

**PREVALENCE OF  
RADON-RESISTANT CONSTRUCTION  
IN THE PHOENIX AND TUCSON  
METROPOLITAN AREAS, ARIZONA**

by  
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## INTRODUCTION

Radon is a colorless, odorless gas produced by the natural radioactive decay of uranium. The U.S. Environmental Protection Agency has determined that exposure to indoor radon increases human risk of developing lung cancer. Indoor-radon levels generally correlate with uranium concentration in underlying rocks and soil, and some areas of Arizona are known to have elevated levels of uranium.

Past improvement in public awareness of radon in Arizona has led to construction of sub-slab ventilation systems in a small fraction of new homes in housing developments in parts of the greater Phoenix and Tucson metropolitan areas. These systems are designed explicitly to eliminate infiltration of radon to the indoor environment. Construction of these ventilation systems reflects increased home-buyer concerns about environmental hazards and, possibly, home-builder concerns about competitive marketing or civil liability. This is being done as a result of increased awareness of radon hazards by builders and buyers without government regulation, and indicates that efforts to educate home builders and buyers are contributing to reducing human radon exposure. In the absence of radon-related regulations, education appears to be the *only* method by which public agencies can reduce human radon exposure in Arizona.

With funding from an EPA State Indoor Radon Grant (SIRG year 8, Grant K1-009544-08-0), the Arizona Geological Survey conducted a telephone survey of home builders in the Phoenix and Tucson metropolitan areas to determine the extent and rationale for building radon-resistant homes. The results and an evaluation of their significance are presented here.

The northern margin of the Phoenix metropolitan area, near the towns of Cave Creek and Carefree, is one of the fastest growing metropolitan areas in Arizona. Housing development is spilling out of the Phoenix area valley floor and onto flanking hills typically underlain by geologically diverse bedrock with a wide range of uranium levels and radon-emanation potentials. Previous studies in this area have recognized uranium levels up about 100 times typical levels in Arizona (Duncan and Spencer, 1993b; Harris, 1997) (typical levels are about 3 ppm; Duncan and Spencer, 1993a). The Tucson area is also growing rapidly, but is not presently expanding into areas of suspected high uranium levels except about 15 miles southeast of Tucson in the Cienega Gap area.

## RESPONSE OF HOME BUILDERS

Home builders were surveyed by telephone about their use of radon-resistant construction techniques and their attitudes or policies about such construction. Following are comments and statements from representatives of the surveyed home building companies that were successfully contacted and willing to answer questions (see also Appendix A).

**Tucson** (telephone survey by R. Harris, fall 1997)

- (1) Home builders will incorporate radon-resistant construction in new homes on request but do not include them in all houses because there is little or no demand.
- (2) Arizona generally does not have a radon problem, so radon is not a topic of concern for developers.
- (3) Most builders will incorporate radon mitigation only in areas shown to be high in radon, or with high potential for radon. Such areas are very rare in Arizona, even according to the EPA.
- (4) Evaluation of radon potential is done on a site-by-site basis by testing soil for radon levels. Only if soil surveys point to high radon will the builder add radon prevention during construction.
- (5) In the few cases where radon potential is high, it is easily taken care of.

- (6) When it comes to choosing a site to build a house, the general public is much more concerned with issues such as proximity to landfills or industries that create toxic waste than they are about radon, which is natural and is everywhere.
- (7) Consumers are more interested in energy efficiency.
- (8) There is some movement, starting in the eastern US toward mandating tighter, better-sealed houses, but that creates a problem with stagnant indoor air that has to be mitigated by installing very expensive ventilation equipment to (A) allow exchange of outdoor air but (B) keep the incoming air at room temperature and (C) meet energy efficiency standards at the same time.
- (9) Since there is no great consumer demand, builders do not want to add unnecessarily to the price of a house.
- (10) Some builders do not incorporate radon-prevention into the construction because they already install air-exchange ventilation, which takes care of any radon.
- (11) Two builders said they hadn't heard the word radon for years; there was some interest in the past, but no one is interested in it anymore.
- (12) Radon is a problem where basements are common, but few Arizona houses have basements (<1 %).
- (13) Builders went through a period in the late 1980s when radon was a hot topic, and radon testing and radon-resistant construction were being promoted, but the interest and urgency are long gone.
- (14) When radon is mentioned, consumers are often confused and needlessly worried.
- (15) Better foundation design and fabrication has reduced the amount of radon entering houses from soil because newer foundations do not crack as much and are less permeable. The newer foundations were not designed with radon reduction in mind, but that has been one of the effects.

