U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 999-90003/94032(DRSS)

Docket No. Not Applicable License No. Not Applicable

Inspection At: 66865 Barret Hill Road
Cambridge, Ohio

Inspection Conducted: October 6, 1993 through March 29, 1994

Inspectors: Raymant L. Glinski — 4-13-94
Raymant L. Glinski
Radiation Specialist — Date

D J Sreniawski — 4-14-94
Donald Sreniawski
Senior Radiation Specialist — Date

George M. McCann — 4/15/94
George M. McCann, Chief
Fuel Facilities and
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Fuel Cycle and Decommissioning
Branch — Date

Inspection Summary

Inspection from October 6, 1993 through March 28, 1994 (Report No. 999-90003/94032(DRSS))
Areas Inspected: This was a special inspection limited to radiological surveys of the addition and basement of a private residence. A slag material believed to contain radioactive material was used as fill under the addition. This inspection included direct radiation measurements, and the collection and radiological analysis of the fill material. A review of the data and the application of the data to a dose assessment was also conducted.
Results: The NRC inspectors identified two areas with radiation levels slightly above ambient background. The samples collected from underneath the home addition contained levels of natural uranium and natural thorium that are approximately two times in excess of NRC guideline values for release for unrestricted use of 10 pCi/g. These guideline values are outlined in the

October 23, 1981, Federal Register, Branch Technical Position "Disposal or Onsite Storage of Thorium and Uranium Wastes from Past Operations." The samples also contained slightly elevated levels of radium-226 and thorium-230. Based upon the inspection findings, it was concluded that although fill material does not constitute a significant or immediate health and safety concern, the NRC believes that further evaluation is warranted.

DETAILS

1. Persons Contacted

Allen Strawsburg, Resident
Steve Hooper, Cypress Foote Mineral

*A number of former Foote Mineral employees, currently employed by Shieldalloy Metallurgical, Inc., who is the current owner of the former Foote Mineral site.

2. Background

Foote Mineral Company, a former NRC source material licensee, occupied an industrial site south of Cambridge, OH from the 1950's to 1987. This site is now owned by Shieldalloy Metallurgical Corporation (SMC) NRC License No. SMB-1507. Foote Mineral was authorized by the Atomic Energy Commission to possess licensable quantities of uranium and thorium contained in columbium ores used in the manufacture of ferrocolumbium alloys. The approximate concentrations of source material in the columbium ores were 0.04% uranium and 2% thorium. The Foote Mineral license, SMB-00850, had a possession limit of 3100 kilograms of uranium and thorium.

The production of the ferrocolumbium alloys was active from approximately 1957 to 1972. After 1972, Foote Mineral was engaged in the production of ferrovanadium alloys which used ores that were not considered source material. In the early 1980's, Foote Mineral began to distribute unlicensed slag generated from its manufacturing processes as fill material to local commercial, private, and public entities. This slag is believed to have been used in an area encompassing a 20 mile radius around the Cambridge facility.

3. Facility Status

The house is approximately sixty years old. An addition was built onto the back of the house in 1983, which is used as a dining room. During the construction of this addition, slag from Foote Mineral was used as fill under the foundation. A 3 to 4 inch concrete slab covers most of the slag, except for a small area under the kitchen stove. The stove area is separated from the slag by wood used in the construction of the floor. The dimensions of the addition are 16 feet by 14 feet and the depth of the slag fill is about 3 feet. The resident believes that 6 to 8 tons of slag were used as fill under the addition. The upper portion of the basement back wall borders the slag. The walls of the basement are ceramic block and there is a window in the back wall that opens to the area under the addition. The fill material is accessible from the basement window.

4. Independent Measurements

A. Exposure/Dose Rate Survey

The field instruments employed for this survey were as follows: a Ludlum Model 3 ratemeter with a Model 44-9 pancake probe, NRC #037310, calibrated May 26, 1993; a Bicron Microrem Meter, NRC #028330, calibrated November 5, 1993; and a Ludlum Model 19 microR meter, NRC #011021, calibrated May 8, 1993.

Background readings for each meter were as follows: 8-12 microRoentgens per hour (μR/h) (2-3 nanocoulombs per kilogram per hour (nC/kg/h)) for the Ludlum Model 19, 5-7 microrem per hour (μrem/h) (50-70 nanosieverts per hour (nSv/h)) for the Bicron μrem meter, and 40-50 counts per minute (cpm) for the Ludlum pancake probe.

