

ELLIOT LAKE PROGRESS REPORT

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By W. Findlay and A.S. Scott

INTRODUCTION

The intent of the remedial program is to

- 1 - Identify those houses in Elliot Lake with annual average WL's in excess of the action criterion of 0.02 WL
- 2 - Demonstrate that the annual average WL is below 0.02 WL in those houses where remedial work was not performed
- 3 - Discover the route(s) of radon entry in identified houses and to close sufficient of them to reduce the annual average WL to less than the action criterion of 0.02 WL
- 4 - Demonstrate that the annual average WL following remedial work is less than the action criterion of 0.02 WL.

To meet these requirements, the Remedial Program is organized in two subprograms, the Survey Program and the Remedial Action Program.

SURVEY PROGRAM

By December 31, 1979, more than 17,000 survey measurements had been carried out, identifying 157 houses where remedial action was required and confirming that remedial action was not required in 413 houses. Program status is summarized in Table 1.

At the beginning of the project there were a number of houses where the average radon daughter concentration was so far in excess of the criterion that a few measurements were sufficient to identify the house as requiring remedial work. However, by early 1978 it was clear that, in many houses, a systematic survey over 12 months would be required to properly estimate the annual average radon daughter concentration. Accordingly, two surveys were started in 1978 to estimate this quantity by making measurements over a period of 12 months. These were the WL survey and the Radon survey.

WL Survey

Statistical analysis shows that the Annual Average WL in a house can be estimated with acceptable accuracy by taking at least 13 measurements at regular intervals through the year.

At the end of 1978, 124 houses were in this survey. By December 31, 1979, the survey had been completed in 123 houses and 6 houses had been added during the year.

Of the 123 houses, 99 were identified as below the remedial action criterion and 14 were identified as above the remedial action criterion. The remaining 10 were close to the criterion, and additional measurements will be made to determine the average more closely.

Radon Survey

The Annual Average radon concentration in a house is estimated from the average radon concentration measured over a 1-week period at 6 equally spaced intervals through the year.

At the end of 1978, 278 houses were in this survey program. On December 31, 1979, the survey had been completed in 248 houses and 42 houses had been added during the year.

Of the 248 houses, 218 were identified as below the derived remedial action criterion of 5 pCi/litre average radon concentration, and 24 were identified as above the derived criterion. The remaining 6 were close to the criterion, and additional measurements will be made to determine the average more closely.

During the year, 60 AECB passive integrating radon monitors were delivered but arrived too late to replace the pump and bag units in the radon survey. They are presently undergoing both field and laboratory tests to determine the precision and accuracy achievable in practice.

Fill-In Survey

Houses with annual average WL in excess of the criterion are often found in apparent clusters separated by a few houses that were below the investigation levels on the 1976 survey. To check if these houses were genuinely below criterion, a fill-in survey was carried out in houses adjacent to those identified as exceeding the criteria.

During 1979, 125 houses adjacent to houses in excess of the criterion were assigned to the survey. By December 31, 1979, the survey had been completed in 119 houses of which 100 were identified as below the remedial action criterion, and 8 were identified as above the criterion. The remaining 11 houses were close to the criterion, and additional measurements will be made to determine their averages more closely.

The proportions observed are not very different from those in the other surveys, suggesting that the clustering of remedial action houses is not an effect of location in town, but is the result of similar construction practices.

Gamma Dose-Rate Survey

Although the program has mainly been concerned with reduction of radon daughter concentrations in houses, there have been a few cases where gamma radiation levels were high enough to require remedial action. During the Task Force Survey of 1976, gamma measurements were made in and at many houses in town, and identified a few driveways where the exposure rate was in excess of the external gamma criterion. These driveways were removed in the first year of the project.

In addition, two houses were identified where the exposure rate inside the house was in excess of the gamma criterion. Both these houses had been built by small contractors in the early days of town expansion. Most houses were built by large contractors, and a gamma survey in about 200 of these houses found none with gamma levels in excess of the criterion. It was therefore thought that internal gamma problems were limited to those 2 houses identified previously, and so the gamma survey program was given low priority.

In September, a routine gamma measurement discovered a house built by a large contractor with internal gamma fields in excess of the criterion.

The concrete used in this house had mine waste-rock as aggregate, and so it was possible that there were other houses in town where the same concrete had been used.

As a result, the gamma survey program has been given higher priority. Exposure rate measurements are being made at and in every privately owned house in town that was built before 1977. To date, 145 houses have been surveyed and one in excess of the criteria has been found. About 800 houses remain to be surveyed.

