

# Radon Alternatives

Several alternatives have been suggested to handle the issue of radon-resistant new construction. These have come from Council members, staff members, and the public. The alternatives are listed below, followed by descriptions, advantages, and disadvantages of each alternative.

1. **No change**
2. **Passive required**
3. **Active required**
4. **Active required for homes with basements, passive required for all others**
5. **Passive required, unless home buyer “opts out”**
6. **Passive required, test required, and activation required based on test result**
7. **Passive required, except caulking not required**
8. **Sub-slab preparation required**
9. **Mitigation required to below 4 picoCuries/liter**

## 1. No change

### Description

This option leaves things as they are. Some builders will continue to install RRNC voluntarily; the current rate is 10% of new homes. Some owners of new homes will fix radon after they move in. Some mitigations will not be successful due to lack of sub-slab preparation (e.g., when concrete slab is poured on native soil).

### Advantages

- Market forces – the preferences of builders and buyers – determine whether RRNC is used.
- No construction costs incurred for consumers who don't want, or buildings that don't need, radon mitigation

### Disadvantages

- Many people assume that building codes handle preventable health issues like radon.
- Some builders do not install radon systems and do not offer this as a choice to buyers.
- Some builders have received legal advice that, if they offer radon reduction to their customers, they may become liable for radon-induced lung cancer that may occur. This factor may help explain why only 10% of homes in 2000-03 were built with passive systems.
- Homebuyers who decide to mitigate after construction must install an active system, usually with a vent pipe outside the building envelope. They will incur operating costs for electricity and maintenance and compromised building appearance.

## **2. Passive required**

### Description

This is the option recommended by staff – require a passive radon reduction system in new homes, consistent with the Model International Residential Code, Appendix F. Components include gas-permeable layer, plastic sheeting in crawlspace, sealing and caulking, vent pipe, & junction box for optional fan. A placard would be placed in the home advising the homeowner to do a radon test after moving in, and to activate system if needed.

### Advantages

- Consistent with USEPA recommendation to install passive systems in areas designated zone-one (all of Larimer County is so designated)
- Passive system specification is accepted by national and international model code developers, after extensive stakeholder involvement, as a building code option for high radon areas.
- Reduces radon by 47% on average
- Many people assume that building codes handle preventable health issues like radon
- Since the passive system removes about half the radon, the homeowner gets a benefit from the added cost without taking further action.
- Offers an element of choice: system can easily be made active if desired.

### Disadvantages

- Increases cost of construction, reduces choice

## **3. Active required**

### Description

Require installation of a fan in addition to the passive radon reduction system, thus making it an active system. The homeowner is advised to monitor system operation using the provided indicator.

### Advantages

- Assumed to reduce radon to near-background level: 0.4 pCi/L
- Occupant exposure is limited to near-background radon levels without further action on his or her part.
- Testing not needed

### Disadvantages

- Highest cost alternative
- Increases cost, reduces choice

## **4. Active required for homes with basements, passive required for all others**

### Description

An active radon reduction system would be required in any home that has a basement. Homes without basements would be required to have the passive system, including the placard advising the buyer to test for radon after moving in. This alternative responds to the fact that basement radon tests average twice as high as ground-floor radon tests.

### Advantages

- Reduced costs, because radon systems are matched somewhat with expected radon levels.
- See other advantages of passive & active systems, above.

### Disadvantages

- See other disadvantages of passive and active systems, above.

## **5. Passive required, unless home buyer opts out**

### Description

- Passive radon system would be placed in every home, except that the home-buyer [the initial occupant] can "opt out" of getting a radon system. Homes built on speculation would have to have a radon system, since the initial occupant is not known prior to construction. The homebuyer who decides to opt out would sign a form which would be sent to the Building and Zoning Department. Building inspectors would enforce the opt-out provision at the point when the sub-slab plumbing is inspected, i.e., before the concrete slab is poured. If the radon system components are missing, then the inspector would "place a hold" on the concrete pour, unless the opt-out form had been received. To assure that the first owner's decision to opt out does not jeopardize subsequent owners' ability to mitigate, minimal sub-slab preparation would be required as in option 8.

### Advantages

- Avoids costs and increases choice for a first occupant who does not want a radon system. This option is most similar to the City's current program to encourage mitigation of existing homes, the "information-at-point-of-sale" ordinance, because it relies on homeowner preference.

