U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF INSPECTOR GENERAL

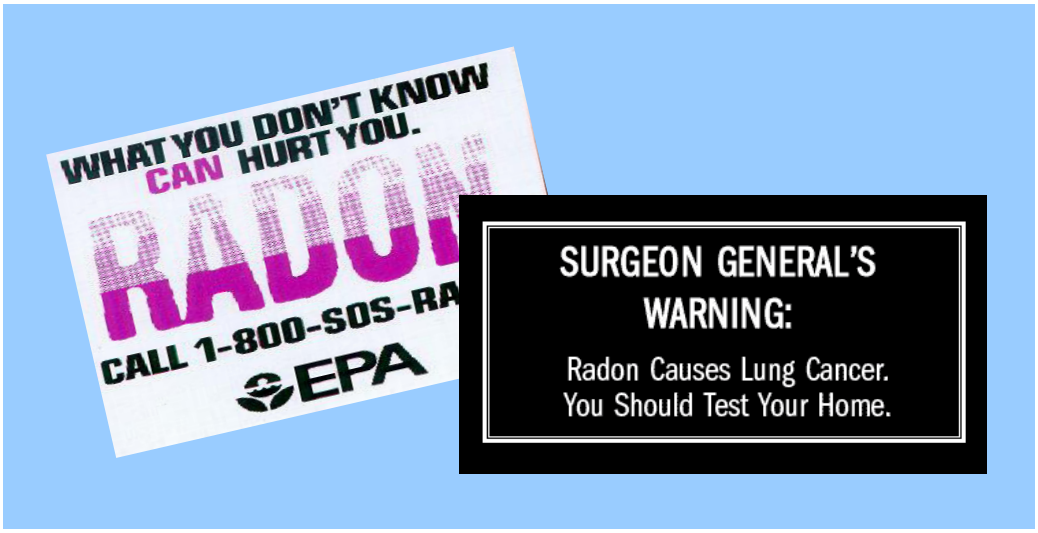
Catalyst for Improving the Environment

Evaluation Report

More Action Needed to Protect Public from Indoor Radon Risks

Report No. 08-P-0174

June 3, 2008



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Abbreviations

EPA	U.S. Environmental Protection Agency
GAO	Government Accountability Office
IRAA	Indoor Radon Abatement Act
OAR	Office of Air and Radiation
OGC	Office of General Counsel
OIG	Office of Inspector General
OMB	Office of Management and Budget
pCi/L	Picocuries Per Liter (of air)
RRNC	Radon-Resistant New Construction
SIRG	State Indoor Radon Grant

Cover photos: U.S. EPA Radon Public Service Announcements at http://www.epapsa.com/newradon/ and University of Wisconsin-Milwaukee, Mechanical Engineering Department, Radon Reduction Technology Laboratory at www.uwm.edu/Dept/radon/

U.S. Environmental Protection Agency
Office of Inspector General

08-P-0174
June 3, 2008

At a Glance

Catalyst for Improving the Environment

Why We Did This Review

Indoor radon is the leading cause of lung cancer among non-smokers and the second leading cause of lung cancer in America, according to the U.S. Environmental Protection Agency (EPA) and U.S. Surgeon General. We conducted this evaluation to determine how EPA measures indoor radon program results, and whether changes at the federal level could improve program effectiveness. We also identified challenges to implementing changes.

Background

Radon is an odorless, tasteless, and invisible gas produced by decay of naturally occurring uranium in soil and water. Radon is found throughout the United States. Indoor residential exposure occurs when radon gas enters through cracks in floors, walls, and construction joints, or gaps in foundations around pipes, wires, and pumps. According to EPA, more than 20,000 Americans die from radon-related lung cancer every year.

For further information, contact our Office of Congressional and Public Liaison at (202) 566-2391.

To view the full report, click on the following link:
www.epa.gov/oig/reports/2008/20080603-08-P-0174.pdf

More Action Needed to Protect Public from Indoor Radon Risks

What We Found

Nearly two decades after passage of the 1988 Indoor Radon Abatement Act (IRAA), exposure to indoor radon continues to grow. Efforts to reduce exposure through mitigation or building with radon-resistant new construction have not kept pace. Of 6.7 million new single family detached homes built nationwide between 2001 and 2005, only about 469,000 incorporated radon-resistant features. Of 76.1 million existing single family homes in the United States in 2005, only about 2.1 million had radon-reducing features in place.

The IRAA established the goal that indoor air should be as free of radon as outdoor air. Since 1988, EPA has administered a voluntary program to reduce exposure to indoor radon by promoting awareness, testing, installation of radon mitigation systems in existing homes, and use of radon-resistant new construction techniques. Still, building codes in some areas do not require new homes to be built with radon-resistant new construction. Much of the progress made in reducing exposure has occurred as a result of real estate transactions. In those cases, a buyer, seller, mortgage lender, and/or real estate agent requested that a home be tested. Some States and localities do not require testing or the disclosure of test results during real estate transactions.

The radon program is not achieving greater results for several reasons. EPA's ability to achieve results with a voluntary program is limited. Potential loss of a sale represents a disincentive for real estate agents and sellers to conduct radon tests during real estate transactions. Added expense represents a disincentive for builders to use radon-resistant new construction. Opportunities exist within the federal community to substantially increase the number of homes tested and mitigated for radon. EPA has not decided how to use all the authorities or tools available to it to achieve the Act's goals. Also, EPA has not been reporting program results in relation to homes at risk in its performance reporting.

What We Recommend

We recommended that EPA develop a strategy for achieving the long-term goal of the IRAA that considered using the authorities authorized by Congress or explain its alternative strategy, which it agreed to do. We also recommended that EPA identify limitations to meeting the goal to Congress. EPA responded that it does not believe the IRAA goal is achievable. While EPA agrees that the problem of radon exposure gets worse each year, it did not agree to notify Congress that the goal set by the statute is unachievable. We consider this issue open and unresolved. We also recommended improvements to how EPA measures and reports program results, which it agreed to do.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
INSPECTOR GENERAL

June 3, 2008

MEMORANDUM

SUBJECT: More Action Needed to Protect Public from Indoor Radon Risks
Report No. 08-P-0174

FROM: Wade T. Najjum
Assistant Inspector General for Program Evaluation

TO: Robert J. Meyers
Principal Deputy Assistant Administrator for Air and Radiation

This is our report on the subject evaluation conducted by the Office of Inspector General (OIG) of the U.S. Environmental Protection Agency (EPA). This report contains findings that describe the problems the OIG has identified and corrective actions the OIG recommends. This report represents the opinion of the OIG and does not necessarily represent the final EPA position. Final determinations on matters in this report will be made by EPA managers in accordance with established audit resolution procedures.

The estimated cost of this report – calculated by multiplying the project's staff days by the applicable daily full cost billing rates in effect at the time – is $629,228.

Action Required

In accordance with EPA Manual 2750, you are required to provide a written response to this report within 90 calendar days. You should include a corrective actions plan for agreed upon actions, including milestone dates. We have no objections to the further release of this report to the public. This report will be available at http://www.epa.gov/oig.

If you or your staff have any questions regarding this report, please contact me at (202) 566-0827 or najjum.wade@epa.gov; or Rick Beusse, Director for Program Evaluation, Air & Research Issues, at (919) 541-5747 or beusse.rick@epa.gov.

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Chapter 1
Introduction

Purpose

This project was initially proposed by the U.S. Environmental Protection Agency's (EPA's) then Acting Assistant Administrator for the Office of Air and Radiation and the EPA Region 2 Regional Administrator. The Acting Assistant Administrator requested assistance from the Office of Inspector General (OIG) on how best to communicate indoor radon health risks to the public. He also asked how to measure program results, and that we identify what additional measures, if any, could be taken within EPA's limited budget to reduce indoor radon health risks. In response to the request, we conducted this evaluation to:

- Determine how EPA measures overall Indoor Radon Program results and the results achieved at the regional and State levels with State Indoor Radon Grant funds.

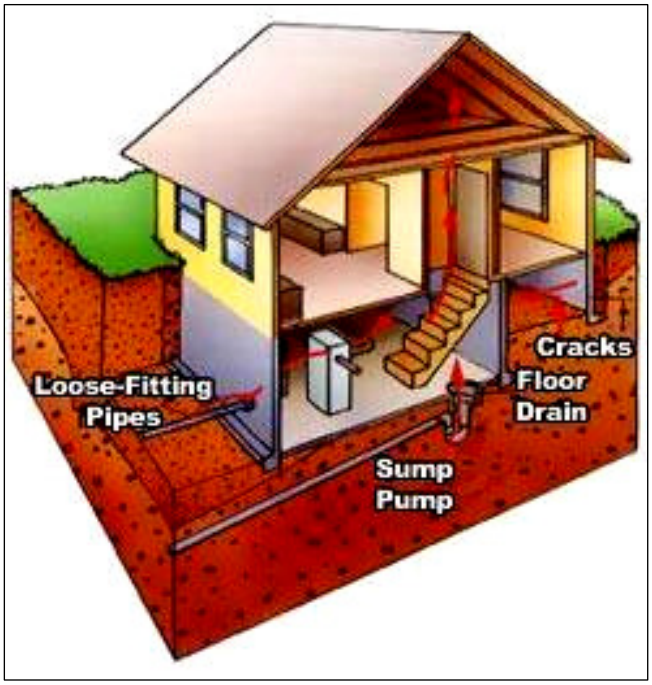
- Identify potential changes and improvements to the Indoor Radon Program at the federal level to improve the effectiveness and efficiency of the program in meeting its short- and long-term goals, as well as identify the challenges or obstacles to employing these potential program changes.

Background

EPA, the National Academy of Sciences, and the U.S. Surgeon General have stated that indoor radon is the second leading cause of lung cancer in America, after smoking. Indoor radon is also the number one cause of lung cancer among non-smokers, according to EPA estimates. In 2005, the Surgeon General warned the American public about the risks of breathing indoor radon by issuing a national health advisory.

Radon is an odorless, tasteless, and invisible gas produced by the decay of naturally occurring uranium present in soil, rock, and water throughout the United States. Because radon, a carcinogen, can collect in the air in homes, it is the public's greatest exposure to naturally occurring radiation. Radon gas can seep into buildings through cracks in floors, walls, and construction joints, or gaps in foundations around pipes, wires, and pumps. Figure 1-1 shows the many paths through which radon gas enters homes.

