the water is agitated during normal household uses such as faucet aerators, dishwashers and showers. Compared to radon entering the home through soil, radon entering the home through well water will be, in most cases, a small source of risk (CRCPD, 2017, p. 2).

Virginia Radon Zone Map



Virginia's Radon Zone Map, shown above, depicts radon prevalence across the Commonwealth based on historically available sample data collected by states and the

Environmental Protection Agency, as well as on four other factors: geology, aerial radioactivity, soil parameters, and foundation types. The red (Zone 1) areas are likely to have 50% of the homes harboring radon levels above 4 pCi/L. In the orange (Zone 2) areas, the average home is predicted to be between 2-4 pCi/L. The yellow (Zone 3) regions are expected to have an average radon level of less than 2 pCi/L. However, it should be understood that areas in Tidewater, not to mention the Commonwealth at-large, have pockets of elevated radon levels due to the existence of mineable quality uranium, the element that begins the decay process that generates radon. These areas are shown on the map provided below:



Public Health Impact

Lung cancer remains the leading cause of cancer mortality for both men and women in the United States, accounting for more than 26% of all cancer deaths. The Centers for Disease Control and Prevention estimates that more than 80% of lung cancer deaths are causally related to smoking (CDC, 2017, para. 1). Because of the magnitude of smoking-induced cancers, the risk posed by the second leading cause of lung cancer – radon – is often overlooked. Scientifically rigorous peer-reviewed epidemiologic studies performed since the 1960s provided

a solid scientific foundation for the Environmental Protection Agency's 2003 risk assessment which estimates that out of a total of 157,400 lung cancer deaths nationally in 1995, 21,100 (13.4%) were radon-related (EPA, 2003, p. 3). More recent direct estimates of the risk posed by radon, obtained from residential case-control studies performed globally, closely align with the 2003 risk estimates. When compared to cancer mortality from all causes, radon-related lung cancer, if it were treated as a distinct disease category, would rank among the top 10 causes of cancer mortality and is considered a leading environmental cause of cancer mortality in the United States (Field and Withers, 2012, pp. 681-703). Radon is understood to be an invisible radiological gas. While radon remains invisible to human eyesight, science, through the inception of a cloud chamber, has made its presence visible.

Radon Testing

Radon gas can be easily measured by using inexpensive do-it-yourself testing kits or by hiring a trained radon professional to perform the testing. Radon test kits can be purchased online or in hardware stores and other retail outlets. Testing for radon in houses is discussed in the Environmental Protection Agency's publication titled "A Citizen's Guide to Radon" (EPA, 2016, Citizen's Guide) and other Environmental Protection Agency publications (see www.epa.gov/radon). The Environmental Protection Agency recommends that all homes be tested for radon – especially during a real estate transaction. The Environmental Protection Agency also recommends that school classrooms that are in contact with the ground be tested for radon. Both homes and classrooms that are found to have elevated radon levels should be mitigated to lower the indoor air concentration below the Environmental Protection Agency radon action level of 4 pCi/L. However, the Environmental Protection Agency also recommends

that lowering radon levels be considered when levels are found to be between 2 and 4 pCi/L (EPA, 1993, p. 11).

Radon Mitigation

The primary method to reduce radon in a home is installing a vent pipe system and fan that pulls radon from beneath the building and vents it to the outside. Radon reduction systems can be installed in homes with or without basements, as well as in homes with crawlspaces. Methods to reduce radon in homes are discussed in the Environmental Protection Agency's "Consumer's Guide to Radon Reduction" (EPA, 2016, Consumer's Guide). The cost of reducing radon in a home depends on how the home was built and the extent of the radon problem. The majority of states maintain a list of names of certified radon contractors doing business within their state, or refer the public to lists maintained by the National Radon Safety Board or National Radon Proficiency Program, as does Virginia, so that they may contact private radon proficiency programs for lists of certified radon professionals in their area. Selecting someone to fix a radon problem is much like choosing a contractor for other home repairs, and people may want to secure references and more than one estimate. In addition, new homes can be built to resist radon entry. The additional cost at the time of construction is minimal. When installed properly, studies have shown that basic radon-resistant new construction techniques may result in an average radon level reduction of 50% (CRCPD, 2017, p. 7). Radon-resistant construction techniques should not be regarded as equivalent to radon mitigation. While results in homes built with these techniques may show a reduction on the average, the result for any particular home is not predictable. Testing, and mitigation if necessary, is always recommended once any home built with these techniques is ready for occupancy. When installed probably, radon-resistant new construction techniques make subsequent mitigation, if needed, easier to perform, and less costly than if done as a retrofit.

