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The State of Maine School Radon Project: The Design Study

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ABSTRACT

The State of Maine, with a population of 1,222,000, has a public school enrollment of 212,000 students (K through 12) in 14,500+ rooms in about 800 buildings in some 160 public school systems. A proposal to study the radon in the school systems was requested by the state. An advisory team was formed, expert on schools, HVAC systems, geology, radon testing and radon mitigation. This group, meeting with experts from NITON Corporation, the chosen testing firm, formulated a comprehensive program to provide thorough testing and, where necessary, retesting, within the constraints of a frugal budget. A quality control program was initiated. So too were plans for informing the public. This paper will describe the major choices and decisions on such questions as: Should the program be spread over several years? Is a statistical sampling of rooms sufficient? Should one test in the summer? Who should set out the tests? How should the tests be monitored?

INTRODUCTION

The State of Maine, with a population of 1,222,000, has a public school enrollment of 212,000 students (K through 12) in some 160 public school systems. A proposal and bid was requested by the state to test for radon in the entire Maine school system. NITON Corporation was chosen as the testing firm.

Henry E. Warren, Director of the Division of Safety & Environmental Services of the Bureau of Public Improvement for the State of Maine formed an advisory team: Expert in schools— Roy Nesbitt, Director of Maine School Facilities; HVAC systems— William A. Turner, PE; geology —Ted Bradstreet, geologist; radon in Maine —Eugene Moreau, Manager of Indoor Air Quality, Department of Human Services. This group met with experts from NITON Corporation, who have much experience in testing schools and other large buildings, and formulated a comprehensive program to provide thorough testing and, where necessary, retesting, within the constrains of a frugal budget. A quality control program was initiated. So, too, were plans for informing the public. This paper discusses the many choices and decisions made by the group.

Many questions had to be decided. The two critical questions were: How many tests should be made and who should place and retrieve them? The answers to these determined the costs, and thus the extent of the testing.

PLANNING

FUNDAMENTAL DECISIONS

How Many Tests?

Determining the number of radon tests required for large buildings is counter-intuitive. It would seem reasonable to expect that testing the four corner rooms of a school will reveal any high levels that may exist. Maine had thus first proposed "4000 tests for approximately 900 buildings."

In the view of NITON and the experts consulted, a program with this proportion is very nearly a waste of money. Four tests that read less than 4 pCi/L do not mean the building itself is below the EPA's action level, only that those four rooms are below the action level. Any other room nearby or any cluster of rooms may be higher and only testing them all reveals which ones.

The location of high radon in large buildings cannot, unfortunately, be predicted, so that every occupied room on the ground or over crawl space must be tested. To uncover radioactivity, the EPA protocol is one's best assurance.

The group recommended: A short-term screening test done over a week-end in (a) every (b) frequently occupied (c) room (d) on the ground or (e) over crawl space. If the budget was limited, use the 4000 tests to do fewer buildings correctly, rather then do them all badly.

The State of Maine chose to follow the EPA protocol and do each building properly to the limit of its budget.

Who should place and retrieve the tests?

To the extent that school personnel could do this task, the costs would drop dramatically and more tests could be done. Travel costs alone, for example, can be prohibitive in a state as large, rural, and winter-bound as Maine, 303 miles from North to South.

Most experts would agree that in many, perhaps most, situations, a professional radon tester is always to be desired. For example, in real estate transfers of homes and commercial property, there are too many questions of placing the test at proper height, in which areas, how the heating system affects numbers and locations, how stone foundations and fireplaces affect placement, and how to maintain closed building conditions, not to mention matters of tampering.

A school, however, poses none of these problems, whose solution requires training and experience. The question of placement, for instance, is minor. Every classroom or school office has a desk, which is exactly the height EPA calls for, 30".

NITON had already had substantial experience in helping public schools to test. Although its products are used almost exclusively by professionals—environmental firms, inspectors, and the like—the company had earlier been approached by a number of Massachusetts public school systems to devise a low-cost system. The schools of Massachusetts had very little money but wanted to test. Without in-school testers, they could not have tested at all.

The program NITON had developed for non-professionals was further refined for Maine. It involved reading and marking all floor plans, an 800 Number Help Line, continuous follow-through, etc. These are described elsewhere in this program under Protocols and Procedures (1).

Because school personnel placed and harvested the tests, the State of Maine was able to afford a test for every designated schoolroom in the state within one year.

Why were short-term charcoal canisters chosen?

The EPA's Interim Protocol for Schools recommends both short-term screening tests (two days or over a week-end) and Alpha Tracks (three months) (2). There are three reasons why the short-term charcoal screening test was chosen for Maine schools:

1. The cost of an Alpha Track is typically about twice that of a charcoal canister.

2. In buildings where people work or go to school, the HV and HVAC systems typically have a set-back cycle during the evenings, week-ends, holidays, and school vacations, making Alpha Tracks inappropriate for long-term testing in these structures. With a 168-hour week, and the systems set back 120 to 136 or more of those hours, ATs will generally give a false high or a false low, and take many months to do it. That is, ATs are skewed in these buildings from 3 to 1 to 7 to 1 or more in the direction of the radon values of the off or set-back cycle. These concentrations may be very much higher or very much lower than during hours of occupation. The problem is aggravated since during the week-ends and vacations, radon can build up to values that may be 10 times the mid-week evening set-back value.