Figure 1-1: Radon Can Enter Home via Many Paths



Source: U.S. Geological Survey

According to EPA, the concentration of radon measured in a house depends on many factors, including the design of the house, local geology and soil conditions, and the weather. When radon decay occurs in air, the decay products can cling to aerosols and dust, and can then be inhaled into the lungs.

Indoor Radon Exposure Poses Significant Risks to Human Health

EPA estimates that about 20,000 lung cancer deaths each year in the United States are related to indoor exposure to radon. A 1999 report by the National Academy of Science estimated about 15,000 to 22,000 Americans die every year from radon-related lung cancer.[1] This represents from 10 to 14 percent of all persons each year who die from lung cancer in the United States.

Although outdoor concentrations of radon are typically low, averaging about 0.4 picocuries per liter (pCi/L) of air (0.16 to 0.57 pCi/L[2]), it can seep into structures and build up to much higher concentrations indoors. As shown in

[1] *Health Effects of Exposure to Radon: Biological Effects of Ionizing Radiation VI*, Committee on Health Risks of Exposure to Radon, Board on Radiation Effects, Research Commission on Life Sciences, National Research Council, National Academy Press, Washington, DC. 1999.
[2] *National Ambient Radon Study,* Hopper RD, Levy RA, Rankin RC, Boyd MA. 1991. Proceedings of the 1991 EPA International Symposium on Radon and Radon Reduction Technology; Las Vegas, NV; EPA-600/4–9 (pp. 9–79).

Table 1-1 and Appendix A, EPA categorizes U.S. counties into one of three zones based on the predicted average indoor radon level[3] in the area.

Table 1-1: Three Categories of Radon Zones and EPA's Estimate of Risk

Category	Predicted Average Indoor Radon Level	Health Risk Potential
Zone 1	>4.0 pCi/L	Highest
Zone 2	2.0 to 4.0 pCi/L	Moderate
Zone 3	< 2.0 pCi/L	Low

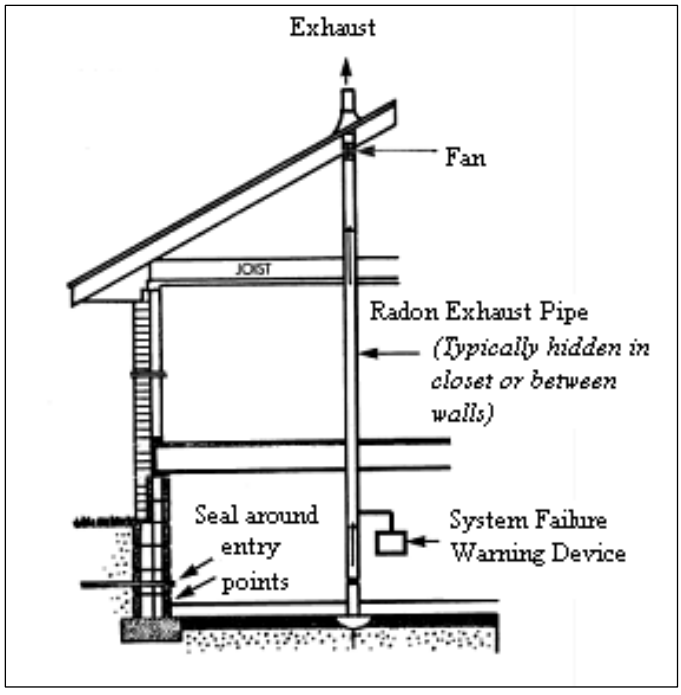
Source: EPA's Radon Website.

Regardless of the radon zone in which a house is located, EPA emphasizes that high radon levels have been found in homes in every zone in the United States. EPA and the Surgeon General recommend testing all homes below the third floor for radon. According to EPA, the average indoor radon concentration is about 1.3 pCi/L of air. However, it is not uncommon for indoor radon levels to be found in the range of 5 to 50 pCi/L. Indoor radon levels have been found as high as 2,000 pCi/L.

EPA Administers Voluntary Program to Address Indoor Radon

EPA's Indoor Environments Division, within the Office of Air and Radiation, administers a voluntary Indoor Radon Program. The program promotes radon awareness, testing, use of radon-resistant new construction (RRNC) techniques, and installation of radon mitigation systems in existing homes. The program promotes mitigation systems when indoor radon levels are above EPA's recommended action level of 4.0 pCi/L of air. According to EPA, the 4.0 pCi/L action level is not the maximum safe level for radon in the home, since any exposure to radon poses some risk.

Figure 1-2: Typical Radon Mitigation System



Source: EPA

[3] EPA uses five factors to determine radon potential: indoor radon measurements, geology, aerial radioactivity, soil permeability, and foundation type. These are discussed further in Appendix A.

Instead, 4.0 pCi/L of air was a decision based on EPA's assessment of technology and cost.[4] Figure 1-2 shows a typical mitigation system.

Generally, a radon mitigation system involves creating a negative field of pressure below the lowest level of the house (slab or crawl space) to prevent the entry of radon gas. A pipe is usually used to channel the air flow from under the house to a safe discharging point above the roofline. A special exhaust fan (radon mitigation fan) is connected to the pipe and used to continuously remove gas from below the house. According to EPA, today's technology can reduce the levels in most homes to 2.0 pCi/L or below. Pre-construction soil testing for radon is not sufficient for determining whether a house should be built radon-resistant. Although radon can be measured in soil, soil testing cannot accurately predict radon levels in the finished home because it cannot predict the impact site preparation will have on introducing new radon pathways or the extent to which a vacuum will be produced by the house.

Testing for indoor radon is largely driven by real estate transactions. EPA's focus on real estate transactions aims to raise the likelihood that the buyer, seller, mortgage lender, and/or real estate agent is aware of indoor radon risks and requests that the home be tested during a sale. EPA also encourages home builders to build new homes with RRNC, as this approach is more cost effective than mitigating an existing home. According to EPA, the cost to install a radon mitigation system in an existing home is relatively inexpensive, and the cost to install radon-resistant features during home construction is even less. However, EPA no longer provides quantitative estimates of costs to mitigate indoor radon.

Authority and Goal of the 1988 Indoor Radon Abatement Act

The authority for EPA's indoor radon activities comes from the 1988 Indoor Radon Abatement Act (IRAA). Although there is no safe level of exposure to radon gas, the goal established by Congress in the 1988 IRAA is clear:

> *The national long-term goal of the United States with respect to radon levels in buildings is that the air within buildings in the United States should be as free of radon as the ambient air outside of buildings.*[5]

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[4] According to EPA's 1992 Technical Support Document for the 1992 Citizen's Guide for Radon, EPA arrived at the level of 4.0 pCi/l by balancing the findings of its technical analysis on risk, testing accuracy, mitigation technology, and cost effectiveness with information it collected from its risk communication outreach. The Technical Support Document stated that lower action levels would introduce more testing uncertainty and that elevated levels of radon can be reduced to 4.0 pCi/l 95 percent of the time. At that time EPA estimated that a level of 2.0 pCi/l could be achieved about 70 percent of the time.

[5] Section 301 of the Toxic Substances Control Act, amended in 1988 to add Title III, Indoor Radon Abatement Act, 15 U.S. Code 2661.

The IRAA authorizes EPA to:

- Issue such regulations as may be necessary to carry out IRAA provisions;
- Administer grants to help States establish radon programs, conduct radon surveys, develop public information on radon, and conduct demonstration and mitigation projects;
- Report on studies of radon in federally-owned buildings;
- Conduct a study of the extent of radon contamination in the Nation's school buildings and report on the results of this study;
- Create a Citizens Guide to radon;
- Develop model construction standards and techniques;
- Establish regional radon training centers;
- Provide technical assistance to States; and
- Establish proficiency programs for firms offering radon-related services.

EPA's Indoor Radon Program Goals and Estimated Lives Saved

EPA's Indoor Radon Program promotes voluntary actions at the State, local, and tribal levels in an effort to achieve two goals:

- Increase the number of homes built with RRNC.
- Increase the number of homes mitigated for indoor radon.

EPA estimated that in 2005 nearly 194,000 additional homes[6] included radon reducing features (i.e., were either constructed with RRNC or mitigated for radon). EPA's goal, as reported to the Office of Management and Budget, is to increase the number of additional homes with radon-reducing features to 380,000 per year in 2012. EPA plans to accomplish this by providing radon information, promoting testing, increasing awareness, and giving to States technical and financial assistance. The Director of the EPA Center for Radon and Air Toxics (within the Indoor Environments Division) called the 2012 goal "very aggressive," as it represents a tripling of the current number of mitigations and doubling current levels of new homes built with RRNC. EPA estimated, based on risk assessments, that:

- The estimated number of homes with radon-reducing features increased from 153,598 during 2000 to 193,996 during 2005.
- The estimated number of lives saved from additional homes having radon-reducing features increased from 369 during 2000 to 577 during 2005.
- The projected number of lives saved from additional homes having radon-reducing features will increase from 645 during 2006 to 1,250 during 2012.

[6] Data provided by EPA only included single family detached homes.

Appendix B provides additional details on those statistics, while Chapter 2 discusses EPA's goals further.

EPA Grants Help Address Indoor Radon Risks

Through its State Indoor Radon Grant (SIRG) program, EPA provides annual grants to States and tribes for indoor radon risk reduction programs. Since 2000, EPA has provided about $62.4 million in such grants via EPA regional offices to address indoor radon. States and tribes are required to provide a minimum of 40 percent matching funds to receive SIRG funds.[7] States and tribes may use SIRG allocations for a variety of purposes, including to:

- Educate consumers, real estate professionals, home inspectors, builders, State and local building code officials, and others;
- Persuade home builders to include RRNC in new homes;
- Encourage local code officials to adopt radon-resistant building codes; and
- Promote testing and mitigation in residential real estate transfers.

In addition, EPA publishes several radon guides for home buyers and sellers, tenants, schools, physicians, home builders, and radon service providers (someone who tests and/or mitigates homes for indoor radon gas).

Noteworthy Achievements

In 2001, the National Academy of Television, Arts, and Sciences selected one of EPA's television public service announcements for a national Emmy Award. The Academy recognized this public service announcement, known as "Take the National Radon Test: Man on the Street," for its efforts to raise awareness of the health effects of radon on the individual and family. The Indoor Radon Program launched a new series of television, radio, and print public service announcements in 2006 and 2007, encouraging people to test and fix their homes for radon. The Agency distributed these radon public service announcements to thousands of television stations, radio stations, and print media outlets across the country, including over 100 real estate trade magazines.