The inspectors surveyed around the outside of the foundation of the addition and did not detect any radiation levels or count rates above ambient background (See Attachment A). A survey of the dining room and kitchen area inside the house indicated slightly elevated radiation levels around the bar, stove, and cabinet (See Attachment B). All the basement walls had radiation levels from 15-22 μR/h (4-5.7 nC/kg/h) and the radiation level at the window was 20-25 μR/h (5.2-6.5 nC/kg/h). The higher radiation levels of the basement walls is believed to be attributable to natural radionuclides in the ceramic block. The window was opened to expose the slag and the count rate with the pancake probe was 50-200 cpm.

The slightly elevated radiation levels in the kitchen and at the basement backwall window do not pose an immediate health and safety concern and do not exceed the dose limits stated in 10 CFR 20 Subpart D "Radiation Dose Limits for Individual Members of the Public."

B. Sample Collection and Analysis

Three samples of the fill material have been collected from under the foundation of the home addition. One sample was collected by the homeowner in October of 1993 and the other samples were collected by NRC inspectors in October 1993 and January 31, 1994. These samples were analyzed by the Region III laboratory by gamma spectrometry. The two samples collected in October of 1993 were also sent to the Oak Ridge Institute for Science and Education (ORISE) laboratory for confirmatory gamma spectrometry and alpha spectrometry analysis.

The results of all the analysis are presented in the tables below. The sample collected by the homeowner is designated as 93-891 and the NRC samples as 93-900 and 94-122. In addition, the inspectors noticed that the fill material consisted of two components, a slag

component (A) and a sand (B) component. Portions of the samples were segregated into the individual components and analyzed separately. The amount of natural thorium and natural uranium in the gamma spectrometry tables were calculated by assuming equilibrium.

TABLE I
GAMMA SPEC ANALYSIS
NRC REGION III LABORATORY

Sample No.	Ra-226	Th-232	U-238	Natural Th	Natural U
93-891A	7.0 ± 0.1	5.6 ± 0.07	10.0 ± 8.7	11.2 pCi/g	20.0 pCi/g
93-891B	2.9 ± 0.6	4.4 ± 0.04	5.3 ± 2.7	8.8 pCi/g	10.6 pCi/g
93-900A	0.8 ± 0.4	0.9 ± 0.3	≤ 0.6	1.8 pCi/g	≤ 1.2
93-900B	3.5 ± 0.7	6.7 ± 0.6	6.9 ± 3.4	13.4 pCi/g	13.8 pCi/g
94-122	3.4 ± 0.6	5.6 ± 0.09	6.6 ± 3.3	11.2 pCi/g	13.2 pCi/g

TABLE II
GAMMA SPEC ANALYSIS
ORISE RADIOLOGICAL LABORATORY

Sample No.	Ra-226	Th-232	U-238	Natural Th	Natural U
93-891	4.6 ± 0.9	5.9 ± 1.1	8.7 ± 4.4	11.8 pCi/g	17.4 pCi/g
93-891A	8.1 ± 0.6	6.0 ± 0.9	5.6 ± 3.1	12.0 pCi/g	11.2 pCi/g
93-891B	5.0 ± 0.6	4.8 ± 0.7	3.4 ± 2.7	9.6 pCi/g	6.8 pCi/g
93-900	2.5 ± 1.0	4.1 ± 1.9	4.4 ± 4.6	8.2 pCi/g	8.8 pCi/g
93-900A	≤ 0.4	0.6 ± 0.3	0.8 ± 0.3	1.2 pCi/g	1.6 pCi/g
93-900B	2.4 ± 0.6	3.8 ± 1.0	6.7 ± 4.5	7.6 pCi/g	13.4 pCi/g

TABLE III
ALPHA SPEC ANALYSIS FOR TOTAL THORIUM
ORISE RADIOLOGICAL LABORATORY

Sample No.	Th-232	Th-230	Th-228	Natural Th
93-900B	4.7 ± 0.3	10.3 ± 0.5	4.6 ± 0.3	9.3 ± 0.4 pCi/g
93-891A	5.6 ± 0.4	13.0 ± 0.6	5.7 ± 0.4	11.3 ± 0.6 pCi/g
93-891B	6.2 ± 0.4	12.7 ± 0.6	6.2 ± 0.4	12.4 ± 0.6 pCi/g

