



Project Summary

Clinton, New Jersey, Radon Mitigation Follow-up and Long-term Monitoring

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During 1986, the U.S. Environmental Protection Agency demonstrated radon reduction techniques in 10 houses in Clinton, New Jersey. Initial radon levels in the 10 houses ranged from 400 to 2200 pCi/l. Radon reductions of more than 95% were achieved by using a variety of subslab ventilation techniques.

Since January 1987 the radon levels in the 10 houses have been monitored with alpha track detectors. The detectors have been installed and removed quarterly. Three detectors were used on the lowest level of each house, and three on the next higher level. Results of the comparison between the radon concentration measured during the first and second quarters of 1987 showed that most of the houses had slightly higher concentrations during the second quarter. These results are contrary to expected trends.

Two houses with slightly elevated radon levels received additional radon reduction applications at the end of the second quarter of 1987. In one house, the radon concentration was successfully reduced, and in the other, essentially unchanged.

This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see

Project Report ordering information at back).

Introduction

Data are being collected on the radon levels in 10 houses in Clinton, New Jersey. The U.S. Environmental Protection Agency had previously screened these 10 houses for indoor radon and had retrofitted them with mitigation systems. The monitoring phase of this activity occurred in the spring of 1986, mitigation systems were installed in the fall of 1986, in time for the winter heating season. All work in 1986 was performed by Research Triangle Institute (RTI) and is documented in the report, "Development and Demonstration of Indoor Radon Reduction Measures for 10 Homes in Clinton, New Jersey," EPA/600/8-87/027 (NTIS PB87-215 356).

To compile a complete data base showing the effects of the radon reduction systems installed in Clinton in 1986, EPA contracted with PEI Associates, Inc., to perform follow-up radon monitoring. Alpha track detectors (ATDs) were installed in each house in January 1987 and retrieved in April 1987. Other ATDs were installed in April 1987 and retrieved in July 1987. Charcoal canisters (CCs) were also installed in each house in April 1987, and a special study entailed installation of additional CCs at some of the houses in June and July 1987.

Radon Monitoring with Alpha Track Detectors

ATDs were obtained from Terradex Corporation in Glenwood, Illinois. The detectors use radiation-sensitive plastic to record the energy transferred by alpha particles emitted during radon decay. Each detector is self-contained in a small lattice-topped plastic casing and is provided with a paper filter to prevent entry of particles formed during radon decay. Radon, a gas, passes through the paper filter and releases an alpha particle as it decays. The alpha particles released while inside the detector transfer their energy to the plastic as they strike it and produce an energy track etching. The tracks are later counted, and the number of counts is converted to a radon concentration. The exposure period of the detector is taken into account during this count.

The ATDs were deployed in each house to obtain a long-term average radon concentration. The planned exposure period was 3 months. Sixty-six SF detectors, numbered consecutively from 474801 to 474850, 477611 to 477613, and 477638 to 477650, were obtained for subsequent deployment on April 16 and 17, 1987, and analysis at the 1pCi/l sensitivity level. The detectors were received in sealed aluminum packages.

Six ATDs were deployed in each study house. Triplicate detectors were placed in two different locations representing high-use areas of each house. The detectors were either placed on a shelf or hung from an interior wall or ceiling beam. An effort was made to place the detectors near the middle of the house, away from exterior walls and windows. The detector number was recorded as each ATD was deployed. The detectors were deployed at random, without regard for maintaining a consecutive number sequence in each house, to minimize bias during analysis and reporting of results. To assist in record-keeping and retrieval, the aluminum packages for each house were clipped together in separate groups. This allowed the field installer to recheck the accuracy of recorded information in the office.

The detectors were retrieved on July 20 and 23, 1987. When retrieved, each detector was placed in its original aluminum package, sealed with tape, and sent to the supplier for analysis. The six extra detectors were also returned to the supplier as blanks after the packages

had been opened and labeled as if they had been deployed with the others.

Radon Monitoring with Charcoal Canisters

CCs were obtained from the EPA Office of Radiation Program's (ORP) Eastern Environmental Radiation Facility in Montgomery, Alabama. The CCs are filled with a measured amount of activated carbon and fitted with a screen to prevent spilling. Each CC is self-contained in a steel container with a filter to prevent entry of particles formed in the monitoring environment. The radon passes through the filter and adsorbs on the carbon. As the radon decays, the decay products remain on the carbon. Because the decay products are gamma emitters, the amount of radon that had decayed on the carbon can be calculated by measuring the activity of the decay products on the carbon.

The CCs are deployed by removing the tape seal and placing the CC in the monitoring area. The exposure period for CCs is 2 to 3 days. Two CCs were deployed in each house included in the special study phase following the second quarter alpha track testing. These samples were taken at the completion of the additional remediation to estimate the benefit of the additional measures.

Additional Mitigation

Between June 29 and July 3, 1987, special studies were performed at two of the study houses to determine if additional remediation could be achieved. The two houses subjected to this special study were C7-E and C10-D. The results obtained during the first sampling period had shown that both houses still had elevated radon concentrations with respect to the target concentration of 4pCi/l. The first sampling period produced 3-month average results of 10.8 and 9.1 pCi/l on the upper and lower levels of house C7-E, respectively; and 4.8 and 10.8 pCi/l on the upper level and basement of house C10-D, respectively. The goal of the special studies was to reduce radon levels in both houses to below the target concentration of 4pCi/l.