**Phoenix** (telephone survey by R. Leighty, winter and spring, 1998)

- (1) Continental Homes is aware of radon, but does not test for it.
- (2) Pinnacle Builders does not specifically test for radon, but their subcontractors may. Their home-buyers generally do not ask about radon.
- (3) Tim Goodrich (on-site land development for Richmond American Homes) stated that Richmond American does Phase I environmental studies, but only tests for radon if it is known to be high in the surrounding area (not common for them). Richmond American has had no significant problems with radon. He was interested in radon-related reports and maps that the Arizona Geological Survey has produced for the north Phoenix area.
- (4) Bob Golly of Homes by Dave Brown stated that he was aware of radon, but it was not a problem for them.
- (5) Brad Olsen of Shea Homes stated that Shea is aware of radon, but most of their customers are not. They do not build homes with basements, but are sensitive to the radon potential in 2 subdivisions (Troon, 136th St & Shea Blvd.) in the northeast valley. He wasn't sure if they tested in these areas, but they have installed the sub-slab pipe ventilation in some homes where they think radon levels are higher. They build to EPA standards at a cost of roughly \$150-200 per home. He thought that this radon-mitigating piping added no significant additional value to the home.
- (6) T.W. Lewis Homes is aware of radon via newspapers and the EPA. Few home-buyers mention radon when ordering their home. T.W. Lewis does not test for radon, except for homes with basements. These homes incorporate outside-vented piping beneath the slab; pumps or fans are not installed. T.W. Lewis would incorporate radon-mitigation construction techniques into their homes upon request, but they do it anyway using EPA standards. Approximate cost of radon construction is \$300, but does not add any significant value to the home; unless asked, they generally don't mention it to the home buyer.

## SUMMARY OF SURVEY RESULTS

Not one of the contractors contacted felt that there would be any change in their policies toward radon in the future unless something drastic happened, such as EPA mandates being imposed. The unifying theme of discussions was that radon is not a problem in Arizona, and therefore, there is no interest about radon on the part of the public. Depending on the method used, radon mitigation added during construction may cost hundreds or thousands of dollars, and that extra cost is passed along to buyers. Without perceived consumer demand, builders are hesitant to add anything to the cost of construction.

## OTHER BUILDER CONCERNS (NATIONAL)

For various reasons, some builders have been reluctant to install radon-reduction equipment. For example, builders have been asked to participate in research projects to build some houses in a tract with various radon-resistant construction and some without. This subject is addressed by the EPA as follows (EPA, 1988a):

Concerns over publicity and potential liability have constrained many builders from participation in radon research projects. It is easy to understand their reluctance. Once radon-resistant construction techniques have been initiated within an existing tract, a future plaintiff may argue that the builder was aware of a potential problem in that tract. The initial techniques tested may be subsidized by the research project, but the builder will be essentially committed to continue radon-resistant construction throughout the remainder of the property at his own expense. Traditionally constructed houses in the tract may be more difficult to sell due to local awareness of the research project. Residents of traditionally constructed houses in the same tract may become anxious and/or demand that radon problems in their houses be remedied by the builder.

Some builders are worried that radon reduction techniques have not been tested over time and that some currently recommended techniques could backfire. One concern is that a sub-slab suction system, drawing radon toward the house that would otherwise have exited the soil at grade, might leak or malfunction and raise the house radon level. Other concerns include potential for sub-slab suction to cause water condensation on slab bottoms, resulting in the swelling of soils.

