RADON GAS TESTING REPORT

FOR

LOW ENERGY HOUSES

By

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Radon gas samples were taken in each of the Saskatoon low energy houses from December 16 to 18, 1980. The samples were taken in the morning after the houses were closed to air exhaust and intake flows for a period of 15 hours escept for a chimney which was not altered for the sampling tests.

The results of these tests are appended to this report, where the units of measurement are pci/ℓ (pico currie per litre of air). The outside atmospheric level of radon gas level of 1.1 pci/ℓ. The average ratio of radon gas level in the basement to that on the main floor was 2.1. This might suggest that air circulation and ventilation in basements is only about one half or less of that on the main floor.

The measured radon gas values varied considerably from house to house. These variations are thought to be due to a number of factors including the average air circulation and ventilation rates prior to the test, the air tightness of the vapour barrier, the materials of construction and the area of basement wall and floor exposed to soil. It is noted that one house, E_1, was tested on two separate days, December 16 and 18. The reading of radon gas level dropped on the main floor by more than a factor of two on the second test, but the reading in the basement remained constant. This again suggests a greater circulation and ventilation on the main floor and very little in this particular basement.

A plot of radon gas concentration versus air tightness for each house is presented in Figure 1(a) to show the relationship between air tightness and radon gas concentration. The amount of scatter on this graph suggests that other factors may be more important than the simple air pressure tightness test at 50 pa. However, if a house is very leaky so that the natural air change rate is large then one might expect low radon gas concentrations.

A factor that maybe of great importance is the permeability of the basement walls and floors to infiltration of gases from the surrounding soils. Studies have shown in areas of high radon gas concentration that the rate of accumulation of radon gas in a house can be reduced to safe levels by sealing off the basement to such gas leaks. In our study, the lowest radon gas concentration was measured in a house with a vapour barrier sealed wood basement.

The concentration of radon gas recorded in these houses would not be considered to be special health risk compared to some other houses that have been tested in Saskatchewan. A comparison of radon gas concentration in these houses with some other data taken in the USA can be made by comparing the data reported here with that in Figure 1. (The units of nci/m^3 are exactly equal to pci/ℓ.) The data reported for the Saskatoon low energy houses all lie within the US Health Guideline Range or below. Furthermore, if these houses were tested when they ventilated continuously as they would be under normal operation, the levels of radon gas would fall considerably. This relationship between ventilation rate and radon gas concentration is implied in Figure 2 where some 17 houses were tested and in Figure 4 where one house was monitored continuously for a period of two weeks when five different air change rates were used. (ach = air change rate in house volumes per hour)

It is difficult to draw any special conclusions from the radon gas tests on the low energy houses in Saskatoon other than that the radon gas concentrations in these particular low energy houses do not appear to be a health problem. This result is likely due in part to the low levels of radon gas in soils around Saskatoon, but it may also be partly due to the fact that the houses are new and their basements are very leak proof after their recent construction and perhaps, as low energy houses, they have been made especially

leak proof. Perhaps more attention should be given to the leak proof design of basements in the future if radon gas from soils is an important factor. Low energy house design with air tight vapour barriers is a step in this direction. A much more extensive testing program would be required to resolve such questions.

Reference

Berk et al "Radon Gas Measurements and Emanation Studies"
Laurence Berkeley Lab, Report 10704 EEB 80-5.