During the course of this evaluation, EPA finalized its State Measures Checklist. The checklist informs State programs of key performance measures, such as estimated number of homes mitigated and estimated number of homes built with RRNC. EPA encourages States to: (1) align their SIRG program activities with the Agency's strategic goals; and (2) demonstrate and report results. EPA also developed a required reporting template and guidance for States to use for Fiscal Year 2007. Data collected through the template could assist the Agency in

[7] The statutory match was 50 percent for States participating in the third year and beyond. In an effort to encourage greater State participation, the matching requirement was reduced to 40 percent in the 2006 EPA appropriation.

rewarding better performing State programs with a greater share of SIRG funds in the future.

Scope and Methodology

We conducted our field work from February through December 2007. We conducted this performance evaluation in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the evaluation to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our evaluation objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our evaluation objectives. Appendix C describes our scope and methodology in more detail, including information on prior reports, data limitations, and management control review.

Chapter 2
Risk of Exposure to Indoor Radon Grows Substantially Despite EPA's Efforts

After nearly two decades of effort, potential exposure to indoor radon continues to grow. As more homes have been built, efforts to reduce exposure through mitigation or building with RRNC have not kept pace. Of an estimated 6.7 million new single family detached homes built nationwide between 2001 and 2005, only about 469,000 incorporated radon-resistant features, or about 7 percent. Inconsistencies in radon requirements among State and local governments and a lack of incentives for key stakeholders to take voluntary actions limit EPA's ability to achieve greater results. Federal agencies have opportunities to reduce radon risks at housing they finance, underwrite, control, or own. Further, EPA has not exercised all the authorities granted to it by the 1988 IRAA. Due to insufficient progress, each year EPA falls further behind in achieving the IRAA long-term goal that indoor radon levels be no higher than outdoor levels.

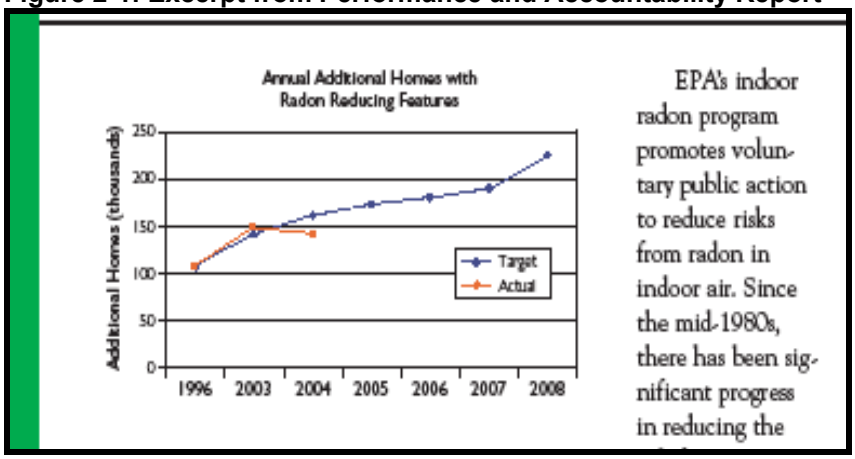
Problem of Exposure to Indoor Radon Grows Larger Each Year

As shown in Figures 2-2 and 2-3 below, the problem of indoor radon exposure increased each year from 2001 to 2005. The number of RRNC actions and mitigations did not keep pace with the number of new homes built nationwide. The Agency's 2006 Performance and Accountability Report stated that:

> *Since the mid-1980s, there has been significant progress in reducing the risk from exposure to radon in homes.*

However, it is difficult to substantiate this claim because the radon performance data in the Fiscal Year 2006 Performance and Accountability Report were reported without a meaningful baseline for comparison. Instead, as indicated in Figure 2-1, the results in this annual report were reported as the absolute number of new homes built with RRNC and existing homes that were mitigated for radon. These results were reported without any mention of the relationship of these numbers to the magnitude of the problem (i.e., the numbers of homes at risk).

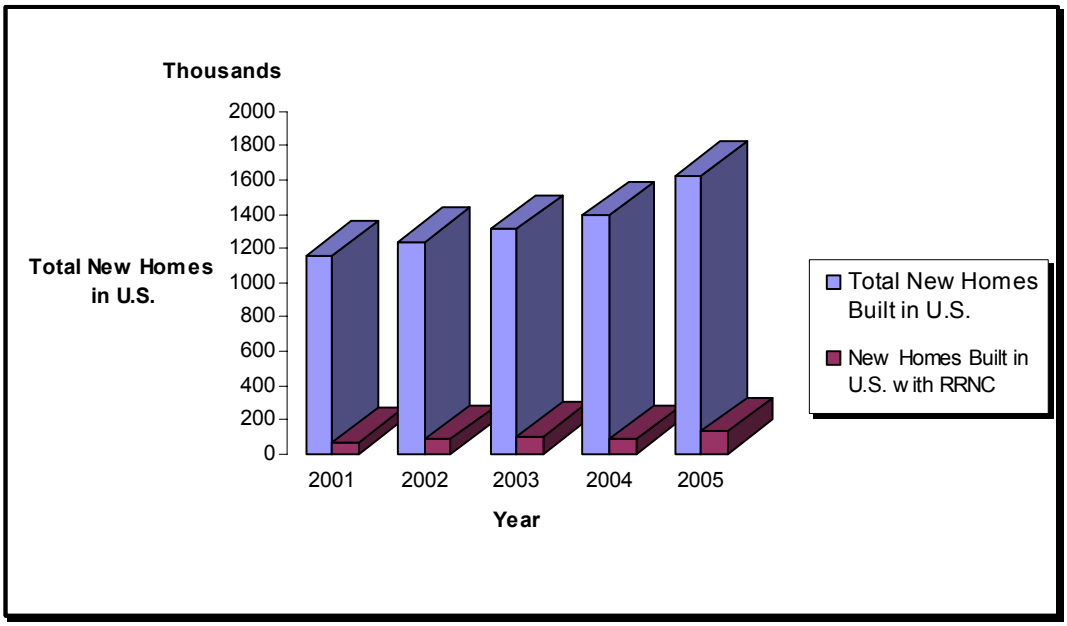
Figure 2-1: Excerpt from Performance and Accountability Report



Source: EPA's Fiscal Year 2006 Performance and Accountability Report

Of an estimated 6.7 million new single family detached homes built nationwide between 2001 and 2005, only about 469,000 incorporated radon-resistant features, or about 7 percent.[8] As shown in Figure 2-2, the number of homes built with RRNC compared to all homes at risk shows that the potential for indoor radon problems continues to grow each year.

Figure 2-2: Total New Homes Built Nationwide Compared to Number of New Homes Built Nationwide with RRNC Features, 2001 to 2005

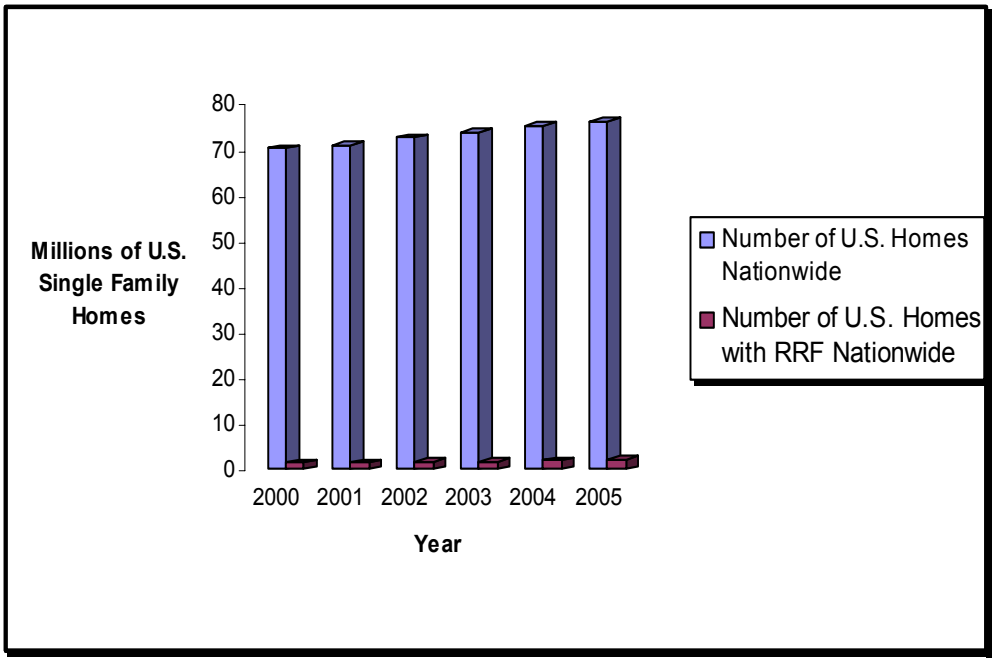


[a] In 2004, EPA began to exclude "Rough-in for Sub-Slab Ventilation" from qualifying as a radon-reducing system. This explains the drop in RRNC between 2003 and 2004.
Source: OIG analysis of National Association of Home Builders data for total new housing starts and estimated total homes built with RRNC information provided by EPA's Indoor Radon Team (see Appendix D, Table D-1 for data).

[8] Based on OIG analysis of National Association of Home Builders data for housing starts and estimated total homes built with RRNC information provided by EPA's Indoor Radon Team.

Of more than 1.5 million new single family detached homes built in high radon-potential Zone 1 areas between 2001 and 2005, less than 282,000 (or 18.4 percent) incorporated radon-resistant features. Nationwide, after 17 years, only about 2.1 million of 76.1 million single family homes in the United States (2.8 percent) had radon-reducing features in place as of 2005. EPA estimates that about 5.1 million homes (6.7 percent) have indoor radon levels above EPA's recommended action level of 4.0 pCi/L. The other 71 million homes are not necessarily safe – they are just estimated to be below the 4.0 pCi/L level.[9] As shown in Figure 2-3, the number of existing homes that have undertaken actions to mitigate indoor radon gas is also significantly less than the total number of homes.

Figure 2-3: Number of Single Family Homes and Number with Radon-Reduction Features (RRF), 2000 to 2005



Source: OIG analysis of U.S. Census Bureau data on homes and gross annual radon fan sales data supplied by fan manufacturers to EPA's Indoor Radon Team.

Appendix D provides details on the number of new homes built with RRNC features nationwide, the number in Zone 1 areas, the number of existing homes at risk, and the number with radon-reducing features.