Findings and Recommendations

Current State of the Virginia Code regarding Radon Professionals

Virginia Code "§ 32.1-229.01, Companies listed as proficient to perform radon screening, testing, or mitigation; compliance, states:

> *A. No person shall conduct or offer to conduct any radon screening, testing, or mitigation in the Commonwealth unless he (i) is listed as a professional by either the National Radon Proficiency Program (NRSB) or the National Radon Safety Board (NRPP) or (ii) meets any other proficiency measures deemed acceptable by the U.S. Environmental Protection Agency or the Board of Health for the purpose of offering such screening, testing, or mitigation.*
>
> *B. Any person conducting or offering to conduct radon screening, testing, or mitigation in the Commonwealth pursuant to subsection A shall comply with (i) the radon testing standards outlined in the U.S. Environmental Protection Agency's publication EPA 402-R-92-003, as revised; (ii) the radon mitigation standards outlined in the American Society for Testing and Materials (ASTM International) Standard E-2121-13, as revised; or (iii) any other radon testing and mitigation standards deemed acceptable by virtue of reference by the U.S. Environmental Protection Agency or the Board."*

The Code does not provide authority for state or local government officials to enforce the provisions therein. The Office of Radiological Health relies upon the National Radon Safety Board and National Radon Proficiency Program to maintain their members' certifications and to investigate violations and institute penalties, if needed. The Code lists acceptable national guidance standards for the testing and mitigation of single-family homes and requires that radon professionals operating in the Commonwealth follow them. However, it does not list any

acceptable testing or mitigation standards for multi-family, commercial or school buildings. Further, the Code does not require radon professionals to provide any testing or mitigation data to the state.

As of August 14, 2018 the Office of Radiological Health found there to be 489 National Radon Safety Board and National Radon Proficiency Program certified radon professionals operating in the Commonwealth: 240 of these individuals are certified only by National Radon Safety Board, 237 only by National Radon Proficiency Program, and 12 are certified by both. There are 389 individuals who are certified only as radon testers, 38 individuals who are certified only for radon mitigation and 62 who are certified to perform both testing and mitigation.

Virginia's radon professionals tend to cluster where the demand for their work is highest. Factors that determine that demand include population, average income levels, and education about radon awareness among the local residents and realtors. In rural areas, radon professionals, and especially mitigators, appear to be more willing to travel longer distances to find work. During the last three years, the vast majority of newly-certified radon professionals have joined the industry as testers and most of those were home inspectors. It is possible that the imposition of significant new licensing requirements and fees, if imposed by the Commonwealth, could cause a significant number of certified radon professionals to terminate radon business operations, but the specifics regarding how many might leave and which sections of the Commonwealth would be most heavily impacted by such a loss are difficult to predict.

History of Complaints regarding Radon Professionals in Virginia (2013 - 2018)

Since reinstating Virginia's Radon Program in 2013, the Office of Radiological Health has received complaints from consumers, realtors and members of the certified radon

professional community regarding radon testers and mitigators doing business in the Commonwealth. The most common compliance issues reported include:

1. Individuals conducted radon testing, mitigation services, or both despite the absence of a current certification from either the National Radon Safety Board or National Radon Proficiency Program. Untrained individuals performing radon testing or mitigation may place the public at risk from radon induced lung cancer due to improper testing or mitigation system installation.
2. Mitigators installed radon mitigation systems that did not meet the American Society for Testing and Materials' ASTM-E2121-13 standards. Failure to follow these standards can cause a system to be less efficient or incapable of reducing indoor radon to acceptable levels. It may also lead to systems with a shorter operational life, or systems that put residents at risk of inhaling discharge gas from improperly located fans and pipes. Failure to follow preferred installation techniques may also lead to objectionable noise or water damage to other household components caused by the buildup of excessive condensation. Wiring that does not follow the National Electric Code can cause an increased risk of fire.
3. Radon testers conducted tests that failed to follow the protocols stipulated in the Environmental Protection Agency's guidance document 402-R-92-003. The failure to follow these protocols can lead to inaccurate test results due to poor quality control, improper placement of test devices or insufficient measures to prevent home sellers from tampering with the radon test device during a real estate transaction.

The Office of Radiological Health investigates and attempts to resolve any reported violations of either the radon testing protocols or radon mitigation standards that are stipulated in the Code. It is the Office of Radiological Health's practice to request a written statement, copies

of paperwork or reports supplied by the radon professional and photographic evidence that detail the alleged violations. The Office of Radiological Health's staff then communicates with the radon professional to obtain an explanation of the situation and suggest that the problem(s) be corrected and voluntary compliance is often achieved. However, the Code does not grant the Office of Radiological Health any enforcement authority or permit actions such as onsite inspections, sending official letters of warning, suspension or revocation of certification, or the imposition of financial penalties for egregious or repeated violations.

During the period between October 1, 2013 and September 30, 2017, the number of complaints received averaged about 21 per year. Of these 21 complaints on average, 9 were related to radon professionals performing either testing or mitigation services without current certification; 8 were related to the installation of deficient mitigation systems; 2 were due to improper testing methods; and 2 were unsubstantiated due to insufficient evidence. It is important to note that this is a description only of complaints received, and does not necessarily characterize the true extent of the problem in the Commonwealth due to underreporting. The number of cases in which the affected parties were not aware that they could report problems to the Virginia Department of Health is an unknown, consumers may not know how to report complaints to the Virginia Department of Health, or they might simply elect against reporting issues or otherwise seek resolution. Accordingly, it is likely that a large number of testing protocol and mitigation system installation violations are neither detected nor reported.