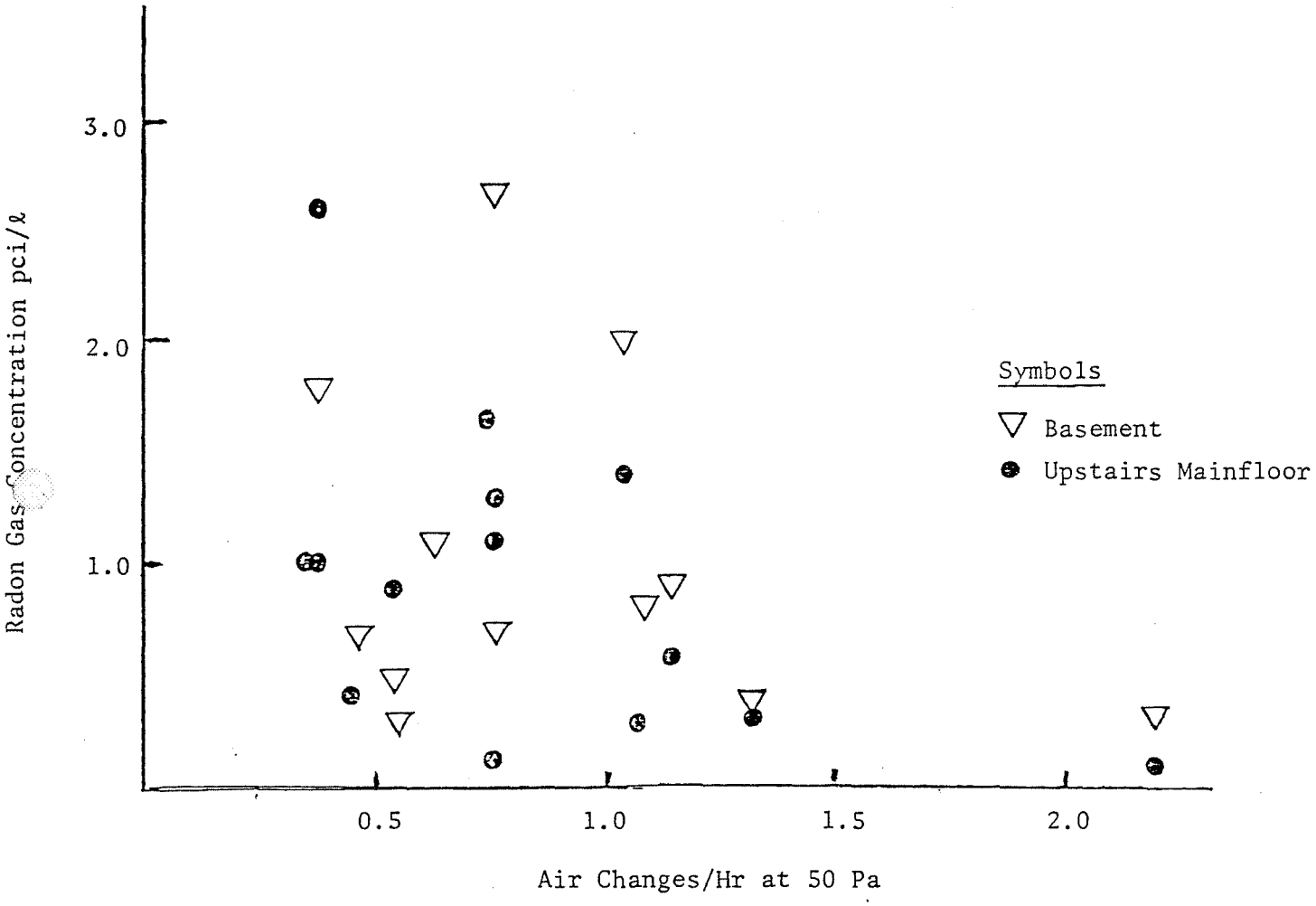


Figure 1(a) Radon Gas Concentration as a Function Of Air Tightness Level

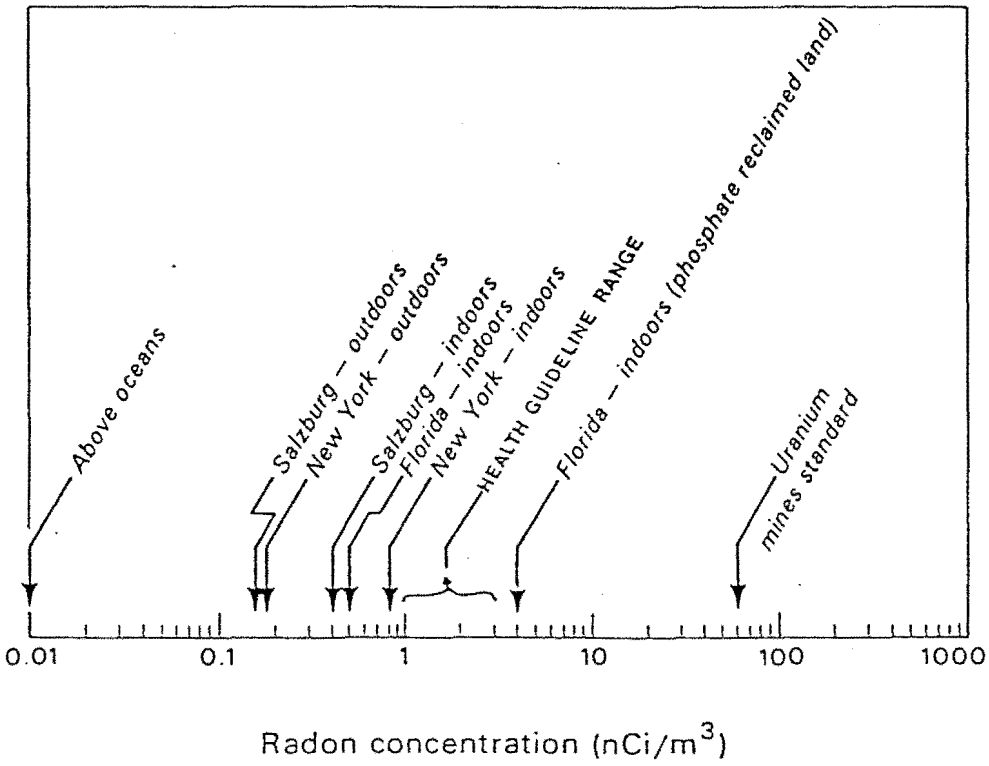
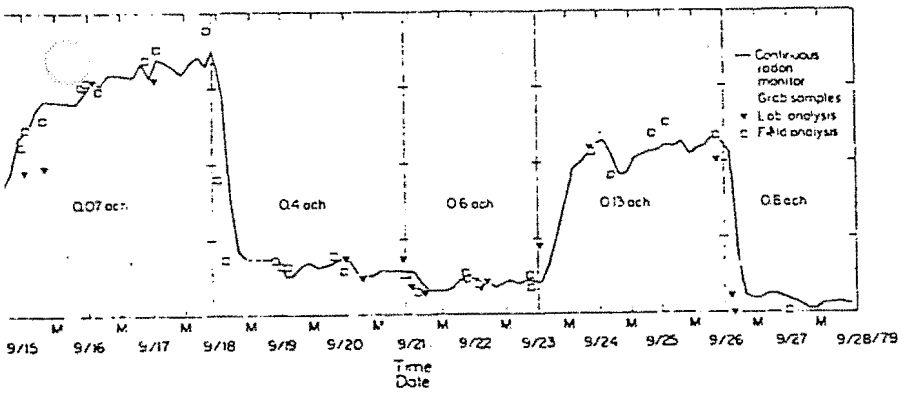


Fig. 1. Typical radon concentrations in air. (XBL 795-1659C)