The Executive Director of the American Association of Radon Scientists and Technologists told us that the rate of radon mitigation and testing is so slow that the efforts are not even keeping up with new construction rates. He pointed out that the nation is building more homes in radon problem areas at a faster pace than testing and mitigations are taking place in existing homes. Therefore, an

[9] See Footnote 4.

even larger radon exposure problem is being created in the country over time, not a lesser problem.

Concerns that the Agency's voluntary strategy could not achieve the long-term IRAA goals had been identified previously. A 1997 EPA OIG report[10] on voluntary programs concluded that voluntary programs can be an effective tool, but they rely heavily on outside organizations in reducing risks. Consequently, voluntary programs must use good management practices, including educating people about incentives, providing quality support, obtaining commitments, and evaluating progress and making adjustments. Still, the report noted good management practices do not guarantee success. Data for 2000 to 2005 show that only limited results have been achieved in reducing radon risks with EPA's voluntary program. Also, a 1992 U.S. Government Accountability Office report[11] stated:

> *Because of the influence federal housing agencies and federally chartered secondary mortgage institutions have on the housing industry, requiring them to address radon could stimulate radon testing for the nation's homes.*

Inconsistencies and Lack of Incentives Limit EPA's Ability to Achieve Greater Results

Since the 1988 IRAA, EPA has administered a voluntary program to reduce exposure to indoor radon by promoting awareness, testing, installation of radon mitigation systems in existing homes, and use of RRNC techniques in new homes. However, inconsistencies in radon-related requirements among State and local governments, a lack of incentives, and misuse of the radon map limit EPA's ability to achieve greater results with a voluntary program. Details follow.

Adoption of Radon Codes and Regulations Inconsistent

EPA has partnered with some federal and State governmental and non-governmental agencies to promote radon-resistant construction of new homes and encourage radon testing when existing homes are sold. However, codes and regulations for indoor radon vary widely between locations. Some States and localities have not adopted radon building codes,[12] while others have done so. These codes include disclosure of indoor radon test results during real estate transactions, the required use of RRNC in homes built in certain areas, and/or

[10] *Risk Reduction Through Voluntary Programs,* EPA OIG Rpt. No. 7100130, April 21, 1997.
[11] *Actions to Promote Radon Testing,* GAO/RCED-93-20, December 1992.
[12] Because EPA does not maintain current data of areas where builders are required to use RRNC or which States require radon service providers to be certified, we were unable to quantify the number of States that require such measures.

certification requirements for radon service providers. Some States only require that radon be listed along with a list of other potential environmental hazards.

Although we did not contact State and local agencies, we discussed State and local radon codes and requirements with the radon staffs of 4 of EPA's 10 regional offices (Regions 2, 4, 7, and 9). Region input confirmed that radon disclosure policies for real estate transactions vary widely between areas. For example, some areas require that the test results be disclosed if a radon test has been performed, while in other areas radon disclosure is voluntary.

Lack of Incentives for Key Stakeholders to Voluntarily Adopt Indoor Radon Policies and Practices

EPA relies on voluntary actions by key stakeholders such as real estate agents, home buyers and sellers, home builders, and home inspectors, to reduce the public's exposure to indoor radon.[13] However, there are disincentives for key stakeholders. According to EPA, much of the progress made over the past 15 years can be attributed to EPA's collaboration and partnerships with States, the radon business community (radon industry, training centers), and other non-governmental entities. Nonetheless, more can be done.

Real Estate Agents and Sellers

According to the Associate General Counsel of the National Association of Realtors,[14] testing for radon and/or disclosing test results during a real estate transaction adds an additional layer to an already taxing house buying process. This has created a disincentive for real estate agents and sellers to bring up radon issues during a sale. The representative said radon is not a high priority in many real estate transactions, and adding another step to the transaction process could be "a negative." Instead, he stated that the Association's position is that radon is a public health issue that individuals should be concerned about irrespective of an impending real estate transaction. He noted that in areas where radon is known to be a problem, it may be beneficial for a seller to obtain a test in advance of putting the home on the market so that results are known to buyers.

Radon testing by the seller, while not commonly undertaken, can also be problematic. Due to an inherent potential conflict of interest, sellers may have little motivation to obtain accurate results or follow the appropriate

[13] According to EPA, the bulk (85%+) of the testing/mitigation activity is real estate driven (buying, selling, and relocation primarily). However, some limited amount of "do-it-yourself" testing is done by sellers who test their homes in preparing to sell, and by homeowners/renters concerned about their family's health.

[14] "Realtor" is a trademarked term describing a member of the National Association of Realtors, which claims over one million members. The generic term for a member of the profession is generally a real estate agent or professional.

radon testing protocols. The testing process itself takes time and can create a potential snag in negotiations.

Home Builders

While EPA has indicated the cost to build a new home radon resistant is relatively low, home builders have a financial incentive to keep building costs as low as possible. The Director of the Market Research Division for the National Association of Home Builders told us that there are many hazards in the home, not all of which could be affordably addressed by builders. He told us home builders prefer an approach outlining prescribed techniques that would allow them to satisfy due diligence in constructing a home. He further stated there may be situations where builders might not be able to get the indoor air quality below the EPA-recommended action level.

The International Residential Code – the building code used to guide home construction at the State or local level in 45 States and the District of Columbia – does not require RRNC as a standard part of the code. RRNC techniques are only included in the International Residential Code's appendix and are optional.

Home Inspectors and Radon Service Providers

Home inspectors and radon service providers who test and mitigate homes could have a financial incentive to perform services. However, we were told by two leading home inspection trade organizations that it is often difficult to make a profit from these services, due to several factors:

- The radon tester must, at a minimum, coordinate two trips to a home site – to set up and later retrieve a test kit. Accurate test results also rely upon the test materials remaining undisturbed for the duration of the test. For example, windows cannot be opened and doors must be kept closed (except for normal entry and exit). Keeping test materials undisturbed is a condition frequently violated. Multiple visits are sometimes needed because the testing process must be repeated. Repeat tests are sometimes conducted at the expense of the radon service provider.

- Lack of certification requirements within a State can undermine the profitability of legitimate, certified radon service providers. Unqualified and/or untrained providers can operate at lower costs, and increase the risk of inaccurate testing or mitigation systems that do not work. Home inspectors said improperly installed and working mitigation systems were not uncommon. Also, according to the American Association of Radon Scientists and Technologists, the cost often quoted in radon publications for

testing and mitigating homes may understate the true cost. As such, it is difficult for some radon service providers to recover their actual costs for proper radon testing and mitigation.

- Obtaining and maintaining professional certification(s) to perform radon-related services can be relatively expensive. Radon testers and service providers can incur hundreds of dollars in initial and annual expenses for certification courses and exams, required continuing education classes, and organizational membership fees.

Properly conducted, radon testing takes hours of work. Yet, as the program is currently implemented, it is not economically viable for legitimate radon service providers in some cases. Thus, there are disincentives for home inspectors to offer radon services.

Radon Zone Map Sometimes Misused

Another factor contributing to difficulty in achieving the long-term radon goal is misuse of EPA's radon zone map. This map (see Appendix A), created in 1993, classifies areas of the United States into three radon-potential zones. EPA intended the map to be used by State and local agencies and national organizations to target their resources in higher radon-potential zones and to implement radon-resistant building codes where they were most needed. However, EPA has consistently recommended that all homes be tested for radon because this is the only way to know whether radon is at an elevated level. EPA's radon Website warns that the map was not intended to determine if a home in a given zone should be tested, and homes with elevated levels of radon have been found in all three zones. However, regional representatives and the Executive Director of the American Association of Radon Scientists and Technologists (which represents radon service providers), said the map is often used as a "risk" map to determine whether certain homes should be tested and/or built with RRNC. According to EPA, being in a "high risk" zone is only one of several factors used to determine allocation of SIRG funds to individual States.

Resources Limited for Achieving Indoor Radon Program Goals

EPA Headquarters and regional representatives told us they would like to do more in terms of radon outreach, education, and other key program activities, but resource constraints have prevented them from doing more. EPA's Indoor Environments Division Director said the States' primary source of funding for the radon program is SIRG money. This money is allocated to the regional offices for distribution to States and tribes. Authorized annual appropriations have been $10 million; however, actual appropriations have been less. Table 2-1 shows the funding for the SIRG program from Fiscal Years 2000 to 2007. In addition to SIRG funds, EPA Headquarters had about $1 million in 2006 for discretionary money that it used to conduct outreach and media campaigns.

Table 2-1: Annual Funding for SIRG Grants

Fiscal Year	EPA Funding for SIRG Grants
2000	$ 8,158,000
2001	8,139,900
2002	8,139,900
2003	8,087,000
2004	8,101,900
2005	6,944,100
2006	7,439,000
2007	7,439,000

Source: EPA Office of Radiation and Indoor Air

In 2007, EPA asked States and tribes to estimate the amount of additional resources they believed they could reasonably use while also meeting the required 40-percent matching funds. The 47 States and 7 tribes that responded told EPA they could use about $15.6 million more in SIRG funds.[15] This is more than double the $7.4 million in SIRG funds EPA allocated in Fiscal Year 2007. As discussed in the "Noteworthy Achievements" section in Chapter 1 of this report, EPA in 2007 created a required reporting template for States to use in reporting what they achieved with their radon grant funds. Data collected through this template could assist the Agency in rewarding better-performing State programs with a greater share of SIRG funds in the future.

EPA has six to seven full-time equivalent positions dedicated to indoor radon at the Headquarters level. EPA regional representatives we contacted said regional radon programs are typically administered by one to three staff, with most staff sharing time between radon and other indoor air issues (such as asthma or environmental tobacco smoke).

Opportunities Exist for Federal Community to Increase Radon Testing and Mitigations

Opportunities exist within the federal community to substantially reduce public health risk by having homes tested and mitigated for radon. Housing financed, underwritten, controlled, or owned by federal departments and agencies represent a significant number of homes that could be tested, mitigated, or built radon resistant. Examples of such federal organizations include the Department of Housing and Urban Development, Department of Defense, Department of

[15] EPA called this informal exercise the "Blue Sky" exercise; the estimate was based on Fiscal Year 2007 program investment and presumption of the current 60/40 match requirement (60 percent Federal, 40 percent States/tribes). EPA does not know whether all estimates were approved by management; however, the estimates were provided by individuals most familiar with their State program's capability/capacity, according to the Indoor Radon Team.

Veterans Affairs, and Department of Agriculture. (We did not solicit input from these organizations for our report).