TABLE IV
ALPHA SPEC ANALYSIS FOR TOTAL URANIUM
ORISE RADIOLOGICAL LABORATORY

Sample No.	U-238	U-235	U-234	Natural U
93-900B	3.1 ± 0.3	0.2 ± 0.1	3.8 ± 0.3	7.3 ± 0.4 pCi/g
93-891A	4.6 ± 0.3	0.2 ± 0.1	4.9 ± 0.3	9.9 ± 0.4 pCi/g
93-891B	3.9 ± 0.3	0.2 ± 0.1	4.7 ± 0.3	8.8 ± 0.4 pCi/g

5. Discussion of the Radioanalytical Results as Related to Origin and Dose

The following observations are made:

- The thorium is in equilibrium.
- The uranium has slightly elevated levels of both uranium-234 and thorium-230. The reason for this is unknown, although it indicates that the material has gone through processing.
- The material is not homogeneous physically or radiologically.
- The concentrations of radionuclides exceed the NRC guideline for release for unrestricted use. NUREG-5849 states that when multiple radionuclides are present, the sum of the ratios of the concentration of each radionuclide to its respective guideline must not exceed 1.0. The alpha spectrometry data from least concentrated of the NRC samples, 93-900B, has 9.3 pCi/g for natural thorium and 7.3 pCi/g for natural uranium. This would result in; 0.93 + 0.73 = 1.7. Further evaluation is warranted to accurately characterize this fill material.
- It is not evident that the slag was generated by licensed activities or from licensed source material. NUREG-1444 indicates that the radioactive slag presently at the SMC site contains less thorium-232 than uranium-238. However, the ORISE alpha spec data indicates that the thorium-232 concentration in the fill slag is higher than the uranium-238 concentration. Therefore, the slag on the fill material appears to have a different composition than the slag material under license at SMC. In addition, the process that used the source material ceased about 1972. This suggests that the slag distributed as fill in the early 1980's did not involve licensed material. Discussions with SMC employees that worked for Foote Mineral Company indicated that the slag from the ferrocolumbium process was formed into large "buttons" that were unsuitable for any use, and the buttons were stored onsite.

Therefore, the timeframe, the physical size, and the radionuclide composition would indicate that the fill was not generated from the licensed source material.