4. Indoor radon concentration vs. ventilation rate controlled a heat exchanger in the NAHB house over a two week period. (XBL 790-4440)

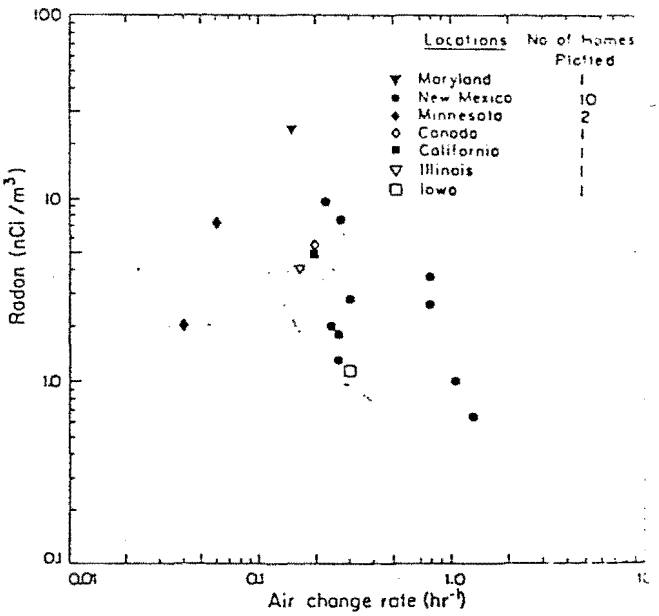


Fig. 2. Radon concentration vs. ventilation in energy-efficient houses. (XBL 796-1875A)