Government-sponsored enterprises such as the Federal Home Loan Bank System, Federal Home Loan Mortgage Corporation (also known as Freddie Mac), and Federal National Mortgage Association (also known as Fannie Mae) represent the largest source of housing finance in the United States. The construction of new homes financed or underwritten by these and other federal departments and agencies present a substantial opportunity to increase the number of homes built with RRNC or mitigated for radon. In January 2005, the Federal Environmental Executive in the Office of the Federal Environmental Executive (a White House-based office) stated that:

> *Based on national averages, we can expect that many of the homes owned or financed by federal government programs would have potentially elevated radon levels. The federal government has an opportunity to lead by example on this public health risk. We can accomplish this by using the outreach and awareness avenues we have, such as EPA's Web site, to share information and encourage action on radon to reduce risks.*

According to EPA's Indoor Environments Division Director, EPA has worked over the years with other federal agencies to promote radon reduction policy as part of their residential real estate portfolios. Although several agencies have acted in one way or another to address radon, more could be done to institutionalize policies to increase radon awareness, testing, and mitigation by the general public, according to EPA. For internal purposes, EPA staff in 2004 prepared a conceptual document listing several possible actions the federal community might take to increase action on radon in federal housing programs. For any housing financially underwritten by the federal government, the staff-identified actions included:

- Providing radon information to home mortgage applicants at the time of application;
- Ensuring subsidized homes are built with RRNC; and
- Ensuring that existing homes are tested for radon and, if appropriate, mitigated.

According to EPA, implementing these actions might involve such complex undertakings as executive orders, Office of Management and Budget (OMB) bulletins, or even regulations.

EPA chose to focus its radon program on working with States, industry, and non-governmental organizations to take actions voluntarily, rather than with other federal agencies, on more complex undertakings. EPA has continued to promote radon awareness and action among members of the federal community through

such venues as the Federal Interagency Committee on Indoor Air Quality, the Office of the Federal Environmental Executive, and interagency working groups and forums devoted to healthy homes and green buildings.

Existing Statutory Authority Could Be Used to Achieve Radon Goals

Although the 1988 IRAA does not require EPA to issue regulations to address indoor radon, it does not *prohibit* EPA from doing so either. Congress authorized the EPA Administrator in Section 310 "to issue such regulations as may be necessary to carry out" the provisions of the IRAA. To date, 19 years after the IRAA was enacted, EPA has not proposed any indoor radon regulations.

In the nearly two decades since passage of the IRAA, exposure to indoor radon has grown annually. Homes continue to be built in high radon-potential areas without installation of radon reducing features. According to EPA, there are technical and policy limitations on the ability to attain levels of 0.4 pCi/L for indoor air (the average level for outdoor air) at an affordable cost. Nonetheless, EPA needs to consider using the full extent of the authorities authorized by Congress to achieve the goal specified in the IRAA or explain its alternatives. Agency officials noted the scope and limits of this authority have never been tested.

Conclusions

As currently designed and implemented, EPA's voluntary indoor radon program has not achieved the goals envisioned in the IRAA. In fact, the number of homeowners potentially exposed to excessive radon has increased each year. Multiple factors contributed to the limited progress made, including disincentives for real estate agents, home inspectors, and home sellers to conduct radon tests during real estate transactions. Disincentives also exist for builders to voluntarily build homes using radon-resistant techniques. Given the Agency's limited progress from its voluntary approach for the past 19 years, it is time for the Agency to consider other means to achieve the 1988 IRAA goal. EPA should assess how it can use the authorities granted in the law to achieve long-term IRAA goals or identify alternatives for achieving the desired results.

Recommendations

We recommend that the Principal Deputy Assistant Administrator for Air and Radiation:

2-1 Develop a strategy for achieving the long-term goal of the IRAA by considering using the authorities authorized by Congress under Section 310 of that Act, or explain its alternative strategy.

2-2 Identify limitations in the authorities authorized by Congress, as well as other limitations that would preclude achieving the long-term IRAA goal, and report these limitations to Congress as appropriate.

2-3 Revise the Agency's performance measuring data to include metrics that will better measure the magnitude of the potential radon problem in relation to the number of homes at risk.

2-4 Revise how the Agency reports the Indoor Radon Program results in EPA's Annual Performance and Accountability Report.

Agency Comments and OIG Evaluation

The Agency agreed with Recommendation 2-1. The Agency agreed to develop a strategy as recommended by the OIG in the context of EPA's available approaches, authorities, and resources. EPA also noted that the level of radon in outdoor air averages about 0.4 pCi/L. The Agency said that radon mitigation methods currently available can significantly reduce the public's exposure to radon from high levels to appreciably lower levels, well below EPA's recommended action level of 4 pCi/L in many cases. However, the Agency said it cannot typically or reliably achieve a level so low as 0.4 pCi/L in a given dwelling, and certainly not in all dwellings. EPA stated that it lacks technologically or economically feasible ways to meet the statutory goal. However, the Agency acknowledged that greater progress to reduce public-health risk from radon is needed and possible. The Agency also stated that before EPA can begin strategizing about how the regulatory authority offered by Section 310 might be utilized to meet the statutory goal, EPA must address the physical and technological limitations to achieving the national goal. We accept that the Agency's voluntary program has contributed to slowing the rate of growth in exposure, but each year EPA gets further away from – not closer to – its goal of protecting the public from indoor radon levels above EPA's action level of 4.0 pCi/L. EPA's position that the goal is unachievable, coupled with results showing an expanding radon problem, calls for more than continuing the same strategy. We believe that EPA needs to consider using all the authorities the statute grants and describe how it will achieve the long-term goal of the statute. The recommendation will remain open until the Agency action plan is completed.

The Agency disagreed with Recommendation 2-2. While EPA agrees that the problem of radon exposure gets worse each year, it did not agree to notify Congress that the goal set by the statute is unachievable. Since the Agency believes that the goal is unachievable, it should report this to Congress along with the limitations that preclude the Agency from achieving better results. As stated in the Agency's response, radon mitigation methods currently available can significantly reduce the public's radon exposure from high levels to appreciably lower levels, well below EPA's action level of 4.0 pCi/L in many cases. EPA also said that it plans to conduct a strategic review of its radon program to include

the rationale and strategy for achieving any alternative to the long-term goal of the IRAA. In our view EPA needs to seek Congress' approval of any alternate long-term goal. The Agency's response was not responsive to the recommendation. We consider this issue open and unresolved.

The Agency agreed with Recommendation 2-3. The Agency said that tracking radon risk reduction in relation to total homes at risk is another useful way to measure progress. The recommendation will remain open until the Agency action plan is completed.

The Agency agreed with Recommendation 2-4. The Office of Air and Radiation (OAR) committed to pursue this change in annual reporting with the Office of the Chief Financial Officer and OMB and, if approved, to revise how the Agency reports the Indoor Radon Program results in its Annual Performance and Accountability Report. If the proposed performance measure is not approved, in our opinion there are other reports where the measure could be published, such as prominently displaying this on the Agency's Indoor Radon Website. The recommendation will remain open until the Agency action plan is completed.

The Agency's complete written response is in Appendix E. Our evaluation of those comments is in Appendix F.

Status of Recommendations and Potential Monetary Benefits

RECOMMENDATIONS						POTENTIAL MONETARY BENEFITS (in $000s)	
Rec. No.	Page No.	Subject	Status[1]	Action Official	Planned Completion Date	Claimed Amount	Agreed To Amount
2-1	17	Develop a strategy for achieving the long-term goal of the IRAA by considering using the authorities authorized by Congress under Section 310 of that Act, or explain its alternative strategy.	O	Principal Deputy Assistant Administrator for Air and Radiation			
2-2	18	Identify limitations in the authorities authorized by Congress, as well as other limitations that would preclude achieving the long-term IRAA goal, and report these limitations to Congress as appropriate.	U	Principal Deputy Assistant Administrator for Air and Radiation			
2-3	18	Revise the Agency's performance measuring data to include metrics that will better measure the magnitude of the potential radon problem in relation to the number of homes at risk.	O	Principal Deputy Assistant Administrator for Air and Radiation			
2-4	18	Revise how the Agency reports the Indoor Radon Program results in EPA's Annual Performance and Accountability Report.	O	Principal Deputy Assistant Administrator for Air and Radiation			

[1] O = recommendation is open with agreed-to corrective actions pending
C = recommendation is closed with all agreed-to actions completed
U = recommendation is undecided with resolution efforts in progress

Appendix A

EPA's Map of Radon Zones

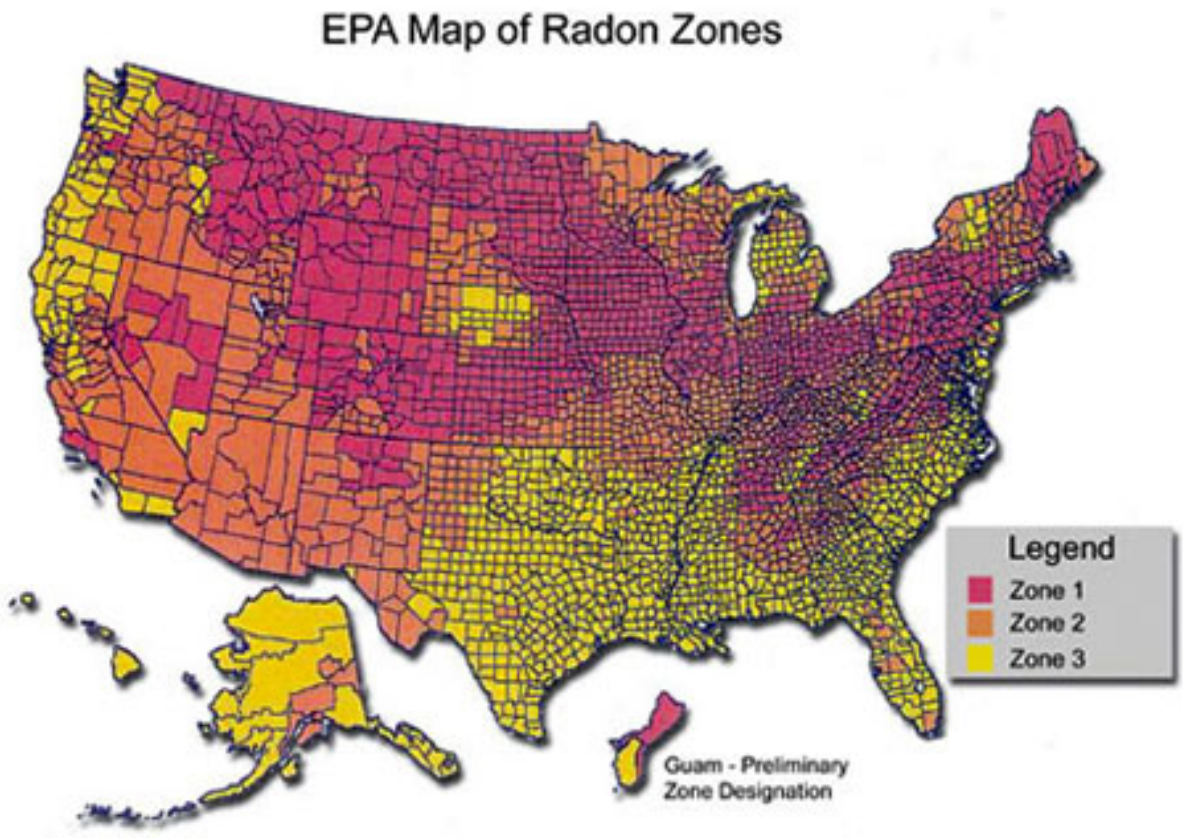
The purpose of this map is to assist national, State, and local organizations in targeting their resources and implementing radon-resistant building codes. This map is not intended to be used to assess risk in any given area, nor is it to be used to determine if a home in a given zone should be tested for radon. Homes with elevated levels of radon have been found in all three zones. Important points to note:

