AN INVESTIGATION OF INFILTRATION AND INDOOR AIR QUALITY IN NEW YORK STATE HOMES

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In December of 1984, the New York State Energy Research and Development Authority (Energy Authority) initiated a major Statewide investigation of infiltration and indoor air quality in New York State homes. The cost of this effort is approximately two million dollars which is cosponsored by the Energy Authority, New York State electric and gas utilities, the United States Environmental Protection Agency, the Gas Research Institute and the Electric Power Research Institute. This paper provides an overview of the program, including the study objectives, research design, experimental protocols and preliminary results to the extent they are available. The overall program has three primary tasks:

1. To assess the impact of conservation measures, including caulking and weatherstripping of windows and doors and the use of storm windows and doors, on house air leakage and air exchange rates;

2. To perform a Statewide radon study in New York State; and

3. To determine the impact of combustion sources and air infiltration rates on indoor air quality.

In the first task, the impact of the common house tightening conservation measures on air leakage and air infiltration is being quantified in a sample of approximately 200 homes. This sample has been stratified into three age categories in each of two different geographic locations in the State. Preliminary results obtained from the first 60 homes indicate that these house tightening conservation measures decrease house air leakage by approximately 20 percent in pre-1940 homes and by approximately 13 percent in 1940 to 1976 homes. Caulking and weatherstripping of windows and doors had a greater effect on house air leakage than did the use of storm windows and doors, particularly for the 1940 to 1976 homes.

Under the second task, State concerns about radon are being addressed in two subtasks. A stratified random sample of approximately 3,000 single-family homes Statewide has been selected using random digit telephone dialing. Through telephone interviews and the use of three alpha track monitors mailed to each of these homes, average annual concentrations of radon in the living areas and basements and average winter concentrations of radon in the living areas are being determined. Winter living-area monitors have been returned from approximately 2,400 homes and preliminary analysis of the results for the first 2,000 homes indicates that approximately 6.5 percent exceed four picoCuries per liter (pCi/l) and 0.5 percent exceed 20 pCi/l.

The second subtask in the Energy Authority's radon study effort is to determine the extent to which home and site characteristics (age, construction

characteristics, geographic location/geology) can be correlated with radon concentrations. Four areas of the State were selected for study. Three of the areas were selected because, based on geology, the areas were believed to have high potential for high radon concentrations. The three areas selected on this basis were in Onondaga, Erie and Orange Counties. A fourth area in Nassau and Suffolk Counties was chosen for comparison because it was believed to have high potential for low radon concentrations.

In each of the areas, radium content of the soil and radon content of the soil gas were measured and radon measurements in 13 to 15 homes located within the area were taken. Data obtained thus far are shown in Table I. The data indicate a somewhat greater potential for high radon concentrations in Onondaga County than in the other counties. This potential appears to be related to the high radium and radon content of the black shales, particularly Marcellus shale.

Table I. Radon survey of four geologic areas.

County	Geology	Mean Ra-226 In Soil (pCi/g)	Mean Rn-222 In Soil (2 ft. depth)(pCi/l)	Indoor Radon 13-15 Homes (pCi/l) Basement	First Fl.
Onondaga	Black Carbonaceous Shale (Marcellus)	2.6	2700	0.9-23	1.4-19.3
Erie	Black Shale	2.4	1060	0.6-12.3	0.3-8.4
Orange	Metamorphosed	1.3	450	1.4-29.7	0.1-11.8
Long Island (Nassau/ Suffolk)	Sandy Deposits	0.5	160	0.4- 4.4	0.2-1.4

The radon concentrations in 13 homes located in the Onondaga County Marcellus shale area are shown in Table II. Eight of the 13 homes had basement radon concentrations exceeding 4 pCi/l. Four of the homes exceeded this concentration at the first floor level. The results obtained in this program thus far are very limited. A complete report of project results is expected to be published by June of 1987.

Table II. Radon concentration levels in Onondaga County Marcellus shale area.

Range pCi/l	Number of Houses Basement (2 Month Ave)*	First Floor (2 Month Average)*
0-2	1	2
2-4	3	7
4-8	5	1
8-12	1	2
12-20	-	1
20-30	3	-
30-40	-	-
	13	13

*January-March 1986

In the third task, the impacts of indoor combustion sources, such as kerosene heaters, wood stoves and fireplaces, gas ranges and smoking, on indoor air quality are being determined. Two hundred homes in each of Suffolk and Onondaga Counties in which one or more of these indoor combustion sources are used have been monitored for a period of one week. Parameters monitored in each home include CO, NO_2, respirable particulates, air infiltration rate, temperature and SO_2. A household questionnaire and daily diary were completed for each household to provide information on housing characteristics, source type and source usage.