SRC Group No. 81-86

Lab No. 488-517

House	Sample Location	Date Sampled	Time Sampled	Radon Level pCi/l
E_1	#1-Basement S.E. corner 2' off floor level	16-12-80	9:50	1.8 ± 0.4
	#2-Upstairs Master BR (N.E. bedroom) 2' off floor level	16-12-80	9:50	2.6 ± 0.4
S_1	#1-Basement S.W. corner 2' off floor level	16-12-80	10:00	0.8 ± 0.2
	#2-Upstairs N.W. bedroom center of room 2' off floor level	16-12-80	10:00	0.3 ± 0.1
P_1	#1-Basement S. central corner 2' off floor level	16-12-80	10:03	2.7 ± 0.4
	#2-Upstairs, centre of living room	16-12-80	10:03	1.6 ± 0.3
C_2	#1-Basement S.E. corner 2' off floor level	16-12-80	10:09	1.5 ± 0.3
	#2-Upstairs N.W. bedroom central area 2' off floor level	16-12-80	10:09	1.3 ± 0.3
A_1	#1-Basement S. central area 2' off floor level	16-12-80	10:13	1.1 ± 0.2
	#2-N.W. bedroom (upstairs) 2' off floor level	16-12-80	10:13	1.1 ± 0.2
V_1	#1-Basement S.E. corner 2' off floor level	17-12-80	9:50	0.7 ± 0.2
	#2-Upstairs N.W. bedroom central area 2' off floor level	17-12-80	9:50	0.4 ± 0.1
C_3	#1-Basement S.W. corner 2' off floor level	17-12-80	9:56	2.0 ± 0.3
	#2-Upstairs S.E. bedroom central area 2' off floor level	17-12-80	9:56	1.2 ± 0.2

House	Sample Location	Date Sampled	Time Sampled	Radon Level pCi/l
S_2	#1-Basement N.E. corner 2' off floor level	17-12-80	10:01	0.9 ± 0.2
	#2-S.W. bedroom central area 2' off floor level	17-12-80	10:01	0.6 ± 0.2
C_4	#1-Basement N.W. corner 2' off floor level	17-12-80	10:06	0.4 ± 0.1
	#2-S.W. bedroom central area 2' off floor level	17-12-80	10:06	0.3 ± 0.1
N	#1-Basement N.W. corner 2' off floor level	17-12-80	10:10	1.6 ± 0.3
	#2-S.W. bedroom central area 2' off floor level	17-12-80	10:10	1.1 ± 0.2
M_1	#1-Basement S.W. corner 2' off floor level	18-12-80	9:04	0.5 ± 0.2
	#2-N.W. bedroom central area 2' off floor level	18-12-80	9:04	0.9 ± 0.2
E_1	#1-Basement S.E. corner 2' off floor level	18-12-80	9:11	1.8 ± 0.3
	#2-N.E. bedroom central area 2' off floor level	18-12-80	9:11	1.0 ± 0.2
M	#1-Basement S.W. corner 2' off floor level	18-12-80	9:15	0.7 ± 0.2
	#2-S.E. bedroom central area 2' off floor level	18-12-80	9:15	<0.1
C_1	#1-Basement N.W. room 2' off floor level	18-12-80	9:23	0.3 ± 0.1
	#2-N.E. bedroom central area 2' off floor level	18-12-80	9:23	<0.1
S_3	#1-Basement S.W. corner 2' off floor level	18-12-80	9:32	0.3 ± 0.1
	#2-N.E. bedroom central area 2' off floor level	18-12-80	9:32	0.3 ± 0.1