A summary of types and number of complaints appears in Table 1 below:

Table 1
Summary of complaints received by Virginia Department of Health's Office of Radiological Health regarding Radon Professionals operating in the Commonwealth

	Nature of Violation				
Years	Lacked Certification	Mitigation Protocol	Testing Protocol	*Incomplete Evidence	Total
SIRG FY 2018[a]	3	4	1	2	10
SIRG FY 2017	12	10	5	8	35
SIRG FY 2016	10	7	5	2	24
SIRG FY 2015	8	6	0	0	14
SIRG FY 2014[b]	10	11	2	0	23
Totals	43	38	13	12	106
NOTES:					
(a) SIRG FY = USEPA Virginia State Indoor Radon Program Fiscal Year					
(*) Incomplete Evidence Totals are significantly underreported.					
(b) Data shown covers only the years since the Virginia SIRG program was reestablished in 2013.					

Problems Associated with Enforcement of Virginia Code § 32.1-229.01.

1. Quality Assurance and Control of Radon Testing

Radon testing requires comparison to recommended scientifically established numerical standards – it is not a simple matter of testing for its mere presence. Therefore, it cannot be fairly compared to the functional testing employed by other professions (e.g., heating, ventilation, and air conditioning or auto repair). Reasonable care must be taken to ensure that the testing equipment is operating within a minimum acceptable range of accuracy. Doing so necessitates yearly calibrations of some devices along with operational competency testing. Furthermore, a certain number of duplicates and samples spiked with a known level of radon should be submitted each year by the radon professional to verify that methods conducted in the field and by the analytical laboratory (if applicable) are not introducing any unacceptable bias. Although the National Radon Safety Board and National Radon Proficiency Program require radon testers to possess a

Quality Assurance/Quality Control plan, they do not review, approve or audit plan performance and the Office of Radiological Health has no regulatory authority to do so. As a result, many radon testing professionals do not fully comply with the recommended Quality Assurance/Quality Control methods which renders the accuracy of test results as questionable.

2. Establishment and Maintenance of National Radon Safety Board and National Radon Proficiency Program Certification

Virginia has a long-standing, 30-year requirement that radon professionals be certified, but this requirement is not widely known. Virginia Department of Health staff encounter citizens, realtors, and new radon professionals who are unaware of this on a routine basis. In order to earn a certificate, a radon professional must take an approved introductory course, pass an approved exam and join either the National Radon Safety Board or National Radon Proficiency Program as a dues-paying member. The radon professional must renew their credentials every two years to maintain their certification current. This involves taking continuing education courses, taking periodic refresher courses, performing device proficiency tests (if applicable) and paying annual dues. Failure to perform these duties in a timely manner results in the expiration of their certification as well as their removal from the certification lists maintained by National Radon Safety Board and National Radon Proficiency Program. In recent years, Virginia Department of Health staff discovered that a significant number of radon professionals have grown weary of this routine yet continue to operate in the Commonwealth with expired certificates – some for as long as several years. While their contract paperwork indicates that they are certified, clients may not know to verify the validity. The Virginia

Department of Health has no regulatory authority to take enforcement action against these individuals.

Additionally, several businesses offer certifications for individuals to perform radon testing and mitigation, but those businesses are not recognized as a certifying entity by the Commonwealth. The business websites invite the public to select a desired service and enter their zip code, upon which a list of providers in their area is generated. However, the radon service professionals are not always credentialed by the National Radon safety Board or the National Radon Proficiency Program. The Office of Radiological Health has no recourse to take action against these businesses or their non-credentialed service providers.

3. Standards for Mitigation and Testing Methods

Virginia Department of Health staff generally learn of mitigation problems only when a system fails a post-installation retest. These violations are reported by the client, realtor, and sometimes by an independent radon professional that is performing a post-installation test to verify that radon levels have diminished. Typically, such violations are easy to document using digital photos. Other installation deficiencies may go undetected even though a system passes the post-installation test. These deficiencies may result in premature system failure or they may place the home's occupants, neighbors, or both at risk of exposure to high levels of radon through improper placement of the discharge pipe.

Testing violations are much more difficult to discern. Certified radon testers have been found to place devices in inappropriate locations, use uncertified staff to position or retrieve the devices, make little or no effort to prevent tampering, fail to employ

sufficient QA/QC methods to ensure accuracy, and perform testing during storms which may cause a temporary upwards spike in the home's radon levels. Unless the client or the realtor involved is educated on these topics, it is likely that a large number of testing protocol violations go undetected or are not reported. Further, it is difficult to obtain written or photographic evidence of testing violations.

4. Dealing with Radon Professionals who Fail to Comply with Existing Regulations

An uncertified individual may perform radon services for months or even years before they complete the initial certification or renewal process, and often do so after their certification has lapsed. Some mitigators have made repeated installation errors despite efforts by Virginia Department of Health staff to encourage them to comply with accepted mitigation guidance standards. Virginia Department of Health staff reach out to radon professionals in cases where uncertified individuals, or the use of improper testing or mitigation methods, are brought to its attention. Again, the Virginia Department of Health lacks regulatory enforcement authority to issue a warning or levy a penalty. Accordingly, a professional's decision whether or not to comply is voluntary. Virginia's Office of the Attorney General typically recommends that aggrieved clients take their case to their local Commonwealth Attorney or small claims court. Due to the relatively low costs and short time periods involved, particularly in real estate transactions, it is more likely that clients will contract with another radon professional to correct unacceptable testing or mitigation work. Virginia Department of Health staff recommend that clients refer violation cases involving certified radon professionals to either the National Radon Safety Board and National Radon Proficiency Program so that they may investigate the case. It is our experience that very few clients will complete this process;

further, the National Radon Safety Board and National Radon Proficiency Program appear reluctant to impose punitive action on their members. Therefore, the current regulatory climate does a poor job of preventing egregious or repeated violations among radon service providers.