- **All homes should test for radon**, regardless of geographic location or zone designation.
- There are many thousands of individual homes with elevated radon levels in Zones 2 and 3. In addition to Zone 1, elevated levels can be found in Zone 2 and 3 counties.
- All users of the map should carefully review the map documentation for information on within-county variations in radon potential and supplement the map with locally available information before making any decisions.
- **The map is not to be used in lieu of radon testing during real estate transactions.**

The map was developed using five factors to determine radon potential: indoor radon measurements, geology, aerial radioactivity, soil permeability, and foundation type. Radon-potential assessment is based on geologic provinces.

Sections 307 and 309 of the IRAA of 1988 directed EPA to list and identify areas of the United States with the potential for elevated indoor radon levels. EPA's Map of Radon Zones assigns each of the 3,141 counties in the United States to one of three zones based on radon potential:

	Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L (red zones)	Highest Potential
	Zone 2 counties have a predicted average indoor radon screening level between 2 and 4 pCi/L (orange zones)	Moderate Potential
	Zone 3 counties have a predicted average indoor radon screening level less than 2 pCi/L (yellow zones)	Low Potential



Source: EPA Website

Appendix B

EPA Radon Program Goals and Progress Toward Achieving Goals

Year	EPA Goal - Additional Homes with Radon Mitigations and New Home RRNCs	Estimated Additional Homes with Radon Reducing Features[2]	Estimated Number of Lives Saved from Additional Homes with Radon-Reducing Features[3]	Projected Number of Lives Saved from Additional Homes with Radon-Reducing Features
2000	---[1]	153,598	369	---
2001	---[1]	97,205	395	---
2002	---[1]	126,801	430	---
2003	149,000	145,620	471	---
2004	162,000	143,182	519	---
2005	173,000	193,996	577	---
2006	180,000	---	---	645
2007	190,000	---	---	715
2008	225,000	---	---	795
2009	265,000	---	---	890
2010	280,000	---	---	995
2011	330,000	---	---	1,110
2012	380,000	---	---	1,250

[1] EPA did not include estimated goal information for 1997 to 2002 in its report to the Office of Management and Budget nor in its Fiscal Year 2006 Performance and Accountability Report.

[2] EPA estimated additional homes with radon reducing features by (1) collecting data annually on the number of new homes built with radon-resistant features based on annual surveys of homebuilding practices conducted by the National Association of Home Builders Research Center, and (2) collecting data annually on the number of existing homes mitigated for elevated radon levels based on radon mitigation fan sales data obtained through voluntary reporting by the fan manufacturers.

[3] EPA's Indoor Radon Team's corrected figures to EPA's Fiscal Year 2006 Performance and Accountability Report.

Source: OIG-developed table from data provided in the Measure Implementation Plan that EPA submitted to the Office of Management and Budget for the Program Assessment Rating Tool review (annual goals starting with 2003) and estimated actual information provided by the EPA's Indoor Radon Team.

Appendix C

Details on Scope and Methodology

Our evaluation focused on the Indoor Environments Division within EPA's Office of Air and Radiation, Office of Radiation and Indoor Air, located in Washington, DC. In addition, we interviewed managers and staff from EPA Regions 2 (New York), 4 (Atlanta), 7 (Kansas City), and 9 (San Francisco) regarding various issues throughout the review. These regions and their staff were recommended by EPA's Indoor Radon Team. We also interviewed representatives of the following non-government stakeholder groups: the National Association of Home Builders, the National Association of Realtors, the American Society of Home Inspectors, the National Association of Certified Home Inspectors, and the American Association of Radon Scientists and Technologists. We also reviewed materials provided by the American Radon Policy Coalition.

To determine how EPA measures indoor radon program results and whether changes at the federal level could improve program effectiveness, we reviewed documents and studies related to indoor radon. These included:

- The National Academy of Sciences' 1999 report, *Biological Effects of Ionizing Radiation VI Report: The Health Effects of Exposure to Indoor Radon*.
- EPA public information and consumer pamphlets regarding indoor radon, including EPA's use of the U.S. Geological Survey's radon-potential map.
- Relevant EPA and U.S. Surgeon General Websites and publications, including television, radio, and print media public service announcements.
- EPA's *National Residential Radon Survey: Summary Report*.
- Results of an Office of Management and Budget Program Assessment Rating Tool on EPA's Indoor Air Program.
- EPA's Annual Performance and Accountability Report(s).
- EPA's congressional justification(s).
- Summary reports containing performance data used by the Agency to measure progress toward its Indoor Radon Program goals.

We also examined EPA's State Indoor Radon Grant Program Website, the SIRG Results Measures Template, the SIRG State Measures Hierarchy, and the State Measures Template Checklist.

To identify potential changes and improvements to the Indoor Radon Program at the federal level and challenges to implementing potential program changes, we discussed these issues with the aforementioned EPA and key non-governmental stakeholder groups.

Review of Management (Internal) Controls

Generally accepted government auditing standards require that auditors obtain an understanding of internal controls significant to the audit objectives and consider whether specific internal control procedures have been properly designed and placed in operation. We examined management and internal controls as they related to our objectives. We reviewed the laws that impact indoor radon and EPA's authority related to indoor radon with assistance from the OIG Office of Counsel. We focused on the responsibilities and authorities that EPA has to protect human health from exposure to indoor radon, including the extent to which EPA has statutory authority to develop a regulatory-based program. We reviewed the policies and procedures, performance measures, and reporting requirements that EPA has established to carry out its voluntary indoor radon program. We reviewed results of an Office of Management and Budget Program Assessment Rating Tool for the Indoor Air Program. We also reviewed analytical, documentary, and testimonial evidence from EPA's Indoor Environments Division and EPA Regions 2, 4, 7, and 9. Chapter 2 identifies findings and recommendations where EPA can improve its management of the Indoor Radon Program.

Limitations

We did not verify the accuracy of EPA data, including EPA performance data. EPA collects two sets of performance data annually, both of which depend on voluntary reporting. First, EPA collects data on the number of new homes built with radon-resistant features. This data is based on a voluntary survey of homebuilding practices conducted by the National Association of Home Builders Research Center. In 2005, this survey only achieved a 4.5-percent response rate. Second, EPA collects data on the number of existing homes mitigated for elevated radon levels. This data is based on radon mitigation fan sales data obtained through voluntary reporting by fan manufacturers. Radon mitigation fans have an estimated life of 10 years. When estimating the number of new radon mitigations annually in existing homes, the data from fan manufacturers is adjusted based on the assumption that previously-installed radon mitigation systems will have their fans replaced once every 10 years. Since these were voluntary measures, we could not independently verify EPA's calculation of the number of new homes built with radon-resistant features, number of existing homes mitigated for elevated radon levels, and estimated future premature cancer deaths prevented.

We also did not perform a detailed analysis of the accuracy of the assumptions EPA used to develop these estimates. We did not review the accuracy of indoor radon tests or mitigation systems, or how well RRNC features are installed. We interviewed 4 of the 10 regions and did not interview State or local officials. We did not interview representatives of other federal agencies that are involved in the housing market or solicit input from them.

Prior Reports

Neither the EPA OIG nor the Government Accountability Office (GAO) has issued any recent reports that addressed EPA actions related to indoor radon. The EPA OIG issued a 1997 report, *Risk Reduction Through Voluntary Programs* (Report No. 7100130, April 21, 1997) that discussed management practices that worked well and areas where improvements were needed in

voluntary programs, including indoor radon. GAO's most recent report that addressed indoor radon was issued in 1992. We reviewed the following GAO reports:

- GAO/RCED-88-103 - April 6, 1988, *Indoor Radon: Limited Federal Response to Reduce Contamination in Housing*
- GAO/T-RCED-91-48 - May 1991, *Radon Testing in Federal Buildings Needs Improvement and HUD's [Department of Housing and Urban Development's]Radon Policy Needs Strengthening*
- GAO/RCED-92-8 - October 1991 - *Indoor Air Pollution Federal Efforts Are Not Effectively Addressing a Growing Problem*
- GAO/RCED-93-20 - December 1992 - *Actions to Promote Radon Testing*

Appendix D

Summary of Homes at Risk and with Radon Reduction Features

Table D-1: Total Homes Built Compared to Total Number of Homes Built With RRNC (Single Family Detached)

Year	Total New Housing Starts in U.S.	Total New Homes Built with RRNC in U.S.	Percent of Total New Homes Built with RRNC
2001	1,159,000	65,205	5.6 %
2002	1,239,000	87,001	7.0 %
2003	1,311,000	100,620	7.7 %
2004[a]	1,392,000	85,182	6.1 %
2005	1,626,000	130,996	8.1 %
Total	**6,727,000**	**469,004**	**7.0 %**

[a] In 2004, EPA began to exclude "Rough-in for Sub-Slab Ventilation" from qualifying as a radon-reducing system. This explains the drop in RRNC between 2003 and 2004. For Rough-in for Sub-Slab Ventilation only the sub-slab pipe is installed and the vent pipe is stubbed above the slab. This is not the recommended method. It is not a functioning system until vented to the outside.