## CONCLUSION

Home builders will incorporate radon-resistant construction in new homes if there is public interest or if the homes are in an area that is known to have high radon levels. At present the public is not very interested, interest appears to be fading, and home builders rarely utilize radon-resistant construction techniques in the Phoenix and Tucson metropolitan areas. Builders do seem to be aware of areas that are known to have elevated risk of high radon levels and will test or utilize radon-resistant construction techniques in these areas. Further efforts at reducing public exposure to radon would be most effective if focused on public education and continued geologic surveys to identify areas with elevated uranium levels. It appears that the *only* means by which the Arizona Geological Survey can contribute to reduction in human radon exposure in Arizona is through (1) public education (Arizona Geological Survey publications on radon are listed in Appendix 3), (2) identifying areas with high uranium levels, and (3) timely dissemination of information regarding these areas (a list of mail recipients for such information is listed in Appendix 2).

## REFERENCES

- Duncan, J.T., and Spencer, J.E., 1993a, A survey of uranium concentrations in rocks and soils in populated areas of Arizona: Methods, *in* Spencer, J.E., ed., Radon in Arizona: Arizona Geological Survey Bulletin 199, p. 93-96.
- Duncan, J.T., and Spencer, J.E., 1993b, Investigations of uranium and radon in the Phoenix metropolitan area, *in* Spencer, J.E., ed., Radon in Arizona: Arizona Geological Survey Bulletin 199, p. 43-50.
- EPA, 1988a, Radon-resistant residential new construction: US Environmental Protection Agency Report EPA/600/8-88/087, 67 p.
- EPA, 1988b, Application of radon reduction methods: US Environmental Protection Agency Report EPA/625/5-88/024, 92 p.
- EPA, 1992a, A citizen's guide to radon (second edition): US Environmental Protection Agency Pamphlet (402-K92-001), 15 p.
- EPA, 1992b, Consumer's guide to radon reduction: US Environmental Protection Agency Pamphlet (402-K92-003), 17 p.
- EPA, 1993, Home buyer's and seller's guide to radon: US Environmental Protection Agency Pamphlet (402-R-93-003), 32 p.
- Harris, R.C., 1997, Uranium distribution in the Cave Creek-Carefree area, central Arizona, and implications for indoor radon: Arizona Geological Survey, Open-File Report 97-06, 11 p., 1 sheet, scale 1:100,000.
- Otton, J.K., Gunderson, L.C.S., and Schumann, R.R., 1993, The geology of radon: US Geological Survey Pamphlet, 29 p.

## APPENDIX 1: Home builders

### TUCSON (contact list prepared by R. Harris, Fall 1997)

1.	Becklin Homes	298-4555	Ed Casalano
2.	New World Homes, Inc.	745-9800	Larry
3.	Pulte Home Corp.	797-1100	
4.	Richmond American	544-2700	
5.	US Home Corp.	747-0997	
6.	Estes Homes	577-7007	John Walker
7.	Canoa Development Inc.	790-6986	Mark Bonzil
8.	KE&G Construction, Inc.	748-0188	Rick Cook
9.	Embassy Construction and Development	296-6196	
10.	A.F. Sterling, LTD.	577-3600	Rob
11.	Lou Benson Construction	797-1237	
12.	The Doucette Company	622-7373	Tom Doucette

### PHOENIX (contact list prepared by R. Leighty, Winter and Spring, 1998)

This list of 23 Phoenix area home builders includes large builders (e.g., Conetintental, Del Webb), as well as smaller builders of custom homes (e.g., Saddleback Homes) in the north Phoenix area. All 23 builders were contacted but 15 did not return calls after receiving voicemail messages. Of the 6 builders that supplied information regarding radon in their home construction, all are aware of radon (especially those that build in the northeast valley). Most do not test for it because they do not consider it a significant problem in their home locations. T.W. Lewis and Shea Homes install sub-slab piping (\$150-300) in some homes.