Benefits of Additional Oversight for Radon Professionals

The purpose of this report, in part, is to provide information to the General Assembly about how additional oversight might benefit radon professionals. Although the main purpose of potential program elements would be a greater reduction of indoor radon levels, it is important to note that some elements might also provide direct benefits to radon professionals as described below:

1. Training and Examination: Certification laws requiring training on best practices for testing, mitigation and laboratory analysis, including the successful completion of a state-approved examination in order to be certified as well as continuing education in order to be recertified, may help assure proficiency and add a heightened level of public trust to the profession. By approving training courses and establishing an examination, states can ensure that radon professionals obtain a minimum level of knowledge about providing radon services, including information about state-specific requirements or protocols which can be advertised to the client base.
2. Testing and Mitigation Protocols: Mandatory minimum standards for performing radon testing and mitigation, if made enforceable, may achieve more consistency and reliability in testing results and mitigation system installations.
3. Reporting Requirements: Requiring certified professionals to report information about their testing and mitigation activities to the state on a regular basis may assist the state in

determining underserved areas where additional professional testing and mitigation services may be needed. Basic reporting requirements should include information about the service provider, address of the property and type of building, type of radon test performed and the results. Mitigation information should include details about the system, (including radon-resistant new construction), along with pre- and post-installation test results.

4. Enforcement: Establishing enforcement authority is likely the cornerstone to ensuring the legitimacy of a radon program, and can be achieved by requiring the inspection of records, equipment and mitigation system installations by state radon professionals or local building code officials; suspension or revocation of certification under specified circumstances; and administrative, civil and criminal penalties for violations. These practices would help reduce the number of uncertified individuals and help assure that those who remain in the business do a better job of following best practices. The elimination of marginal or deficient radon professionals from the market may allow those who follow the rules to charge a more reasonable fee for their services.

5. Fees: Fees for certification, re-certification and inspections, if levied by the Commonwealth, could be deposited in a designated special fund to allow the indoor radon program to be self-supporting. Remaining funds, if any, could be used to support public radon awareness efforts. The Virginia Department of Health's evaluation suggests that the number of certified radon professionals conducting business in the Commonwealth could support a licensing program that would be funded by the radon community at large, through registration fees, inspection fees and mitigation system tags

for example, without necessitating the use of general funds, as is the practice in other states that regulate radon professionals.

Feedback from Currently Certified Radon Professionals in Virginia

During the 2018 General Assembly's consideration of House Bill 1534, some 371 Virginia resident certified radon professionals and constituents were contacted via email in an effort to obtain their opinions regarding the pending legislation. These included radon professionals known to conduct business in the Commonwealth as well as Virginia's Radiation Advisory Board members. Comments from stakeholders who supported the bill are summarized below:

1. More effective enforcement and penalties are needed for mitigation companies found to install systems in violation of the American Society for Testing and Materials' guidance standard ASTM E2121-13.
2. Legislation is needed to help increase public awareness about radon.
3. Radon testers should be required to provide a non-interference testing agreement to home sellers and real estate agents should be required to make sellers aware of the need to sign such an agreement.
4. Radon testers should provide the Virginia Department of Health with a log of testing results in order to better determine areas where more consumer awareness efforts are needed.
5. Notifying homebuyers during real estate transactions about the risks associated with radon exposure would likely increase radon awareness throughout the Commonwealth, thereby increasing radon testing and creating an atmosphere conducive to the growth of the radon industry while at the same time protecting public health.

Comments from stakeholders who opposed the bill are summarized below:

1. Radon professionals certified to perform both testing and mitigation feared that they might be forced to give up their testing business in order to satisfy conflict of interest concerns. They believe that performing both testing and mitigation does not pose a conflict of interest (much like vehicle, heating, ventilation and air conditioning and pest control professionals diagnose and repair).
2. Radon professionals already incur significant annual costs (of approximately $1000 per year) in continuing education, license, calibration, and competency test fees and that they would struggle to pay any additional regulatory fees.
3. National Radon Safety Board and National Radon Proficiency Program certifications are already required for radon testing and mitigation professionals and that these certifications include ethics and conflict of interest oversight and training.
4. Many commenters stated that existing methods and procedures adequately address radon testing protocols and equipment standards, and that more regulations are not needed.
5. Tampering with test results is both possible and not preventable, even if an agreement is signed. Requiring home sellers to sign a non-interference contract was strongly opposed because it is deemed impractical and unenforceable.
6. Many real estate transaction contracts already require that the radon professionals used in the transaction must be currently certified. Many contracts specifically list radon testing and mitigation protocol requirements to be followed and allow for recourse should the protocols not be followed.