Source: OIG analysis of National Association of Home Builders data for total new housing starts and estimated total homes built with RRNC information provided by EPA's Indoor Radon Team.

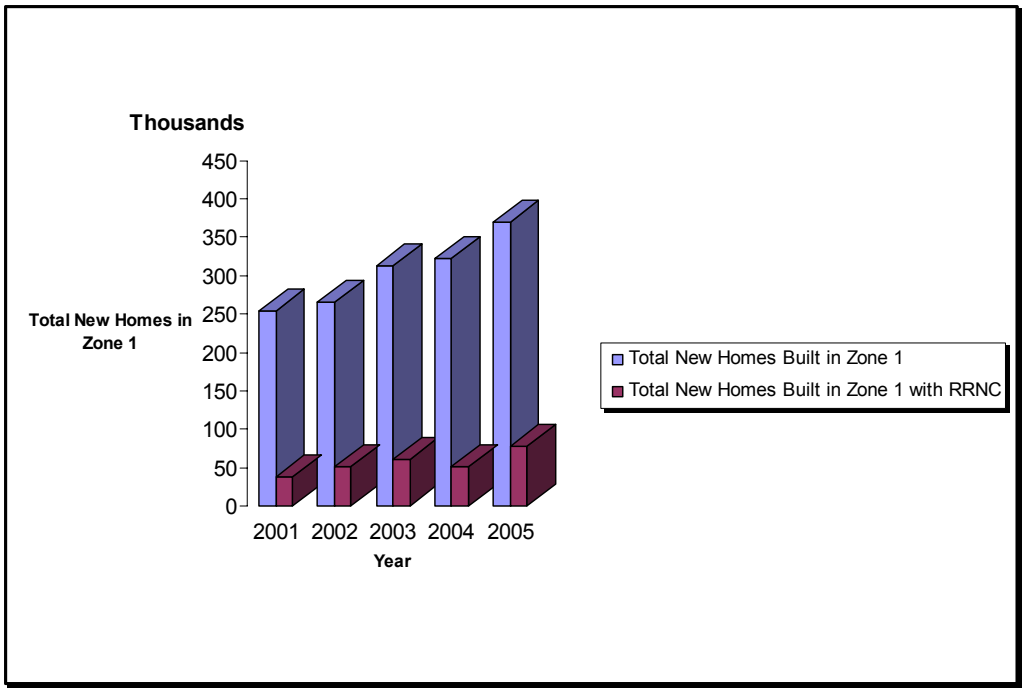
Table D-2: Homes Built in High Radon-Potential Zone 1 Compared to Number of Homes Built With RRNC in Zone 1 (Single Family Detached)

Year	New Housing Starts in High Radon-Potential Zone 1 Only	Total New Homes Built with RRNC In Zone 1 [a]	Percent of Total New Homes Built with RRNC in Zone 1
2001	255,000	39,123	15.3%
2002	266,000	52,201	19.6%
2003	313,000	60,372	19.3%
2004[a]	323,000	51,109	15.8%
2005	370,000	78,597	21.2%
Total	**1,527,000**	**281,402**	**18.4%**

[a] EPA estimates that 60 percent of all homes built with RRNC are in Zone 1.

Source: OIG analysis of National Association of Home Builders data for new starts in Zone 1 and estimated total homes built with RRNC information provided by EPA's Indoor Radon Team.

Figure D-1: Total New Homes Built In Zone 1 Areas Compared to Number of New Homes Built with RRNC Features In Zone 1 Areas, 2001 to 2005



[a] New homes built with RRNC in Zone 1 is based on EPA's estimate that 60 percent of all homes built with RRNC are in Zone 1.

Source: OIG analysis of National Association of Home Builders data for total new housing starts in Zone 1, and estimated total homes built with RRNC provided by EPA's Indoor Radon Team.

Table D-3: Total Radon Reducing Features Nationwide, 2000 to 2005

Year	Number of Homes Nationwide (a)	Estimated Total Number of Homes with Radon-Reducing Features Nationwide (b)	Percent of Total Homes with Radon-Reducing Features[1] (c)	Net New Mitigations Annually (Existing Homes) (d)	Cumulative Mitigations (Existing Homes) (e)	Total New Homes Built with RRNC In U.S. (f)	Cumulative New Homes Built with RRNC In U.S.[2] (g)
2000	70.0 million	1,345,374	1.9%	25,100	397,100	128,498	948,274
2001	70.8 million	1,442,579	2.0%	32,000	429,100	65,205	1,013,479
2002	72.4 million	1,569,380	2.2%	39,800	468,900	87,001	1,100,480
2003	73.6 million	1,715,000	2.3%	45,000	513,900	100,620	1,201,100
2004	75.1 million	1,858,182	2.5%	58.000	571,900	85,182	1,286,282
2005	76.1 million	2,052,178	2.8%	63,000	634,900	130,996	1,417,278

1. Percent of Total Homes with Radon-Reducing Features = column a / column b.
2. Cumulative New Homes Built with RRNC in U.S. = column b – column e.

Source: OIG analysis of estimated total homes built with RRNC and number of existing homes with added radon-reducing features information provided by EPA's Indoor Radon Team. The number of single family detached structures (column a above) is from U.S. Census Bureau data.

Appendix E

Agency Response to Draft Report

May 28, 2008

MEMORANDUM

SUBJECT: Comments on the Draft Evaluation Report: More Action Needed to Protect Public from Indoor Radon Risks

FROM: Robert J. Meyers
Principal Deputy Assistant Administrator
Office of Air and Radiation

TO: Wade T. Najjum
Assistant Inspector General for Program Evaluation
Office of Inspector General

The EPA Office of Air and Radiation appreciates the opportunity to review and comment on the OIG's draft report *"More Action Needed to Protect Public from Indoor Radon Risks"* (Assignment No. 2007-000308). We are grateful to have OIG's input on the important public health challenge of reducing indoor radon exposure.

While we acknowledge that the public health risk of indoor radon exposure remains high, EPA believes our accomplishments to date are significant and should be noted. Due to EPA's work with States and industry, more than two million measured or potentially high-risk U.S. homes now have radon-reducing features, with the result that an estimated 6,000 lung cancer deaths have been prevented to date. We have helped establish a revitalized State and industry infrastructure (a key to organizing risk reduction in a voluntary/market-driven program). This includes development of a private proficiency program for measurement and mitigation, the establishment of a system of State programs (through State Indoor Radon Grant (SIRG) and the institution of training capability (through the Regional Radon Training Centers) to support the radon community at large.

EPA has also helped broker broad-scale scientific consensus on radon risk, garnered millions of dollars of donated media time for the Agency's radon media campaigns, and generated high levels of awareness among the public, identifying radon as a health hazard. More recently, EPA's partners have responded to EPA's call to reinvigorate action on the radon issue. This effort is already yielding an important resurgence in interest and action, including a substantial increase in reported State and local public outreach events occurring during National Radon Action Month.

Below are OAR's responses to OIG's specific recommendations.

2-1 Develop a strategy for achieving the long-term goal of the IRAA by considering using the authorities authorized by Congress under Section 310 of that Act, or explain its alternative strategy.

Response: The goal of IRAA, stated in Section 301, is to "reduce radon levels in all buildings to that of ambient outdoor air." The level of radon in outdoor air averages about 0.4 pCi/L. Radon mitigation methods currently available can significantly reduce the public's exposure to radon from high levels to appreciably lower levels, well below our recommended action level of 4 pCi/L in many cases. They cannot typically or reliably achieve a level so low as 0.4 pCi/L in a given dwelling, and certainly not in all dwellings. Lacking technologically or economically feasible ways to meet the statutory goal, the regulatory authority offered by Section 310 to meet the provisions of IRAA will not enable its achievement. Accordingly, as discussed in further detail below, the principal limitations to meeting the statutory goal are physical and technological. Thus, before EPA can begin strategizing about how the regulatory authority offered by Section 310 might be utilized to meet the statutory goal, EPA must address the physical and technological limitations to achieving the national goal.

Despite this, OAR agrees with the OIG that greater progress is needed and possible to reduce public-health risk from radon. This conviction underlies our recent actions to reinvigorate the program through clear Federal leadership and more aggressive and focused public outreach, involving stronger organization and collaboration with States and the radon industry. In response to this recommendation, OAR agrees to develop a strategy as recommended in the context of our available approaches, authorities, and resources.

See Appendix F
Note 1 for OIG Response

2-2 Identify limitations in the authorities authorized by Congress, as well as other limitations that would preclude achieving the long-term IRAA goal, and report these limitations to Congress as appropriate.

Response: As stated in section 2-1, OAR believes the long-term IRAA goal is not achievable. The principal limitations to meeting the national goal are physical and technological, not statutory. Radon is a naturally occurring radioactive element. Its levels indoors can rise or fall based on such variables as soil-gas availability, relative pressure, temperature, ventilation, and humidity. Indoor concentrations can also vary according to the design and construction of an individual dwelling, as well as the living habits of its occupants. We do not believe such geological and social limitations are subject to remedy through legislative enactment. OAR will consider authorities and limitations with respect to accelerating risk reduction in the context of the strategic review we will conduct in response to Recommendation 2-1. This review will also

include the rationale and strategy for achieving any alternative to the long-term goal of IRAA.

See Appendix F
Note 2 for OIG Response

2-3 Revise the Agency's performance measuring data to include metrics that will better measure the magnitude of the potential radon problem in relation to the number of homes at risk.

Response: We agree with OIG that tracking radon risk reduction in relation to total homes at risk is another useful way to measure progress. We will therefore create an additional measure calculating total active mitigations, combined with new homes built with RRNC in Zone 1 areas, as a portion of all homes at risk.

See Appendix F
Note 3 for OIG Response

2-4 Revise how the Agency reports the Indoor Radon Program results in EPA's Annual Performance and Accountability Report.

Response: EPA is obliged to report its results under requirements laid down by OMB in its budgetary formulation and through the PART process. For this reason we will continue to report homes mitigated and built RRNC, the results on which we have direct influence, as OMB requires. In addition, we will propose to the Office of the Chief Financial Officer and OMB the inclusion of the new measure described in Recommendation 2-3 in future reports.

See Appendix F
Note 4 for OIG Response

Thank you again for the opportunity to comment on the draft evaluation report. If you have questions, please contact Bill Long, Director for the Center of Radon and Air Toxics, at (202) 343-9733.