**bold type** = Builder supplied some degree of radon-related information.

normal type = Left voicemail message but call not returned.

*italic type* = Relevant contact is out of town.

1.	Beazer Homes	967-8655	Karen Williamson (x223).
2.	Centex Homes	264-9284	Joan Scarborough (Land Development).
3.	<b>Continental Homes</b>	483-0006	
4.	Crown Homes	955-5517	Joe
5.	Dell Webb	488-6600	Joyce Pinchcliff(?)
6.	Elliot Homes	831-9200	Jeff Klem
7.	Estes Homes	866-2000	David McNicholl (220-0404)
8.	Fulton Homes	753-6789	
9.	Geoffrey Edmunds	951-0782	Kevin Dermot
10.	Golden Heritage Homes	998-7901	Kirby ( V.P. of Construction)
11.	Hancock Communities	303-6700	Mike (General Superintendent)
12.	<b>Homes by Dave Brown</b>	921-1400	
13.	Lennar Homes	331-9300	Mike Sexton
14.	Monterey Homes	998-8700	Will Herman(?)
15.	Monument Homes	493-0700	
16.	<b>Pinnacle Builders</b>	954-6616	
17.	<i>Pulte Homes</i>	598-2100	Willis Martin (V.P. of Land Development)
18.	<b>Richmond American Homes</b>	956-4100	
19.	Ryland Homes	214-5474	Kathy Eads (Marketing Director).
20.	<i>Saddleback Homes</i>	596-8899	
21.	<b>Shea Homes</b>	348-6000	
22.	<b>T.W. Lewis</b>	820-0807	
23.	UDC Homes	627-3000	Scott Moore (Operations).

## **APPENDIX 2: Mailing list for reports identifying areas of high uranium levels**

Ms. Jean Richmond, Executive Director  
Northern Arizona Home Builders Association  
2900 North West Street, Suite #1  
Flagstaff, AZ 86004

Ms. Connie Wilhelm, Executive Director  
Home Builders Association of Central Arizona  
2111 East Highland Ave.  
Phoenix, AZ 85016

Mr. Allan Lurie, Executive Director  
Southern Arizona Home Builders Association  
2840 N. Country Club Road  
Tucson, AZ 85716

Jerry Holt, Commissioner  
Arizona Real Estate Department  
2910 N. 44th St., Suite 100  
Phoenix, AZ 85018

Joe Aymami  
Customer Services Office  
Arizona Real Estate Department  
2910 N. 44th St., Suite 100  
Phoenix, AZ 85018  
*(Joe Aymami is responsible for the content of  
information packets that are given to each applicant  
for a new or renewed Realtor's license)*

Gary Freeland  
Arizona Radiation Regulatory Agency  
4814 S. 40th St.  
Phoenix, AZ  
85040

John Stewart  
Arizona Radiation Regulatory Agency  
4814 S. 40th St.  
Phoenix, AZ  
85040

Curt Leaf, Program and Projects Specialist  
Customer Services Office  
Arizona Real Estate Department  
2910 N. 44th St., Suite 100  
Phoenix, AZ 85018  
*(Mr. Leaf authored the "Radon Student Activity  
Book" published jointly by ARRA and Real Estate  
Department)*

Maricopa County Dept. of Planning and Infrastructure  
301 West Jefferson St., 3rd Floor  
Phoenix, AZ 85003  
*(Most of the Phoenix Metropolitan area, including the  
primary study area, are within Maricopa County)*

Frank Krogman, Health Services Director  
Mohave County Health Department  
PO Box 7000  
Kingman, AZ 86402  
*(Lake Havasu City is in Mohave County)*

Norm Marrah  
Environmental Health Manager  
Mohave County Health Department  
PO Box 7000  
Kingman, AZ 86402

Louise A. Hill  
US Environmental Protection Agency  
75 Hawthorne St.  
San Francisco, CA  
94105-3901

Sheldon Rosenblum  
US Environmental Protection Agency  
75 Hawthorne St.  
San Francisco, CA  
94105-3901



## APPENDIX 3: Selected AZGS radon publications

### DOWN TO EARTH SERIES (1992)

Spencer, J. E., 1992, Radon gas: A geologic hazard in Arizona: Arizona Geological Survey, Down-to-Earth Series, no. 2, 17 p.