7. Any additional regulatory requirements may result in additional costs being passed on to the consumer, which may discourage many citizens from performing radon testing, mitigation, or both.
8. Some testers opposed the suggestion to require that their radon test results be submitted to the state, as this would take significantly more time and effort for them to comply. Many expressed that the cost associated with maintaining their certification is onerous, especially when compared to those required for a home inspector.
9. Commenters stated that the best way to protect the public from radon-caused cancer is for the state to increase the public's awareness and understanding of radon and the importance of testing through more advertising, classes and public events.

Feedback received from Radon professionals during the USEPA Region 3 Stakeholder's Meeting in Winchester, Virginia on June 26, 2018.

Radon professionals were offered an opportunity to provide input on regulatory changes that might benefit radon professionals when the Office of Radiological Health hosted an Environmental Protection Agency Region 3 Stakeholder's Meeting in Winchester, Virginia on June 26, 2018. During the meeting, a licensure panel discussion was conducted in which comments were solicited. This session lasted for approximately 45 minutes and approximately 39 Virginia certified radon professionals attended. Radon professionals attending meetings of this type typically demonstrate a higher than average degree of professional knowledge, experience and conscientiousness. The agenda for this discussion included:

- A brief overview of radon professional licensing programs by representatives from the neighboring states of Pennsylvania and West Virginia.

- A summary of Virginia Code requirements and its limitations, focusing on the absence of effective enforcement options.
- A list of common testing and mitigation protocol violations made known to or identified by Virginia's Office of Radiological Health.
- A discussion by Mr. Wally Dorsey, a certified radon tester from the Richmond, Virginia area, who has been active in promoting the need for a radon professional licensing program among Virginia's legislature. Mr. Dorsey discussed his involvement in the 2018 session of the Virginia General Assembly and his plans for the future.
- A brief question and answer session which allowed the audience to interact with all the presenters.

Feedback received from Virginia's radon professionals at the meeting was generally positive and supportive as opposed to the stakeholder comments received in February 2018. Some of the comments expressed during the meeting and received in emails afterwards are summarized below:

1. More effort should be made to enlist the support of realtors. Many realtors are unaware of radon testing and mitigation protocols and they often perceive radon testing as an unnecessary obstacle to sales.
2. The primary focus should be on protecting the health of citizens by preventing fraud, making sure that mitigation occurs when and where it is needed.
3. The Virginia Department of Professional and Occupational Regulation (DPOR) has encountered a similar situation with home inspectors, who used to be required to carry a national certification for performing home inspections but are now required to

be licensed by DPOR. An equivalent program, if considered, would need to address both radon testing and mitigation.

4. National certification programs and DPOR's licensing program for home inspectors could be used to help ensure that home inspectors maintain their National Radon Safety Board and National Radon Proficiency Program certifications current.
5. A radon professional wrote that he did not oppose licensing per se, but expressed concerns regarding the imposition of unnecessary regulatory burdens. This individual went on to express concerns regarding the imposition of licensing fees that could force some radon professionals out of business, and asked if it was possible to better determine the extent of non-compliance by radon professionals through the collection of more hard data such as surveys rather than by relying on anecdotal evidence.

Comparison of Radon Laws in other States

A summary of Indoor Air Radon laws and regulations across the 50 states and Washington, D.C. is provided as Appendix A, Legal Environmental Scan of Indoor Air Radon Laws at State Level (CDC, 2017, Legal Environmental Scan). Laws were collected and analyzed by the Centers for Disease Control and Prevention between June 1, 2016-July 15, 2016. There were seven categories identified by National Center for Environmental Health partners as areas of interest with regard to indoor air radiation. The Office of Radiological Health conducted additional research and literature reviews resulting in a more detailed analysis of key radon topics as provided below:

1. Public School Testing

About 20 states have various policies or requirements regarding radon testing in public schools and day care facilities. Code of Virginia § 22.1-138, Minimum standards for public school buildings, provides that all K-12 public school classrooms that are in contact with the ground be tested for radon. With the Department of Education's cooperation, all existing schools were tested with long-term radon test kits between 1993 and 1994. All new school buildings or additions built since then are required to be tested. Though the Virginia Code was one of the first in the country to require school testing, it does not include day care facilities or private schools, there is no deadline by which newly opened schools should complete testing, it does not require any periodic retesting, and it does not require mitigation measures to be taken if high radon levels are found. Most other states that require school testing have included some or all of these provisions in their Code.

Virginia's public schools are required to send the Virginia Department of Health's Office of Radiological Health copies of their test results as they are completed. According to the Department of Education, about twelve new public schools are built each year in the Commonwealth. This number does not take into account expansions of existing school buildings. The Office of Radiological Health routinely collaborates with the Virginia Department of Education to disseminate letters to public school systems reminding them of their obligation relating to radon testing and reporting for newly constructed schools and additions.

2. Radon Resistant New Construction (RRNC)

It is both possible and practical to build a new home to reduce or prevent hazardous levels of radon gas from entering the structure. The physical interventions that prevent radon

entry into the living space are channeling radon from below the ground and foundation into a pipe that exhausts safely to the outdoors, and sealing the foundation and other building components so radon cannot seep from the ground into the home. Laws and regulations require that builders use radon-resistant construction methods in sixteen states. Elements of Radon Resistant New construction legislation or regulations might include:

a. Enacting RRNC by changing the state or local building code to require Appendix F of the International Residential Code in areas that have been designated as high or moderate risk by the Environmental Protection Agency. It is important to note that hazardous radon levels have been found among homes in low radon risk zones.
b. Requiring RRNC in multi-family and single family residential dwellings.