Most of the time during the special study was spent on house C7-E, which was of different construction from that of all the other houses in the Clinton radon study. Grab samples were collected at numerous locations within the crawl space and the exterior walls of the house by using Lucas cells. A Pylon monitor

operated continuously was also used on the outside of the house to investigate the possibility of reentrainment from the suction exhaust point. All sample results which were assessed qualitatively indicated that two exterior block walls on the slab-on-grade had high radon levels, and that these walls were not affected by the block wall suction system previously installed in the house. Reentrainment had not been observed. The additional remediation warranted by these results was to apply a suction to these two walls to contain high radon concentrations. Suction was applied to the two exterior block walls by first increasing the fan size in the suction system and then installing a 4-in. (10 cm) PVC pipe in the corner of the two adjoining walls. This 4-in. (10 cm) pipe was then joined to the existing block wall suction system. Because of access limitations, the new pipe was run on the outside of the house. Pressure differential measurements at the completion of the installation indicated that the two block walls were adequately connected to the suction system. The cost to install the additional remediation system was about \$500, including skilled labor and supplies.

Work in house C10-D was concentrated in the basement, where the previously installed system consisted of two subslab suction points: one at the sump and the other at the opposite end of the basement. Investigations of possible remedies consisted of measuring the negative pressure field below the slab, measuring the negative pressure on the block walls, and using Lucas cells to collect grab samples for qualitative analysis. These investigations revealed that the negative pressure field below the basement slab was adequately distributed throughout the entire area and that the negative pressure extended in some of the block walls. Three of the walls, those closest to the slab-on-grade portion of the house, however, showed no indication of negative pressure. Based on the investigation conducted, the additional necessary remediation consisted of sealing the air around the sump and most of the seal between the floor and walls of the basement. In addition, the three block walls determined to be without negative pressure were connected directly to the suction system by tapping into the intersecting corner of two of the walls by installing a 4-in. (10 cm) PVC pipe between the corner and the subslab suction system. Measurements were made to determine the requirements to deliver

adequate suction to all portions of the slab area and basement block walls. The cost to perform the additional remediation was minimal (based on the use of two tubes of sealant), and is not considered an increase in the original cost of remediation.

Results and Discussion

Based on the control samples and the triplicate ATDs, the results reported by the analytical laboratory appear to be good. Table 1 presents the ATD average concentration for both sampling periods for each house and compares these levels with the premitigation levels measured by charcoal canisters. Results of the comparison between periods generally show radon levels similar to those measured during the first sampling period, but results for most of the houses indicate slightly higher concentrations during the second period. These results are contrary to expected trends: for the first period, samples were collected during the heating season, when radon concentrations are assumed to be higher than in other seasons. The results for the second sampling period in House C2-B are significantly higher than those for the first period. The second-period results at House C5-B are also significantly

higher than the first-period results. All other second-period results, although slightly different, are not significantly different from results obtained during the first sampling period.

The data presented in Table 1 reveal a condition that warrants further attention. Table 1 shows a second period radon concentration of over 11 pCi/l on both levels of the house C2-B. This leads to the conclusion that the radon reduction system in house C2-B experienced reduced effectiveness during the second period.

Although a direct comparison of pre- and post-mitigation concentrations results in only partially valid conclusions (because the measurements were made during different seasons and house conditions), the data in Table 1 indicate that substantial reductions have been achieved in many study houses.

Based on CC samples collected shortly after the additional remediation was completed in the two houses included in the special study, an improvement was shown in the radon levels in house C10-D, but little or no improvement in the levels was measured in house C7-E. Because of the short-term nature of the charcoal canister measurements, however, the effect of the

additional remediation in these two houses cannot be fully assessed until after an additional 3-month ATD average concentration is obtained.

Table 1 Comparison of Radon Levels Between Sampling Periods

House No.	ATD Average Period 1, Jan-April, 1987, pCi/l	ATD Average Period 2, April-July, 1987, pCi/l	Concentrations at Beginning of Study, March 1986, pCi/l
C1-A	2.6 ^a 2.9 ^b	3.7 ^a 3.8 ^b	2254 ^b
C2-B	5.0 3.3	15.6 11.6	691
C3-C	5.4 4.2	4.8 5.5	1190
C4-A	3.4 3.6	2.9 3.1	1500
C5-A	5.4 8.5	8.6 11.6	635
C6-B	7.2 8.4	9.4 9.2	936
C7-E ^c	10.8 9.1	12.0 12.3	426
C8-A	1.5 1.7	1.8 2.1	791
C9-B	6.3 6.0	3.1 3.8	670
C10-D ^c	4.8 10.8	3.3 12.8	1357

^aupstairs.

^bDownstairs.

^cModifications to radon reduction systems in houses C7 and C10 were completed at the end of the second period and are therefore not reflected in these results

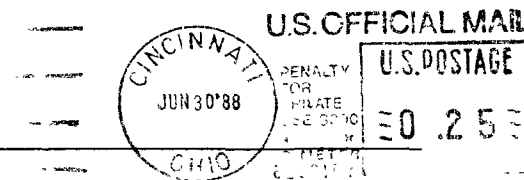
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The complete report, entitled "Clinton, New Jersey, Radon Mitigation Follow-up and Long-term Monitoring," (Order No. PB 88-198 528/AS; Cost: \$12.95, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
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Telephone: 703-487-4650
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