Business Survey

A survey of commercial premises was started in late 1979. Work completed includes tracing owners and obtaining permission to survey from both owners and tenants in 152 premises. Visual inspection of the larger buildings to determine suitable sites for installation of passive integrating radon monitors, plus determination of ventilation patterns is still in progress.

Additional surveys are planned for 1980. The first is a verification survey, in which 10 percent of the remaining 900 privately owned houses that were below criterion in the 1976 survey will be surveyed. If a significant number of these houses are found to be above the criterion, the use of the Task Force Survey as a guide to investigation will be reexamined. The second is an Extra Survey, in which additional measurements will be made in all those houses found to be close to the criterion by previous surveys.

REMEDIAL PROGRAM

Introduction

Elliot Lake is a town whose sole purpose is to house the labor force directly and indirectly involved in the mining of uranium. The town's growth and prosperity is directly linked to that of the uranium industry. Briefly then, construction started in 1953, peaked in the late 50's, died away in the 60's when the demand for uranium slumped, and picked up again in the 70's with major building starting in the mid 70's. House construction is essentially the mass building of standard subdivision type houses, i.e., groups of similar types of houses. As a result of similar house designs and similar construction practices, many houses have similar routes of soil gas entry. It was therefore possible to develop a number of standard remedial measures to apply to standard problems. The list is shown in Table 2.

Experience has shown that soil gas entry routes can be adequately closed using simple techniques and materials common in the building trades. However, the apparently simple solution of blocking off entry routes is complicated by two factors.

The first is that basements were not intended to be gas-tight and have been designed and built with numerous openings to facilitate common construction methods, added to by the ingenuity of the tradesmen and frequently by owners.

The second is the difficulty in persuading contractor's forces to constantly apply high standards of attention to detail and cleanliness, for it is foreign to their background of mass production and a final cleanup. As a result, continuous supervision has been found necessary. This is all the more important as the policy is not to remove the occupants from the house during construction.

Organization

The method set up last year has been continued, and the various steps are shown on the flow diagram. A 2-stage approach is used. Stage 1 consists of an investigation limited to what can be seen. The relative importance of the routes of entry found is assessed, and they are then dealt with in order of estimated importance. The majority of houses are brought to below criterion by the end of Stage 1. If the remedial measures are unsuccessful, the house is returned for detailed investigation and testing in Stage 2. During this investigation, concealed routes are sought out by testing and the removal of finish.

Investigation

The progress during the current year is shown in Table 3. In total, 88 investigations were carried out.

Remedial Work Stage 1

The status of the work as of December 31, 1979 is shown in Table 4. The remedial measures used to close the entry points found in Stage 1 can be any of the standard listing. The visual nature of the identification can be seen in the number of floor drains, wall floor joints and cracks and openings which were treated.

Remedial Work Stage 2

This phase of the remedial program covers houses where the detailed techniques of Stage 2 investigation have been employed to locate hidden entry routes. The houses investigated have failed to respond to the closing of obvious routes or they were houses where the extent of the interior finish precluded visual inspection of the walls and floor.

The remedial treatment to be employed is usually one of the standard measures. However, the work is greatly increased by the necessity of exposing the area of entry and in the subsequent rehabilitation.

The status of the work as of December 31, 1979 is shown in Table 5. At that time, 13 houses had been successfully treated. The number of each type of fix reflects the less obvious nature of the routes being closed.

Work Deferred

In the course of Stage 2 investigation and Stage 2 remedial program, work was deferred on houses because the estimate of the costs involved were considered excessive and the probability of success with current techniques was not considered high enough. At the present time this includes houses which have a high degree of finish in the basements (such as apartments), houses with basements constructed of concrete block, and houses with water seepage.

Reduction of Gamma Levels

Three houses were identified as having gamma levels exceeding the criterion. They also had high WL's. Each house required a different approach.

House No. 1 - This was a single-storey house with a concrete block basement. Approximately half of the floor was above criterion, and when it was removed it was found that the radiation came from mine waste-rock used as sub-floor fill over half the floor.

Twelve inches of fill was replaced and a new floor slab poured. Some cracks and openings in the other half of the old floor slab were repaired. The radon daughter concentrations were found to have been reduced to below criterion.