Attachments

Attachment

Additional Comments on OIG Evaluation Report: More Action Needed to Protect Public from Indoor Radon Risks

Assignment No. 2007-0000398, February 13, 2008

General Comments

- OAR believes that the IRAA long-term goal is not achievable and this belief highly influences our response to two of the four OIG recommendations.

- EPA believes Federal-level voluntary methods are appropriate to this program and that, given the many problems of design and implementation that would accompany a structure of national mandates, Federal regulation is unlikely to provide a workable solution to a unique, ubiquitous, and exceptionally complex public-health problem.

- OAR believes that, when imposed at the appropriate level of government, regulatory approaches to radon risk reduction may be warranted and often effective. An example is the enactment of building codes which require radon-resistant techniques in new-home construction. Historically, the authority to impose such restrictions was been exercised at the state and local level.

See Appendix F
Note 5 for OIG Response

Specific Comments

"At a glance" section
"EPA's ability to achieve results with a voluntary program is limited."

OAR agrees, since the nature of the radon problem defies even the best efforts of Government to meet the statutory goal. OAR believes EPA's ability to achieve results within a Federal-level regulatory regime is also limited. While we have not yet solved the problem of radon exposure using voluntary approaches, we do not believe these approaches should be abandoned.

See Appendix F
Note 6 for OIG Response

Page 3
"Instead, 4.0 pCi/l of air is the point at which the cost to the homeowner for fixing the problem (taking action) is warranted by the risk from the radon."

The action level was a technological/cost decision, not a health risk/cost based decision. Footnote number 8 on page 9 provides a good, accurate explanation.

See Appendix F
Note 7 for OIG Response

Page 6
The "Noteworthy Achievements" section

OAR believes OIG should acknowledge EPA's substantial achievements in mitigation and Radon-Resistant New Construction in this section. Viewed apart from the statutory goal, these results are noteworthy given the ubiquity of the pollutant and the inherent difficulty of the task. We believe the protection of more than 2 million potentially high-risk U.S. homes with radon reducing features is significant, as is the avoidance of approximately 6,000 cumulative lung cancer deaths. Other notable achievements include the establishment of an industry infrastructure (a key to organizing risk reduction in a voluntary/market driven program). This includes development of a private proficiency program for measurement and mitigation, the establishment of a system of state programs (through SIRG) and the institution of training capability (through the Regional Radon Training Centers) to support the radon community at large.

EPA has also helped broker broad-scale scientific consensus on radon risk, garnered millions of dollars of donated media time for the Agency's radon media campaigns, and generated generally high levels of awareness among the public identifying radon as a health hazard. More recently, EPA's partners have responded to EPA's call to reinvigorate action on the radon issue. This effort is already yielding important results, including a substantial increase in reported state and local public-outreach events occurring during National Radon Action Month.

See Appendix F
Note 8 for OIG Response

Page 9
"Further, EPA has not exercised all the authorities granted to it by the 1988 IRAA. Due to insufficient progress, each year EPA falls further behind in achieving the IRAA long-term goal that indoor radon levels be no higher than outdoor levels."

We believe the report makes an incorrect inference that EPA's limited historical reliance on Section 310 of IRAA is causally linked to a growing action gap. Also, it assumes achieving the long-term IRAA goal is technically feasible.

See Appendix F
Note 9 for OIG Response

Page 9
". . . below the 4.0 pCi/lL level, which is EPA's assessment that the cost to fix the problem is not warranted by the risk from the radon."

As stated above, this is not how the 4.0 pCi/lL was set. Footnote number 8 on page 9 provides a good, accurate explanation.

See Appendix F
Note 10 for OIG Response

Page 10
"A 1992 review by EPA's Office of Policy, Planning, and Evaluation concluded that the radon program had made some progress in increasing radon awareness and testing. However, that office also found that public information alone would not be sufficient to achieve significant long-term risk reduction. Stronger actions, such as requiring radon testing in real estate transactions and building radon-resistant new homes, were encouraged and seen as cost effective"

OAR has reviewed the findings of this 16 year-old report. The study does recommend consideration of strategies beyond public information to accelerate radon risk-reduction, some of which EPA has adopted. While it does comment on the use of alternative regulatory approaches, specifically in the areas of code amendment and real estate transfers, it places these responsibilities within the province of state and local government.

See Appendix F
Note 11 for OIG Response

Page 11
"Adoption of Radon Codes and Regulations Inconsistent"

The report asserts that State and local adoption of codes has been "inconsistent". We believe this characterization incorrectly implies a "one best way" approach to adoption of building codes. The reality is that all States have different processes, and many do not have any statewide building codes.

See Appendix F
Note 12 for OIG Response

Page 16
". Congress authorized the EPA Administrator in Section 310 "to issue such regulations as may be necessary to carry out" the provisions of the IRAA. To date, 19 years after the IRAA was enacted, EPA has not proposed any indoor radon regulations."

In 1995 EPA cited Section 310 authority to promulgate a 'user-fee rule' as required by Sec. 305(e) of IRAA in order to defray the operating costs of EPA's then National Radon Proficiency Program (NRPP). That program, initially authorized by IRAA for three years, is now managed by private non-profit organizations, and the fee rule is no longer in effect. In addition, EPA used authority under IRAA to promulgate two Federal grant programs (the State Indoor Radon Grants and Performance Partnership Grants programs)

See Appendix F
Note 13 for OIG Response

Appendix F

OIG Evaluation of Agency Response

We acknowledge that addressing indoor radon is not an easy task. Radon is an odorless, tasteless, and invisible gas. In our draft report, we acknowledged that there are numerous impediments impacting EPA's progress, including inconsistencies in radon-related requirements among State and local governments, and a lack of incentives for many key stakeholders. It is clear that the Agency has made some progress; however, after nearly two decades of effort by EPA, potential exposure to indoor radon continues to grow each year. EPA did not dispute the data in this report, and has agreed to develop a strategy to further reduce public-health risk from radon. EPA agreed that it has the authority to issue regulations for this program; however, it said that before EPA can begin strategizing about how the regulatory authority offered by Section 310 might be utilized to meet the statutory goal, EPA must address the physical and technological limitations to achieving the national goal. The Agency believes that the long-term goal of the IRAA is not attainable, but acknowledges that greater progress toward the statutory goal is needed and possible.

We continue to believe that more action is needed than "reinvigorating" the current program. EPA should reassess its radon program strategy and structure, and inform Congress what level is attainable considering technology and other factors, and what the Agency plans to do to achieve this level.

Note 1- EPA acknowledges that the health risks from radon exposure remain high and has agreed to develop a strategy as recommended by the OIG in the context of its available approaches, authorities, and resources. We agree with EPA's planned actions to develop a strategy.

Note 2- If the Agency believes that the long-term goal of the IRAA is not achievable, it should report this to Congress as a program limitation. The Agency should also inform Congress as to what level is attainable considering technology and other factors, as well as what the Agency plans to do to achieve this level. We acknowledge that there may be technical and policy limitations to attaining levels of 0.4 pCi/L for indoor air at an affordable cost. We note that in 1992 EPA determined that a level of 2.0 pCi/L for indoor air was achievable 70 percent of the time. EPA also said that it plans to conduct a strategic review of its radon program to include the rationale and strategy for achieving any alternative to the long-term goal of IRAA. In our view EPA needs to seek Congress' approval of any alternate long-term goals. We did not make changes to Recommendation 2-2.

Note 3- We agree with the Agency's planned actions to address Recommendation 2-3.

Note 4- We agree with the Agency's commitment to propose the measure to OMB. If OMB does not approve the measure for inclusion in the Agency's Annual Performance and Accountability Report, the Agency should consider other places

where the measure could be published, such as prominently displaying this on the Agency's Indoor Radon Website.

Note 5- The OIG identified EPA's concerns with whether the IRAA long-term goal is achievable. For example, in Chapter 2 our draft report stated "According to EPA, there may be technical and policy limitations on the ability to attain levels of 0.4 pCi/L for indoor air (the average level for outdoor air) at an affordable cost." After more than 19 years, we believe EPA needs to disclose to Congress and the public that its Radon program will never achieve the goals Congress set for it. Not reporting EPA's lack of capability and progress impedes Congress from making informed decisions about Radon and the nation's health.

Note 6- We do not state in the report that the Agency's voluntary approach to the radon program should be abandoned. We suggested developing alternatives for reaching the goal of the IRAA. In the 19 years since Congress passed the IRAA the number of homeowners potentially exposed to excessive radon has increased each year. We recommended EPA reassess its radon program strategy and structure for meeting the goal of the Indoor Radon Abatement Act. If the IRAA long-term goal is the problem, then the Agency should inform Congress as to what level is attainable considering technology and other factors, and what the Agency plans to do to achieve this level.

Note 7- We revised the report based on this comment. We deleted "the point at which the cost to the homeowner for fixing the problem (taking action) is warranted by the risk" and added "was a decision based on EPA's assessment of technology and cost".

Note 8- We did not make changes to the Noteworthy Achievements section. The report already contained information in Chapters 1 and 2 and in the Appendices related to the estimated homes with radon reducing features and the number of lives saved. We believe that the information in the Noteworthy Achievements section is descriptive of the Agency's accomplishments.

Note 9- The radon problem gets worse each year. We believe that the Agency should reassess how to achieve desired results. As discussed in Chapter 2, multiple factors have contributed to limit the progress made in the voluntary radon program. There are disincentives for real estate agents, home inspectors, and home sellers to conduct radon tests during real estate transactions. We also stated in Chapter 2 that given the Agency's limited progress from its voluntary approach for the past 19 years, it is time for the Agency to consider other means to achieve the 1988 IRAA goal. As discussed in Note 2 above, if the Agency believes that the long-term goal of the IRAA is not attainable, it should report this to Congress as a limitation of the program. If this is the case, then the Agency should also inform Congress as to what level is attainable considering technology and other factors, and what the Agency plans to do to achieve this level.

Note 10- See our response in Note 7 above.

Note 11- We deleted the information related to the 1992 report from the Final Report.

Note 12- We do not believe there is a "one best way" to adopt radon codes; however, we do point out that the current way is not producing the desired results. In this section we point out the inconsistencies of the participants in the radon program and how those inconsistencies limit EPA's ability to achieve greater results. As noted in Chapter 2, some States and localities have not adopted radon building codes, and in some areas where radon tests are performed the disclosure of results is voluntary.

Note 13- No change necessary. This information is not pertinent to the issues addressed in Chapter 2 of the report.

Appendix G

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