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# RADON MITIGATION SYSTEM FAILURE DETECTION DEVICES*

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## ABSTRACT

Radon mitigation system failure includes ineffective radon reduction, mechanical system failure, backdrafting caused by mitigation system-induced house depressurization, and exacerbation of existing mechanical system problems and house pressure imbalances. Homeowner and mitigator affordable and user friendly detection devices are commercially available for detection of radon mitigation system failure. An EPA-listed continuous radon monitor (CRM), a UL-listed electronic carbon monoxide detector, and backdraft indicators are available to monitor radon mitigation failure. Homeowner use of the CRM after the installation of a mitigation system has detected sump pump failure (drain tile of a drain tile depressurization system became filled with water) and winter-time freeze-up of the effluent pipe. Backdraft indicators have shown inadequate venting problems. System failure devices should be provided with all radon mitigation systems.

## INTRODUCTION

The radon mitigator encounters existing health or life-threatening deficiencies in many cold-climate homes. The most serious problem is house depressurization in homes with natural draft combustion appliances. An informal "Residential Backdrafting Workshop" devoted to residential backdrafting was conducted May 14 and 15, 1993 in St. Paul, Minnesota†. Many homeowners have responded to the "energy conservation message" by making their homes more air tight. Most homes do not have provision for supply air for exhaust fans, clothes dryers, furnaces, water heaters, and other air-consuming appliances. Thus many homes have air pressure imbalances that do not always allow natural draft appliances to draft properly. An active soil depressurization (ASD) radon mitigation system has the potential to exacerbate existing pressure imbalances or create a pressure imbalance where none occurred before.

The recent availability of user friendly and relatively low cost CRMs, UL-listed carbon monoxide detectors, and backdraft indicators has allowed the provision of these detection devices with all radon mitigation systems installed by American Radon Services. The user friendly detection devices allow homeowner involvement in maintaining indoor air quality.

## MATERIALS & METHODS

American Radon Services provides a "user" CRM to every homeowner that calls and schedules a Phase 1 radon system design. The CRM becomes part of the Phase 2 (installation of the radon mitigation system). A blower door is used during the Phase 1 to determine the air-tightness of the home. The air-tightness of the home is used to estimate the potential for house depressurization and the potential for house pressurization as a mitigation technique. The homeowner is apprised about the potential for backdrafting (if natural draft combustion appliances are present) during the on-site visit and in the Phase 1 written report. Homeowner awareness of the backdrafting potential is created. It is suggested that the present natural draft combustion appliances be replaced with sealed combustion appliances or electric heating units when the present units are to be replaced. Occasionally it is recommended that the natural draft combustion appliances be replaced before the installation of the radon mitigation system.

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† Grimsrud, David, Residential Backdrafting Workshop Summary, Minnesota Building Research Center, University of Minnesota, May 14-15, 1993.

Occasionally the mechanical introduction of outside air is recommended. Passive introduction of outside air is never recommended.

Backdraft indicators are installed on natural draft combustion appliances and a UL-listed electronic carbon monoxide detector is provided during Phase 2 (the installation of the radon mitigation system).

## RESULTS

Radon mitigation system freeze-up

An Iowa City homeowner observed that during the course of a day that the radon continued to increase (the homeowner called three times during the day with the observations). Pre-mitigation radon concentrations were 1100 to 1500 Bq. The homeowner did not look at the U-tube manometer until asked to do so. The U-tube manometer read "zero," i.e., no suction. The homeowner reported that the fan seemed to be running. The homeowner discovered that the PVC effluent pipe was plugged with what looked like snow. The high moisture radon system effluent *acted like* a snow-making machine and plugged itself. Freeze-up of the termination of the radon mitigation system occurred twice last winter.

Sump pump failure

Two homeowners have reported radon mitigation system failure that turned out to be sump pump failure. The sump pump fails and the weepage tile (the radon system manifold) fills full of water and the radon system becomes ineffective. The one home was particularly perplexing because part of the time the radon system worked and part of the time it did not work. The sump pump seemed to be erratic; i.e., it worked part of the time and part of the time it did not work. The homeowner had never looked at the U-tube manometer. The sump failure and the subsequent blockage of the tile by water caused the pressure differential in the U-tube manometer to increase dramatically.

Backdrafting

Five homeowners have reported that their backdraft indicators have turned black which indicates an incidence of venting failure.

Carbon monoxide

UL-listed carbon monoxide detectors have been provided with all radon mitigation systems since March 1993. There have been no reports of carbon monoxide problems to date associated with the installation of radon mitigation systems.

## DISCUSSION

User-friendly and relatively inexpensive continuous radon monitors, backdraft indicators, and carbon monoxide detectors have shown indoor air pollutants that may be pre-existing or that may be exacerbated by the installation of an active soil depressurization radon mitigation system. Radon system failure caused by winter-time freeze-up of the radon exhaust PVC pipe and sump pump failure have been detected.

The EPA's Radon Contractor Proficiency standards require the installation of a device that allows the homeowner to monitor active soil depressurization (ASD) radon mitigation systems. U-tube manometers are probably most commonly used as an indicator of radon system function because of their relative low cost. U-tube manometers are a passive device that measures the pressure differential between the inside of the PVC pipe (used in active radon mitigation systems) and the ambient air. The function of the U-tube manometers is not understood by many homeowners. A common statement in regards to the U-tube manometers is "it doesn't mean anything to me."

Flue gas spillage has been detected by the use of backdraft detectors.

## CONCLUSIONS

Radon system failure caused by freeze-up and sump pump failure is likely to occur with other ASD radon systems that have been installed in cold-climate homes and in homes where the sump pit/weeping tile are used as the manifold for the pressure field extension. It is recommended that continuous radon monitors, backdraft indicators, and UL-listed carbon monoxide detectors be provided as part of the active soil depressurization radon mitigation system. Failure of ASD systems is likely to be much greater than recognized.