### BULLETIN (1993)

Spencer, J.E., ed., 1993, Radon in Arizona: Arizona Geological Survey, Bulletin 199, 96 p., 2 plates, scales 1:1,000,000 and 1:32,000.

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- Spencer, J.E., 1993, Geology and radon in Arizona: Introduction and overview, *in* Spencer, J.E., ed., Radon in Arizona: Arizona Geological Survey Bulletin 199, p. 1-9.
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- Duncan, J.T., and Spencer, J.E., 1993, Uranium and radon in southeastern Arizona, *in* Spencer, J.E., ed., Radon in Arizona: Arizona Geological Survey Bulletin 199, p. 40-43.
- Duncan, J.T., and Spencer, J.E., 1993, Investigations of uranium and radon in the Phoenix metropolitan area, *in* Spencer, J.E., ed., Radon in Arizona: Arizona Geological Survey Bulletin 199, p. 43-50.
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- Proctor, P.D., Fleck, K.S., and Shahin, A.N., 1993, Radiometric and petrochemical characteristics of the Dells Granite, Yavapai County, *in* Spencer, J.E., ed., Radon in Arizona: Arizona Geological Survey Bulletin 199, p.61-81.
- Taylor, M.A., and Duncan, J.T., 1993, Radon on the Navajo Nation Indian Reservation, Arizona, New Mexico, and Utah, *in* Spencer, J.E., ed., Radon in Arizona: Arizona Geological Survey Bulletin 199, p. 82-85.
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- Duncan, J.T., and Spencer, J.E., 1993, A survey of uranium concentrations in rocks and soils in populated areas of Arizona: Methods, *in* Spencer, J.E., ed., Radon in Arizona: Arizona Geological Survey Bulletin 199, p. 93-96.
- Spencer, J.E., Shenk, J.D., and Duncan, J.T., 1993, Areas in Arizona with elevated concentrations of uranium, *in* Spencer, J.E., ed., Radon in Arizona: Arizona Geological Survey Bulletin 199, Plate 1, scale 1:1,000,000.
- Duncan, J.T., and Spencer, J.E., 1993, Geology and uranium concentrations in Verde Valley, Yavapai County, Arizona, *in* Spencer, J.E., ed., Radon in Arizona: Arizona Geological Survey Bulletin 199, scale 1:32,200.

## **APPENDIX 3 CONTINUED: Selected AZGS radon publications**

### **OPEN-FILE-REPORTS (1994-1997)**

- Harris, R.C., 1994, Uranium distribution in sediments of the Safford and Duncan basins, southeast Arizona, and implications for indoor radon: Arizona Geological Survey, Open-File Report 94-04, 11 p., 2 sheets, scales 1:24,000 and 1:100,000.
- Harris, R.C. and Trapp, R.A., 1994, Comprehensive bibliography of uranium and radon in Arizona: Arizona Geological Survey, Open-File Report 94-25, 50 p.
- Harris, R.C., 1995, Uranium distribution in sediments of the upper San Pedro basin, southeast Arizona, and implications for indoor radon: Arizona Geological Survey, Open-File Report 95-03, 9 p., 2 sheets, scale 1:62,500.
- Harris, R.C., 1995, Uranium distribution in sediments of the lower San Pedro valley, southeast Arizona, and implications for indoor radon: Arizona Geological Survey, Open-File Report 96-02, 10 p., 1 sheet, scale 1:100,000.
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