SUDBURY NEUTRINO OBSERVATORY
RADON MEASUREMENTS - JANUARY 1992
6800 ft LEVEL - CREIGHTON MINE

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INTRODUCTION:

To establish the acceptibility of the proposed liner design for the SNO detector cavity, levels of radon present in the compressed air supply at the 6800 ft level of the Creighton Mine, and radon emanation measurements from typical rock surfaces coated with shotcrete, must be evaluated. This report gives results from the first set of measurements in the evaluation program. Two sets of results for radon and radon decay products in the compressed air, and in the mine air are reported. Also measured was the radon emanation from the rock surfaces of a closed 2 inch drill hole.

THE RADON MEASUREMENTS:

Radon measurements were made for the compressed air supply from an outlet at the 'old' wash station - a widened section of the entrance drift for the SNO laboratory (location A). Mine air measurements were also made at this location as well as at the junction of the control and utility rooms (location B). The drill hole for the radon emanation measurement was the lower of two blind holes on the north side of the old wash station, used in a previous emanation study (SNO-STR 90-129).

A portable radon monitor (Pylon Model R2000) was used with 180 mL scintillation cells (for radon measurements) or a 30 mm diameter scintillator tray (for radon decay product counts from 25 mm 0.8 um air filters. Radon levels (pCi/L) and decay product levels (in Working Level units WL) are listed in Tables 1 and 2. Decay product activities were found using the Kusnetz method. In all cases, air filtering was carried out for 10 minutes at an air flow rate of approximately 13 L/min.

To sample the compressed air lines, a 4 L flow-through sampling canister was set up as shown in Figure 1. Air flow rates and purging times are listed in Table 1.

Figure 1: Compressed air sampling system

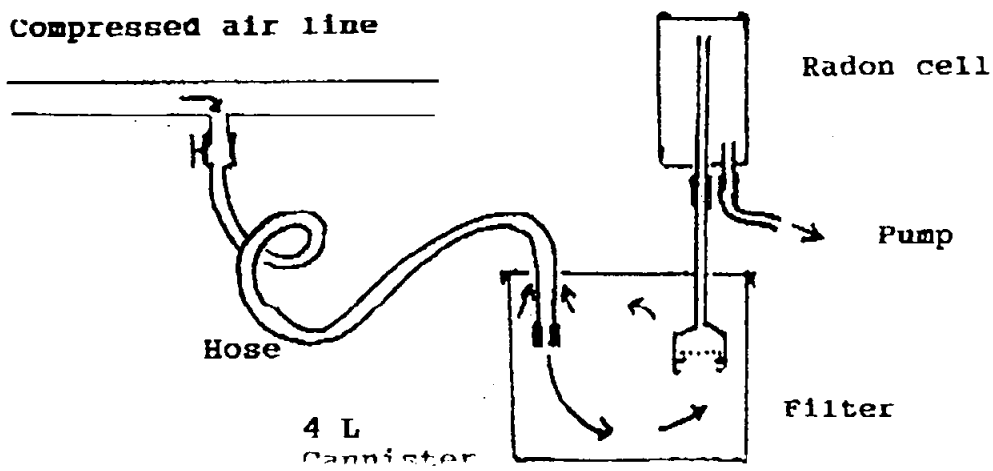

Table 1: Compressed Air Radon and Radon Decay Products

Cell # (filter #)	Background (cpm)	Net Counts (cpm)	R(Rn)* (pCi/L)	Air Vol.(L)	Filter (cpm)	W.L.	F
4 (3)	0.50	3.00	3.51 (0.5)	129	0.85	0.0001	0.003
1 (1)	1.15	0.86	1.5 (0.8)	130	1.75	0.0006	0.04

* average of two determinations corrected for decay of the radon sample

The cell # 4 compressed air sample was collected at an air flow rate of 100 L/min, following a 2 minute purge.
The cell # 1 compressed air sample was collected at an air flow rate of 1000 L/min, following a 35 minute purge.

From Table 1, it is evident that radon concentrations of 2.5 +/- 1.0 pCi/L are typical of the compressed air on the 6800 ft level. There is a suggestion that the longer purge time and higher flow rate for the second sample results in lower radon levels. A conservative upper limit for radon content would appear to be 4 pCi/L - a value typical of the mine air which enters the compressed air system at the underground compressor station. Very little radon decay products are observed in this air (average F = 0.02 +/- 0.02), compared to typical mine air. This result is understandable, given the large interior surfaces of the supply pipes which probably serve as scavengers of the decay products.

Table 2: Mine drift air Radon and Radon Decay Products

Cell # (filter #)	Background (cpm)	Net Counts (cpm)	R(Rn)* (pCi/L)	Air Vol.(L)	Filter (cpm)	W.L.	F
2 (2)	1.15	0.83	1.3 (0.6)	130	29	0.0058	0.45
5 (5)	0.73	2.23	3.0 (0.3)	130	16.3	0.0033	0.11

* average of two determinations corrected for decay of the radon sample

The cell # 2 sample was collected at location A
The cell # 5 sample was collected at location B

Note: 1 W.L. is the activity of decay products when 100 pCi/L ^{222}Rn is in equilibrium with its decay products.
F = 100 x W.L./R(Rn) is an equilibrium factor, indicating the degree of decay product loss through ventilation or plate-out.

The radon results of Table 2 indicate an average radon level of 2.2 +/- 0.8 pCi/L in the mine air. Radon decay product levels averaged 0.0046 +/- 0.0015 W.L., with an average F = 0.28. These results compare quite well with earlier measurements made in June 1990 (SNO report SNO-STR -90-129), where radon levels of 3.3 +/- 0.8 pCi/L and decay product levels of 0.0058 +/- 0.0016 were found. The lower values of the latest measurements would be consistent with the better ventilation now in effect at the sample locations.

Drill Hole Radon Measurements

Radon scintillation cell # 3 (volume = 160 mL) was evacuated, and connected to an opening into the blind drill hole at the wash station which had been plugged for many months. The radon activity of the air sample obtained was measured at two times, and results were corrected for radon decay. The average radon activity was found to be 15.3 +/- 1.5 pCi/L (with a cell count rate of 9.81 cpm). This compares very well with the measurements of July 1990 for the same hole, where a count rate of 13.0 x 0.73 (correction for cell volume difference) = 9.45 cpm was observed.

Reference:

E.D. Hallman and D.L. Cluff, Radon and Dust Measurements - July 1990 Sudbury Neutrino Observatory Site Report SNO-STR-90-129(1990).