3. More importantly, a short-term test will efficiently find high radon levels in a short time. In addition, tests are less likely to be misplaced or forgotten. Any tests that are lost or mishandled can be quickly and inexpensively replaced and the test promptly redone, again over a weekend. If an AT is lost, the three months of testing is lost and the next three-month test has to start again. If the air handling equipment is on its regular mid-week cycle, the set-back cycle dominates by a

factor of only 2 to 1 (16 hours set back, 8 hours on). If the system is kept on continuously as this Maine protocol calls for, the occupied conditions are more nearly met.

One should not have to wait many months to learn of occupied rooms with high radon levels. In Maine, 8.7% of rooms were found to be more than 4 pCi/L, 1.9% were more than 10, and 0.7% were more than 20 pCi/L, and results were available within a week, including the testing.

OPERATIONS ORGANIZATION

Where should the tests go?

NITON read and marked the plans of every school building. For details, see Protocols and Procedures (1).

When should the tests be done?

Schools were tested from late Friday afternoon to early Monday morning, a time period recommended by the EPA that is becoming standard practice for testing schools (3). NITON vials are calibrated from 24-72 hours for screening.

This week-end period assures that outside windows and doors will be kept shut to maximize the radon potential. It is also felt that students will not tamper with the tests.

Heating and ventilation cycles on?

When there are sufficient funds, one would ideally screen test all rooms with all systems down, to learn how much radon is entering the building; then one would retest, with HV or HVAC systems on, to learn the effectiveness of these systems at clearing away radon gas or creating negative pressure and sucking it in. Given an extremely limited budget, the group felt it was most important to learn what the radon levels were when students and adults were actually occupying the building. It was decided to request that the Heating and Ventilating be on continuously. The instructions were made part of the Data Entry Sheet.

Test in spring and fall, or continue through summer?

With testing scheduled to begin at the end of February, the question of continuing the testing through the summer or waiting until fall to recommence the testing came up.

Based on preliminary evidence, the EPA Interim School Protocol calls for testing in the wintertime only (4). Warren checked with Maria Van der Werff, Radon Coordinator, EPA, Region #1 and William Turner, PE, who agreed with NITON that mounting evidence was showing that summer testing was valid.

For example, NITON had done comparison testing of 89 rooms in 5 schools in Massachusetts six months apart and found slightly higher readings in the summer; 80% of the rooms were within 1 pCi/L (5). Summer is, in fact, an excellent time for two-day screen testing. The custodians have more time, there are fewer distractions, and it costs very little to put the HVAC onto continuous cycle for the short test period.

MANAGEMENT OF NON-PROFESSIONALS

HOW TO KEEP THE PROGRAM ON SCHEDULE?

Even with professionals, schedules need to be set up. With non-professionals, schedules have to be far more detailed, and people need to be monitored very closely and continuously. Maine had previously provided free radon tests to several schools, most of whom had never returned their tests to the lab, or had returned them months after exposure. Maine was particularly concerned with this point. The system devised worked for 98.5% of the tests.

NITON was given the name, principal's name, and phone number of every school in the State of Maine. Many schools were in towns and cities, with facilities maintenance staffs. Some were out on islands or Indian reservations with no staffs. Some were one-room schoolhouses, with no principal and no custodian. NITON devised a checking system that kept track of all of them at every stage in the program, from sending in floor plans to returning tests.

RE-TESTING: WHERE AND HOW

It was already known that some areas of Maine were high in radon; 60 pCi/L in basements was not so rare in those parts. When the first very high readings showed up in schools there, the EPA was called in and mitigation begun.

The decision was made to retest every room with a reading over 3 pCi/L. Ideally, one would want a sensitive electronic continuous radon monitor to give hour-by-hour results in every such room, but the cost is high.

A cost-effective way to retest is the use of NITON vials to learn day and night readings. The NITON vial is calibrated to 8 hours, and is extremely sensitive as well as accurate at low levels (a liquid scintillation counter counts virtually 100% of 5 decaying particles). At 1 pCi/L, the Standard Deviation is 10%; in retests, all tests are counted to a Standard Deviation of 2% at 3 pCi/L. Thus, a reading may be taken during the school day, when the building is occupied, and another in the same room at night, when the systems are set back. Rooms confirmed to be high would then be candidates for careful diagnosis of all conditions, beginning with the HVAC.

QUALITY CONTROL

QUALITY ASSURANCE FOR TESTING VIALS

To test the tests, two procedures were used. Side-by-side NITON vials were set out in some 150 rooms. In addition, 50 of the 4" charcoal canisters (75 gr) were supplied by the State of Maine and analyzed in the Maine Radon Lab. More information on this is given in the presentation on Results in the State of Maine School Radon Project (6).

DATA REPORTING

It was decided that test results would be sent to Henry Warren's office within two business days of the arrival of the tests at the lab. In addition, NITON would make the data available on discs for further analysis.

PUBLIC RELATIONS

The decision was made to tell the public of results as they were learned. Disclosure of even high radon values can be made without arousing undue alarm provided it is done early. This has been proven again and again in towns and school systems where such information was provided to the public early, instead of being withheld and then "revealed" by an outside source.

Note: The wisdom of this policy was demonstrated in the towns in the Sebago Lake region, where the radon was in excess of occupational levels for uranium mines, yet there was no hue and cry to close the schools, as there has been in areas where high results have been kept secret for too long.

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