The Virginia Construction Code allows local jurisdictions that have been designated by the Environmental Protection Agency as high risk for radon the option to implement Appendix F of the International Residential Code in their local building code. Appendix F applies only to single-family dwellings and exempts homes built over ventilated crawl spaces. As of this writing only 4 of 46 eligible counties and 7 independent cites have adopted Appendix F.

3. Testing of Existing Homes

Radon testing is the only way to determine whether an existing building's radon level is below the Environmental Protection Agency maximum standard of 4.0 picocuries/liter (pCi/L). Without test results, the buyer has no way to know whether occupying a home will increase their risk of lung cancer. At this time, no state in the country has yet to require that a radon test occur as part of a real estate transaction.

4. Radon Disclosure and Awareness

Radon awareness laws require that homebuyers be informed of the risks of radon and the possibility that radon is present in the residence that they are considering purchasing. The standard warning statement, which must be included in sales contracts where awareness laws exist, advises buyers to have the home tested for radon and, if elevated radon levels are found, have the radon mitigated. Awareness laws empower buyers of all homes with a basic level of self-protective information, unlike disclosure requirements that offer only specific radon test results only to buyers of homes where such testing has occurred. Disclosure laws work hand-in-hand with awareness: as buyers are notified of general risk, the policy should ensure that they are also notified of any known risk specific to the home that they wish to purchase. Such awareness laws were identified to exist in nine states.

About 30 states have radon disclosure laws in which, during a real estate transaction, the seller must disclose all known radon levels or testing results. If no known testing has occurred, the decision of whether or not to test for radon is left to the buyer unless otherwise required by the purchase contract or mortgage lender. A small list of states require sellers to include a warning about the possible presence of radon in the home. This is generally included in the sale contract or in an amendment to the sale documents. Many people purchase a home without knowing about radon or if high levels of radon exist. A homebuyer or renter needs complete information about radon in order to make an informed decision. Elements of a disclosure/awareness law or regulation might include:

a. Radon Disclosure: Prior to the sale or rental of a residential property, requiring that the property owner disclose in writing to the buyer or renter any knowledge of radon levels in the property including:

1. Whether radon testing has occurred and current records pertaining to radon concentrations;
2. A description of any radon concentrations, mitigation, or remediation; and
3. Information regarding the radon mitigation system, including system description and documentation, if such a system has been installed.

b. Radon Awareness: Providing a radon warning statement about the risks of radon to the prospective buyer or renter.

c. Transaction Types: Ensuring disclosure requirements apply to the transfer of any interest in residential real estate, whether by sale, exchange, deed, contract for deed, lease, lease with an option to purchase, or any other option.

d. Real Estate Agent: Allowing the property owner to convey disclosure and radon awareness information through a real estate agent representing or assisting the prospective buyer or renter, as long as the real estate agent provides a copy to the prospective buyer.

The Virginia Required Disclosure Code 55-519 no longer mentions radon as an environmental contaminant that may be found inside a home. The Code was amended in 2008 to remove any mention of radon along with other hazards. Virginia does not require that any radon educational or awareness information be provided to the buyer during a real estate transaction.

5. Professional Licensure

Radon certification laws address individuals that provide professional radon testing and mitigation services. Proper radon testing and mitigation methods can be complex and require that personnel be appropriately trained to follow nationally recognized standards. Up until 1998, the Environmental Protection Agency maintained a certification program for

radon professionals, but they transferred that responsibility to two private organizations – the National Radon Safety Board and the National Radon Proficiency Program. About 12 states require national certification by either National Radon Safety Board or National Radon Proficiency Program for radon professionals operating in their borders. An additional 14 states have established their own license programs for radon professionals. Elements of radon licensing legislation might include:

a. State Radon Program Authorization: Establishing a program to administer certifications, collect fees, have necessary staff and equipment, conduct inspections and levy enforcement.
b. Licensing: Authorizing a state radon program to establish and implement criteria, based on standards and ethical requirements promulgated by the Environmental Protection Agency, National Radon Safety Board, National Radon Proficiency Program or the American National Standards Institute for mandatory licensure and certification of persons involved in the following services pertaining to radon:
    1. Testing of radon in air, water or both;
    2. Mitigation services; and
    3. Training courses to meet the licensing and certification requirements.
c. Certification and Standards Requirement: Authorizing the program to ensure that a person performing radon services is licensed by the state radon program or certified by the National Radon Safety Board or National Radon Proficiency Program, and that work practices adhere to recognized standards.
d. Requirement for Certified or Licensed Radon Professionals to provide their testing and mitigation data to the State: Many states with licensing programs require their radon

professionals to provide detailed data to the state for each radon test they conduct or mitigation system that they install. This allows for better oversight of their work, provides more local data to state officials so that they can more efficiently target public outreach activities, and helps prevent the under-reporting of all radon testing and mitigation activity that is occurring in the state.