House No. 2 - This was a single-storey frame house with a concrete block basement. The structural stability of the walls of the basement was such that it was considered inadvisable to remove the floor slab. There was sufficient headroom to pour a shielding slab and this approach was adopted. Gamma levels were reduced but radon concentration remained high. The walls have been filled with grout, columns replaced and the perimeter sealed. However, chimneys in the mortar of the blocks have been found which bypass the perimeter seal. Work to seal these is now in progress.

House No. 3 - This was a wood frame slab-on-grade house. The design is common in Elliot Lake, with at least 25 similar houses in the immediate vicinity.

The occupants were moved out and all furniture and fillings were removed.

The floor slab was cut by a diamond saw along the perimeter of each room following the line of the heating duct and the concrete was broken by jackhammers and removed. The concrete was radioactive, with mine waste-rock used as aggregate, and mine waste-rock had also been used as fill beneath the slab to a depth of 12 inches.

Cracks in the balance of the foundation were drilled out horizontally and sealed. A new slab was poured and sealed to the remaining foundation walls. Electric heating was installed to replace the forced air system and subfloor distribution ducts.

Water Entry

Several houses were found to have highly variable radon daughter concentrations. One cause of these fluctuations was that the routes of soil gas entry also allowed the entry of soil water. When the cracks or fissures were filled with water, soil gas could not enter. This raised two separate difficulties, first the routes of entry could not always be positively identified, and second the presence of water, at times under pressure, prevented the use of standard remedial treatments. In order to deal with the radon problem, it was therefore necessary to first prevent the entry of water.

Various methods were used in a number of houses, ranging from excavating around the house and replacing (or installing) weeping tile, to diverting rainwater spouts away from the house.

The successful procedures were difficult and expensive. As a result, installation of a subfloor exhaust system in such houses is now being considered as a preferred remedial measure, for it would not necessarily require that water leakage be stopped to be effective.

