



National Institutes
of Health



RADON: WORKER AND EMPLOYER GUIDE TO HAZARDS AND RECOMMENDED CONTROLS



Installing a radon reduction system during rehabilitation or rebuilding, such as after a disaster, is easier for a qualified radon remediation contractor to perform and less expensive for a homeowner to have done. While natural disasters are unlikely to change an individual's long-term risks from radon exposure, workers and employers should still be aware of hazards associated with radon exposure and ways to limit exposure whenever possible.

WHAT IS RADON?

Radon is found everywhere in outdoor and indoor air of buildings of all kinds, including homes. It is a naturally occurring, radioactive element—meaning it gives off radiation—that occurs as a colorless, odorless, tasteless gas. Radon comes from the natural decay of radioactive elements in soil, rock and water. As these elements, such as uranium and radium decay, they form radon that gets into the air you breathe.

WHAT ARE THE HAZARDS OF RADON?

Radon gas breaks down into radioactive particles that can get trapped in your lungs when you breathe. As they break down further, these particles release small bursts of energy. This can damage lung tissue and lead to lung cancer over the course of your lifetime.

The primary cause of lung cancer among non-smokers is exposure to radon, and the particles from its decay. Overall, radon is the second leading cause of lung cancer.ⁱ Radon is responsible for about 21,000 lung cancer deaths every year. About 2,900 of these deaths occur among people who have never smoked.ⁱⁱ Radon exposure also increases the risk of lung cancer and death for workers.

Not everyone exposed to elevated levels of radon will develop lung cancer; and the amount of time between exposure and the onset of the disease may be many years.



Where radon enters a home:

1. Cracks in solid floors
2. Construction joints
3. Cracks in walls
4. Gaps in suspended floors
5. Gaps around service pipes
6. Cavities inside walls
7. The water supply
(if water comes from groundwater)

Source: U.S. Environmental Protection Agency (EPA)

WHERE DOES RADON COME FROM?

Radon can be found everywhere outdoors at relatively low levels—around 0.4 picocuries per liter of air (pCi/L). However, the average indoor level is 1.25 pCi/L and nearly one out of every 15 homes in the U.S. is estimated to have elevated radon levels at or above EPA's action level of 4 pCi/L. Most radon enters homes through walls and floors in contact with the earth, especially in/around basements and foundations.ⁱⁱⁱ Since radon is a gas, it can come in through cracks in solid floors, construction joints, cracks in walls, gaps in suspended floors, gaps around service pipes, cavities inside walls, and in drinking water that comes from groundwater.

Radon decays into solids, not gases, and can stick to surfaces. These solids can settle on home furnishings, floors, walls, and other materials, as well as on dust particles suspended in the air. Inhaling dust contaminated with radon can expose you to radon particles.

The U.S. Environmental Protection Agency (EPA) offers an online guide that can help you identify a state's radon office and other resources. Visit <http://www.epa.gov/radon/wherelive.html> to learn more. Homes with an elevated radon level have been found in every part of the country. Radon can also affect some homes and not others: for example, a home with a high radon level could be next door to a home with a low radon level (less than 1 pCi/L.)

PROTECTING WORKERS

Workers performing disaster recovery tasks in homes, including rehabilitation and rebuilding work, are not typically considered among workers who are at risk for significant radon exposures. However, employers and workers can still take steps to minimize exposure to radon, including following OSHA's Hazardous Waste Operations and Emergency Response (HAZWOPER) ([29 CFR 1910.120](#)) and Ionizing Radiation ([29 CFR 1910.1096](#) and [29 CFR 1926.53](#)) standards.

Stay informed about radon levels in the geographic area where a worksite is located. In areas known to have homes with elevated radon levels, working with the homeowner to obtain a radon test may provide useful information to both the resident and individuals working at the home.

Employers should ensure that workers are not exposed to working environments with high radon levels. The U.S. Nuclear Regulatory Commission sets an exposure limit for adult workers at 30 pCi/L averaged over a one-year period. Air monitoring can help warn employers and workers about elevated radon levels in a work area, including homes and other residential buildings where they may be performing rehabilitation and rebuilding work.

In work areas with elevated radon levels—including radon remediation work—worker protection involves engineering controls, work practices and personal protective equipment (PPE). Inhalation is the route of exposure of most concern to cleanup workers.

Engineering Controls

- In homes with elevated radon levels, it may be possible to work with the homeowner to agree to install a radon remediation system.

Work practices

- Open windows and doors to homes to ventilate the structure. Ensuring that working areas receive plenty of fresh air may help disperse radon gas from the working environment.
- Do not eat, drink, or smoke in work areas.