### Disadvantages

- It may be hard to properly define "home-buyer" so that the buyer who opts out is a person who will actually live in the new home, as opposed to a realtor, agent, or institutional buyer.
- A subsequent owner who decides to mitigate would have to pay more than the cost of a passive system, with higher electricity usage and compromised building appearance.

## **6. Passive required, test required, activation required based on test result**

### Description

Require a passive radon reduction system in new homes. Require that each new home be tested for radon. If the radon test is high, require that the radon system be made active by installing a fan. The radon test would be done after occupancy, when testing conditions are more accurate than during construction. This option would be enforced by issuing a conditional Certificate of Occupancy (CO). A permanent CO would be issued following completion of a radon test and activation of the radon system, if needed.

### Advantages

- The alternative would be more cost-effective than requiring active systems in all homes, because the system would only be activated if needed to reduce radon levels.

### Disadvantages

- City would have to specify a performance standard (radon level), the manner of testing, and a testing procedure.

## **7. Passive required, except caulking not required**

### Description

All the components of the passive system would be required except for caulking the floor-to-wall joints, expansion joints, and utility penetrations. This alternative is based on the idea that caulking and sealing is no more difficult or expensive for the homeowner to complete than for the builder. The home would have a placard attached that states the passive system is incomplete, recommending a radon test and system completion and activation if needed, and that cracks must be sealed prior to finish. However, in homes where the lowest living area of the home is “finished” during construction, so that the concrete joints and penetrations are no longer accessible, caulking and sealing would be required during construction.

### Advantages

- Delays the cost of caulking and sealing until the homeowner finishes the lowest living area of the home, when cracks and joints are required to be sealed.
- Limits requirements to only those components that must be installed during construction.

### Disadvantages

- Because there is less radon reduction from the incomplete passive system, the owner receives less benefit from the money invested in other parts of the system, unless he/she opts to complete the system later. This factor would reduce cost-effectiveness.
- Sealing and caulking, although technically possible, may be more difficult after construction. Many homeowners are likely to finish such areas without obtaining a building permit and inspection, which may cause the slab joints and penetrations to be inaccessible.

## 8. Sub-slab preparation required

### Description

This is a minimal alternative that would assure that every home could be successfully mitigated after construction. Sub-slab preparation would allow soil gasses to pass freely under the slab, assuring the effectiveness of a later-installed sub-slab depressurization system. Sub-slab preparation alternatives include: aggregate, perforated pipe loop, or soil mat. The latter two alternatives would have to be stubbed through the slab and capped, since it would be difficult to locate the pipe or soil mat after the slab is poured. A placard would be attached to home indicating how home has been prepared for radon mitigation, and recommending radon testing and mitigation, if needed.

### Advantages

- This is the least-cost alternative that assures that each home can be mitigated after construction.

### Disadvantages

- No radon reduction benefit, unless the homeowner opts to mitigate after construction.
- Mitigation requires an active system, usually with a vent pipe outside the building envelope. Homeowner loses the benefit of the stack effect that occurs when the vent pipe lies within the building envelope.

## 9. Mitigation required to below 4 pCi/L

### Description

Require that each finished building be tested and that the test result must fall below a specific level. This gives the builder a choice whether to install passive or active systems during construction, or install retrofit systems after construction. The City would specify the performance standard (radon level), manner of testing, and enforcement mechanism.

Cost: not estimated

### Advantages

- Less prescriptive -- focuses directly on limiting radon exposure.
- Market forces and individual initiative determine radon mitigation practice within the limits of the performance standard.
- Potentially less costly overall, if only houses that need radon reduction are equipped with radon systems.

### Disadvantages

- More complicated for builders. Requires builders to become skilled in judging which building sites and housing types are more likely to need radon mitigation.
- City must specify a performance standard (radon level), the manner of testing, testing procedure, and an enforcement mechanism.
- Although testing is desirable, it is hard to get an accurate test in the period of real estate transactions.
- If the City denies Certificate of Occupancy unless the house is at or below 4 pCi/L on a short-term test, then about 70% of the houses would need at least a passive system. Under that scenario, probably all builders would routinely install passive systems, and the testing requirement would make this alternative more costly than requiring passive systems.