The Commonwealth does not operate a state licensing program for radon professionals, but Virginia Code 32.1-229.01 requires that radon professionals be certified by either the National Radon Safety Board or National Radon Proficiency Program. Virginia's radon professionals tend to be located in clusters where the demand for work is highest and the demand is generally determined by population, income levels, education/radon awareness among local population and realtors, and radon risk level. The Commonwealth looks to the National Radon Safety Board and National Radon Proficiency Program to maintain their members' certifications and to investigate violations and institute penalties, if needed. The Code does not provide any enforcement authority or capability to state or local government officials. The Code lists acceptable national guidance standards for the testing and mitigation of single-family homes and it requires that radon professionals operating in the Commonwealth follow them. However, it does not list any acceptable testing or mitigation standards for multi-family, commercial or school buildings. Further, the Code does not require radon professionals to provide any testing or mitigation data to the state.

Conclusion

Radon is an odorless, colorless, tasteless radioactive gas that occurs naturally in soil and groundwater. Radon enters homes and buildings through openings in foundations, and unless vented to the atmosphere, may be present in buildings and become hazardous to human health. Prolonged exposure to elevated concentrations of radon has been associated with an increase in the risk of contracting lung cancer. Therefore, there is a need to protect human health and prevent exposure to elevated concentrations of radon.

The most effective means to protect the public from the cancer-causing effects of radon exposure is through increasing public awareness and education regarding the existence of radon, its adverse health effects, testing options, mitigation options and how to select a qualified radon testing or mitigation professional. An added layer of assurance would be achieved by extending to the Virginia Department of Health enforcement authority with regard to radon professionals' certification, testing, and mitigation protocols. Enforcement authority would help prevent radon testing and mitigation by uncertified individuals, improper testing, and sub-standard mitigation system installations.

Additional oversight may provide additional health and safety benefits but would likely require extensive revisions to the Code of Virginia and to the Virginia Department of Health's Radiation Protection Regulations. A regulatory framework pertaining to the heightened oversight of radon professionals, if considered, should address the certification and licensing of radon testing and mitigation professionals, complaint investigations, inspections, enforcement, penalties, and fees necessary to sustain such a program.

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Appendix A
Legal Environmental Scan of Indoor Air Radon Laws at State Level

(Reprinted from CDC, 2017, Legal Environmental Scan)

The Public Health Law Program (PHLP), located in the Office for State, Tribal, Local and Territorial Support (OSTLTS), assisted the Radiation Studies Branch in the National Center for Environmental Health (NCEH) with an environmental scan of indoor air radon laws, including both statues and regulations, to determine the current legal landscape in the 50 states and the District of Columbia. This document is specific to state law only. There may also be relevant local law that apply to indoor air radon (CDC, 2017, Legal Environmental Scan).

A legal researcher from CDC's Public Health Law Program used the legal database WestlawNext to conduct an environmental scan of the indoor air radon laws across the 50 states and DC. Laws were collected and analyzed between June 1, 2016 – July 15, 2016. Categorizations were created based upon topical areas identified by scientific partners in NCEH. The laws were analyzed and the results were compiled in a Microsoft Excel table. The table is broken down by state and provides legal citations for each category. There were 7 categories identified by NCEH partners as areas of interest with regard to indoor air radiation. Each category is listed below along with an explanation of the category and a review of the findings. It is possible that the same law could be included in multiple categories if the language was relevant to multiple categories.

Category 1	States with laws under which radon is listed as a hazardous pollutant, toxic pollutant or an air pollutant.
Category 2	States with laws that define radon or include radon in a definition.
Category 3	States with laws referencing disclosure of radon in the sale or transfer of property.
Category 4	States with laws referencing radon standards in the construction of residential or commercial buildings.
Category 5	States with laws referencing radon testing, mitigation, construction standards or licensing with regard to special populations including schools, daycares and foster care.

Category 6	States with laws referencing certification, licensure or regulation of individuals who test for or mitigate radon.
Category 7	States with laws referencing grants for radon testing, mitigation or awareness.

Category #1: States with laws under which radon is listed as a hazardous pollutant, toxic pollutant or an air pollutant.

In thirty states, there was at least one law that listed radon as a hazardous pollutant, toxic pollutant, or an air pollutant. It is important to note that this particular category was not limited to indoor air radon laws. These definitions may be applicable to other areas relevant to radon including water standards and waste removal.

- In Cal. Code Regs. tit. 17, § 93001 radionuclides including radon are listed as hazardous air pollutants.
- In Conn. Agencies Regs. 22a-174-1, "air pollutant" is defined to include noble gases including radon.

Category #2: States with laws that define radon or include radon in a definition.

Forty-one states have a law that either defines radon or includes radon in the definition of another term. Similar to Category 1, it is important to note that this particular category was not limited to indoor air radon laws. Definitions may be applicable to other areas relevant to radon including water and waste removal. In many states, the definition of both "background radiation" and "working level" reference radon.

- In Fla. Admin. Code Ann. r. 64E-5.101 "background radiation" is defined as "radiation from cosmic sources; naturally occurring radioactive materials, including radon" and working level "means any combination of short-lived radon daughters in 1 liter of air that will result in the ultimate emission of 1.3 x 105 MeV of potential alpha particle energy."