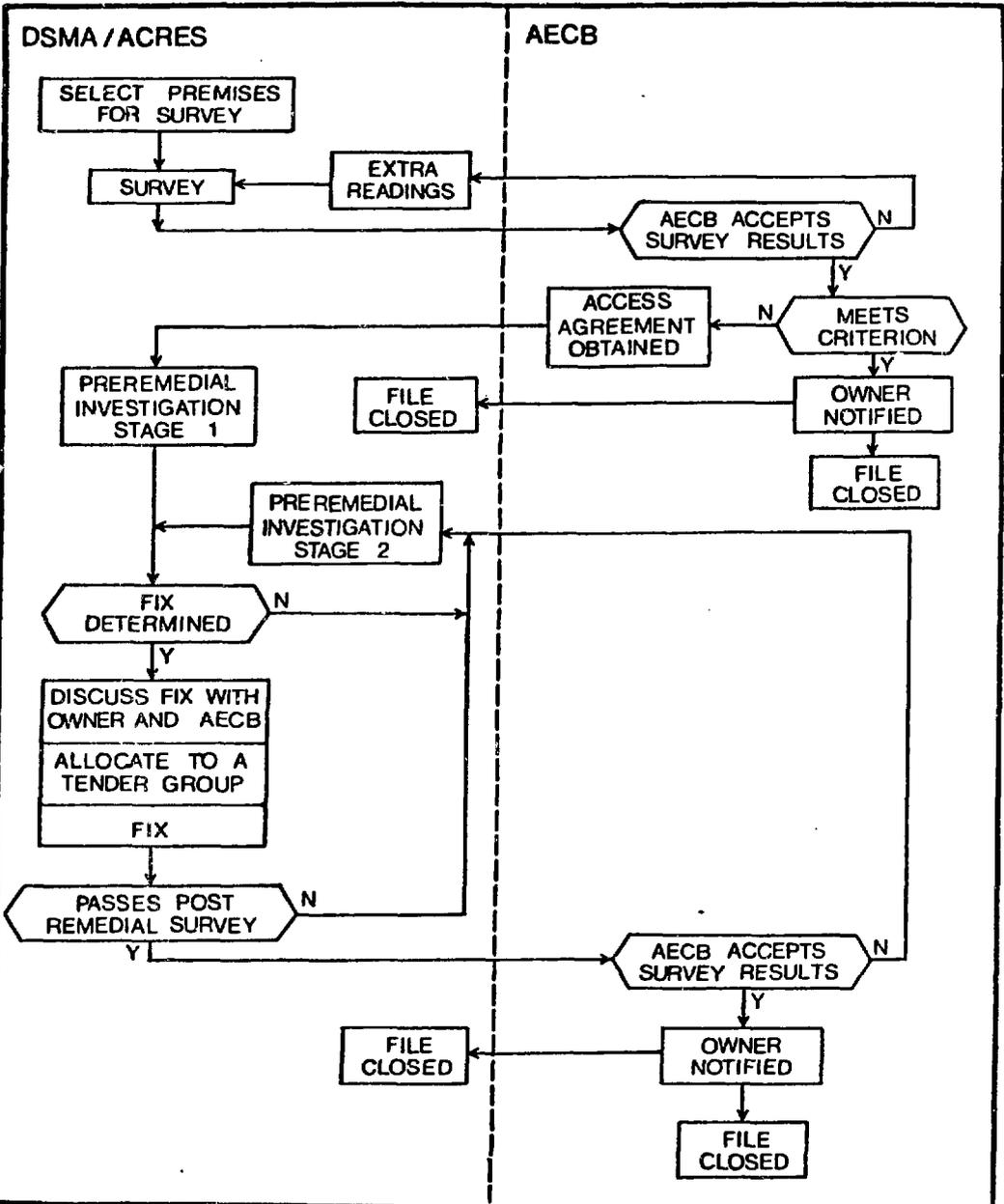


FIGURE 1
REMEDIAL PROGRAM LOGIC DIAGRAM

TABLE I

SUMMARY OF PROGRAM STATUS ON 31 DECEMBER 1979

SURVEY

Houses under survey	105
Premises with survey planned	227
Houses with survey completed	561
Houses exceeding the criterion	155
Houses with gamma survey planned	827
Houses with gamma survey completed	145
Houses exceeding the criterion	1

INVESTIGATION

Houses under investigation	28
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CONSTRUCTION

Houses receiving remedial work	7
Houses with remedial work planned	18
Houses with remedial work completed	98

MISCELLANEOUS

Survey refused	14
Remedial work refused	5

TABLE 2

STANDARD REMEDIAL ACTIONS

<u>Fix Number</u>	<u>Description</u>
1	Water-trap weeping tile connected to floor drain
2	Water-trap weeping tile connected to sump
3	Close wall-floor joint
4	Close cracks and openings through poured concrete surfaces
5	Seal exterior surface of basement walls
6	Cover exposed earth in basements
7	Cover exposed rock in basements
8	Seal interior surface of basement walls
9	Fill concrete block walls with cement grout
10	Remove radioactive concrete or fill
11	Place shielding over active concrete
12	Install fan for improved ventilation

TABLE 3

INVESTIGATION PROGRAM
TO 31 DECEMBER 1979

STAGE I

HOUSES IN PROCESS	14
INVESTIGATION COMPLETED	41

STAGE II

HOUSES IN PROCESS	14
INVESTIGATION COMPLETED	19

TABLE 4

STAGE 1 REMEDIAL PROGRAM
TO 31 DECEMBER 1979

HOUSES COMPLETED 22

<u>FIX NUMBER</u>	<u>DESCRIPTION</u>	<u>TIMES PERFORMED</u>
1	FLOOR DRAIN	15
2	SUMP	2
3	WALL-FLOOR JOINT	7
4	CRACKS	8
5	EXTERIOR SEAL	3
6	EXPOSED EARTH	-
7	EXPOSED ROCK	-
8	INTERIOR SEAL	-
9	GROUT WALLS	-
10	REMOVE ACTIVITY	1
11	SHIELD ACTIVITY	1
12	VENTILATION FAN	1

HOUSES IN PROCESS 19

TABLE 5

STAGE 2 REMEDIAL PROGRAM
TO 31 DECEMBER 1979

	HOUSES COMPLETED	13
<u>FIX NUMBER</u>	<u>DESCRIPTION</u>	<u>TIMES PERFORMED</u>
1	FLOOR DRAIN	6
2	SUMP	6
3	WALL-FLOOR JOINT	8
4	CRACKS	9
5	EXTERIOR SEAL	-
6	EXPOSED EARTH	-
7	EXPOSED ROCK	3
8	INTERIOR SEAL	-
9	GROUT WALLS	4
10	REMOVE ACTIVITY	1
11	SHIELD ACTIVITY	-
12	VENTILATION FAN	-
	HOUSES IN PROCESS	6

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Comments/Questions

- A. George : What is the activity of the water supply in Elliot Lake?
- A. Scott : 10 pico-curies per liter
- E. Wagner : What does "shield activity" (Table 5) mean?
- W. Findlay : Shielding consists of pouring five inches of concrete.