Personal Protective Equipment (PPE)

- A particulate-filtering respirator can help reduce inhalation of radon and other radioactive particles that have collected on airborne dust particles in the working environment.
- In many instances, the PPE used to protect workers from other indoor environmental pollutants is sufficient to control exposures to radon, especially when those pollutants are also of concern due to inhalation exposure.
 - Workers who are adequately protected from airborne asbestos or silica dust, for example, are likely to be protected from inhaling radioactive particles.
 - Use of a NIOSH-approved respirator appropriate for other indoor environmental pollutants of concern for the particular work site or situation may also help protect the worker from inhaling radon radioactive particles.

Radon Remediation

There are a variety of requirements and qualifications to perform radon testing, measurement, and mitigation, which vary by state. Businesses intending to provide these services to homeowners should contact their State Radon Office to determine what are, or whether there are, such requirements. In general terms, radon remediation systems prevent (see www.epa.gov/radon/whereyoulive.html) radon-contaminated air from entering a building, and vent contaminated air through a pipe to the outdoors.

General contractors should check with that office to find qualified or state-certified radon professional contractors in your area. Contractors can also contact radon certification programs for lists of certified radon professionals (see www.epa.gov/radon/rnlinks.html for links to the National Radon Proficiency Program and the National Radon Safety Board), and find radon guidance from the American Association of Radon Scientists and Technologists at www.aarst.org.

REBUILDING FOR RADON RESISTANCE

EPA recommends several building techniques to help add radon-resistance to homes during rebuilding and rehabilitation.^{iv} Depending on the scope of the rebuilding, only some of these actions may apply:

- If the house is on a poorly ventilated crawl space, install a crawl space exhaust fan.
- If the house is on a slab foundation and has high radon levels, install a low-cost “subslab depressurization system.”
- If the house is being built or rebuilt on a new slab foundation, use a 4-inch layer of clean, coarse **gravel** below a home’s foundation (i.e., the concrete slab), to allow the soil gases, including radon, to move freely underneath the house.
- Place heavy duty **plastic sheeting** (6 mil. polyethylene) or a vapor retarder on top of the gravel to prevent the soil gases from entering the house. The sheeting also keeps the concrete from clogging the gravel layer when the slab is poured.
- Run a 3-inch (or 4-inch for large homes) vent pipe labeled “Radon System” vertically from the gravel layer through the house’s conditioned space and roof to safely **vent radon** and other soil gases outside above the house.
- **Seal all openings**, cracks, and crevices, installing stud shoes to reinforce any studs notched in construction, in the concrete foundation floor (including the slab perimeter crack) and walls with polyurethane caulk to prevent radon from entering the home.

Install an electrical junction box (outlet) in the attic near the vent pipe for use with a vent fan, should a more robust system be needed now or later.

OTHER SAFETY AND HEALTH HAZARDS

Recovery workers involved in radon remediation and other types of work in homes may face additional hazards on the job site. Common hazards include downed electrical wires, carbon monoxide and electrical hazards from portable generators, fall and “struck-by” hazards from tree limbs or working at heights, being caught in unprotected excavations or confined spaces, burns, lacerations, musculoskeletal injuries, being struck by traffic or heavy equipment, and encountering contaminated water during cleanup and recovery efforts.

ADDITIONAL RESOURCES

- OSHA Safety and Health Topics page on Ionizing Radiation: <http://www.osha.gov/SLTC/radiationionizing>
- Environmental Protection Agency (EPA) Radon web site: <http://www.epa.gov/radon/index.html>
- EPA “A Citizen’s Guide to Radon: The Guide to Protecting Yourself and Your Family from Radon”: <http://www.epa.gov/radon/pubs/citguide.html>

ASSISTANCE FOR EMPLOYERS

OSHA’s On-site Consultation Program offers free and confidential advice to small and medium-sized businesses in all states across the country, with priority given to high-hazard worksites. On-site Consultation services are separate from enforcement and do not result in penalties or citations. Consultants from state agencies or universities work with employers to identify workplace hazards, provide advice on compliance with OSHA standards, and assist in establishing safety and health management systems. To locate the OSHA On-site Consultation Program nearest you, call 1-800-321-OSHA (6742) or visit <http://www.osha.gov/dcs/smallbusiness/index.html>.

This guidance document creates no new legal obligations. It contains recommendations as well as descriptions of OSHA safety and health standards. For a comprehensive list of compliance requirements of OSHA standards or regulations, refer to Title 29 of the Code of Federal Regulations. This information will be made available by the OSHA Office of Communications to sensory-impaired individuals upon request. The voice phone is (202) 693-1999; teletypewriter (TTY) number: (877) 889-5627.

i. EPA. 2014. Radon – Health Risks. <http://www.epa.gov/radon/healthrisks.html>

ii. EPA. 2014. Radon – Health Risks. <http://www.epa.gov/radon/healthrisks.html>

iii. EPA. 2014. A Citizen’s Guide to Radon. <http://www.epa.gov/radon/pubs/citguide.html>

iv. EPA. 2014. Radon-Resistant New Construction – Builders: Basic Techniques. http://www.epa.gov/radon/rrnc/basic_techniques_builder.html