- There are also states with definition sections devoted to radon testing or mitigation. For example Conn. Gen. Stat. Ann. § 19a-14b, defines both "radon diagnosis" and "radon mitigation" as well as other terminology relevant to mitigation.

Category #3: States with laws referencing disclosure of radon in the sale or transfer of property.

Thirty states have laws that reference the disclosure or non-disclosure of radon in the sale or transfer of property. This category captures a number of variations, including laws requiring disclosure in residential property, disclosures in real estate, and warranties for new buildings. Laws captured in this category include laws that require disclosure, laws that encourage disclosure and also laws that explicitly do not require disclosure. Further, disclosure laws can apply to both buyers and sellers. For example,

- In Ariz. Rev. Stat. Ann. § 33-423, a disclosure report may be provided to a buyer or seller that discloses "[r]adon gas potential zones as shown on current maps issued by the United States environmental protection agency."
- In Maryland "[i]f the builder does not participate in a new home warranty security plan . . . . [t]he builder must make a disclosure at the time of the purchase or construction contract containing an explanation . . . that . . . [d]escribes any hazardous or regulated materials, including . . . radon." Md. Code Ann., Real Prop. § 10-603.

Category #4: States with laws referencing radon standards in the construction of residential or commercial buildings.

Sixteen states have at least one law that references both radon and construction standards of residential or commercial buildings. School specific construction standards are captured in Category 5 and are therefore not within the scope of this category. The scope of this category is

broad. The laws in this category are not making the assertion that states are requiring or setting any radon standards. Rather, there is some reference to radon standards within the laws.

- In 25 Tex. Admin. Code § 297.4 a radon assessment should be completed when considering the site of new construction.
- In 35 Pa. Stat. Ann. § 7502 under the Radon Gas Demonstration Project the "Department of Environmental Resources shall have the power and its duty shall be to develop and implement, in cooperation with the United States Government and private industry, methods of remedial action to reduce unsafe levels of naturally occurring radon gas in residential buildings. The department may enter into contracts with builders, remodelers and other private contractors to assist the department in developing experimental or prototypic systems of remedial action."
- W. Va. Code Ann. § 16-34-5 makes it clear that although the Director of the Division of Health "shall license radon testers, mitigation specialists, mitigation contractors and radon laboratories" he or she is not allowed to "[r]equire the performance of a test for radon" or to "regulate construction practices."

Category #5: States with laws referencing radon testing, mitigation, construction standards, or licensing with regard to special populations including schools, daycares and foster care.

Twenty states have laws specific to radon levels in buildings used for the education or care of children. This category captures state laws referencing radon testing, mitigation, construction, or licensing with regard to special populations including schools, daycares and foster care homes.

- In Florida, applicants to become family foster care homes must include safety documentation including "radon testing results when applicable." Fla. Admin. Code Ann. r. 65C-13.025.
- In 1 Colo. Code Regs. § 303(1):4.1.10.2 public school construction guidelines suggest that "[a]ll new facilities and additions shall conduct radon testing following completion of construction within nineteen months after occupancy as required by Colorado Department of Public Health and Environment."

In some states there are mandatory requirements for radon testing in buildings that are used to house or educate children.

- In Fla. Admin. Code Ann. r. 64E-5.1208 a list of the buildings that "are required to be measured for radon or radon progeny" includes "[a]ll public and private school buildings or school sites housing students in kindergarten through grade 12" and "[a]ll state-licensed day care centers for children or minors."

In other states allowable levels or radon are explicitly set.

- For example, In Michigan "[t]he lowest level of the child care home shall have levels of radon gases not to exceed 4 picocuries per liter of air." Mich. Admin. Code R. 400.1934.

Category #6: States with laws referencing certification, licensure, or regulation of individuals who test for or mitigate radon.

Twenty-two states have laws referencing the certification, licensure, or regulation of individuals or businesses who test for or mitigate radon.

- In Conn. Gen. Stat. Ann. § 20 "contractors performing removal or replacement of residential underground heating oil storage tank systems" must have a certificate of

registration which will only be provided when a contractor "provides evidence, satisfactory to the commissioner, that the contractor is certified as a radon mitigator by the National Radon Safety Board or the National Environmental Health Association."

- States like Florida also have certification requirements for radon measurement businesses. Florida Fla. Admin. Code Ann. r. 64E-5.1206.
- In Maine, a person may not participate in radon testing or radon mitigation unless registered with the division of environmental health within the Department of Health and Human Services. Me. Rev. Stat. tit. 22, § 771-784.

Category #7: States with laws referencing grants for radon testing, mitigation, or awareness.

Twelve states have laws referencing grants for radon testing, mitigation, or awareness. This category is specific to grants and does not capture other possible forms of financial contributions, such as loans.

- In Georgia, Ga. Comp. R. & Regs. 391-7-2-.01 establishes a Radon Awareness Grant Program to "provide funds to local governments and community-based organizations to address radon issues in their communities."
- In Illinois the Emergency Management Agency "may undertake projects to determine whether and to what extent radon and radon progeny are present in dwellings and other buildings, to determine to what extent their presence constitutes a risk to public health, and to determine what measures are effective in reducing and preventing the risk to public health" and may "[a]pply for, accept, and use grants . . . to implement this Act."