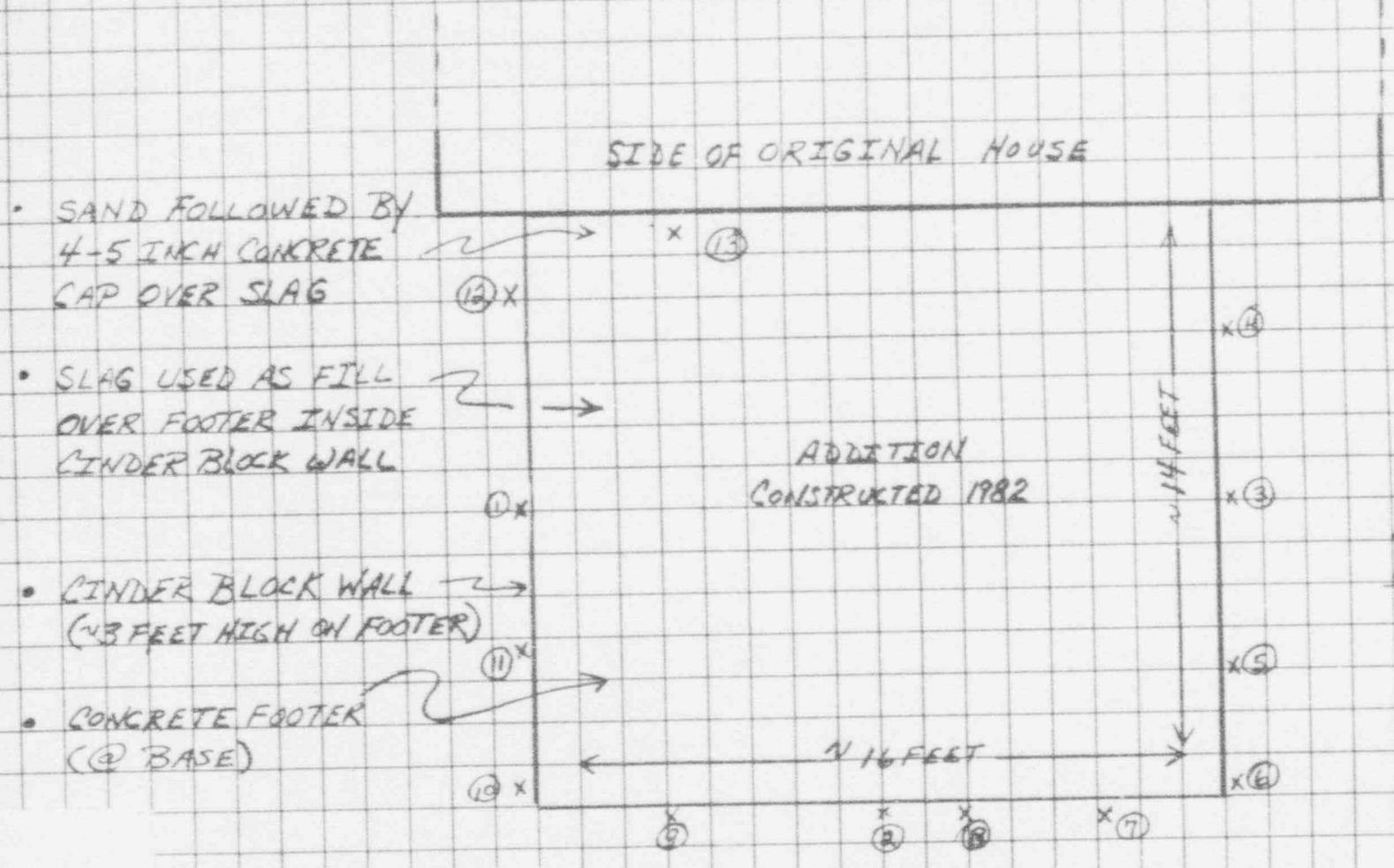
- The fill material does not have the same ratios of nuclides as the SMC zircon sand used in the Grainol process. The concentration of natural uranium in the zircon sand is a much higher than the concentration of natural thorium. This would indicate that the fill material did not come from slag resulting from Grainol production.

- RESRAD analysis of the potential dose from the fill material was conducted using the alpha spec data for uranium and thorium, and gamma spec data for radium-226. The analysis indicated that for the first ten years after placement, the dose would have been approximately 20 millirem per year (mrem/y) (0.2 milliSieverts per year - mSv/y). For the next 20 years, the dose will gradually rise to approximately 26 mrem/y (0.26 mSv/y) and then the dose will increase to a maximum level of 46.5 mrem/y after 100 years (0.47 mSv/y) (See Attachment C). These values are less than the 100 mrem per year specified in 10 CFR 20.1301(a)(1) as the dose limit for individual members of the public from licensed operations.

6. Exit Meeting

The inspectors discussed with the homeowner the results of the field surveys. The inspectors have also discussed the results of the sample analysis in subsequent conversations. The inspectors indicated that any further action by the NRC would be contingent on the results of further analysis and dose assessment.

FIGURE 1 - PLAIN VIEW OF ADDITION



BACKGROUND EXPOSURE RATE AT SITE
9-10 μR/h
80 CPM

EXPOSURE RATES (CPM)

① ~~80~~ CPM (SURFACE)
② 80-90 CPM (SURFACE)
③ 80-90 CPM (SURFACE)

EXPOSURE RATES (μR/h)

④ 12 μR/h (SURFACE)
⑤ 10 μR/h "
⑥ 10 μR/h "
⑦ 10 μR/h "
⑧ 10 μR/h (SURFACE)
⑨ 10 μR/h "
⑩ 10 μR/h "
⑪ 10 μR/h "
⑫ 10 μR/h "
⑬ 16 μR/h "

NOTE: EXPOSURE RATE MEASURED AT LOCATION #6 INSIDE CINDER BLOCK ON CONTACT WITH SLAG

ATTACHMENT A

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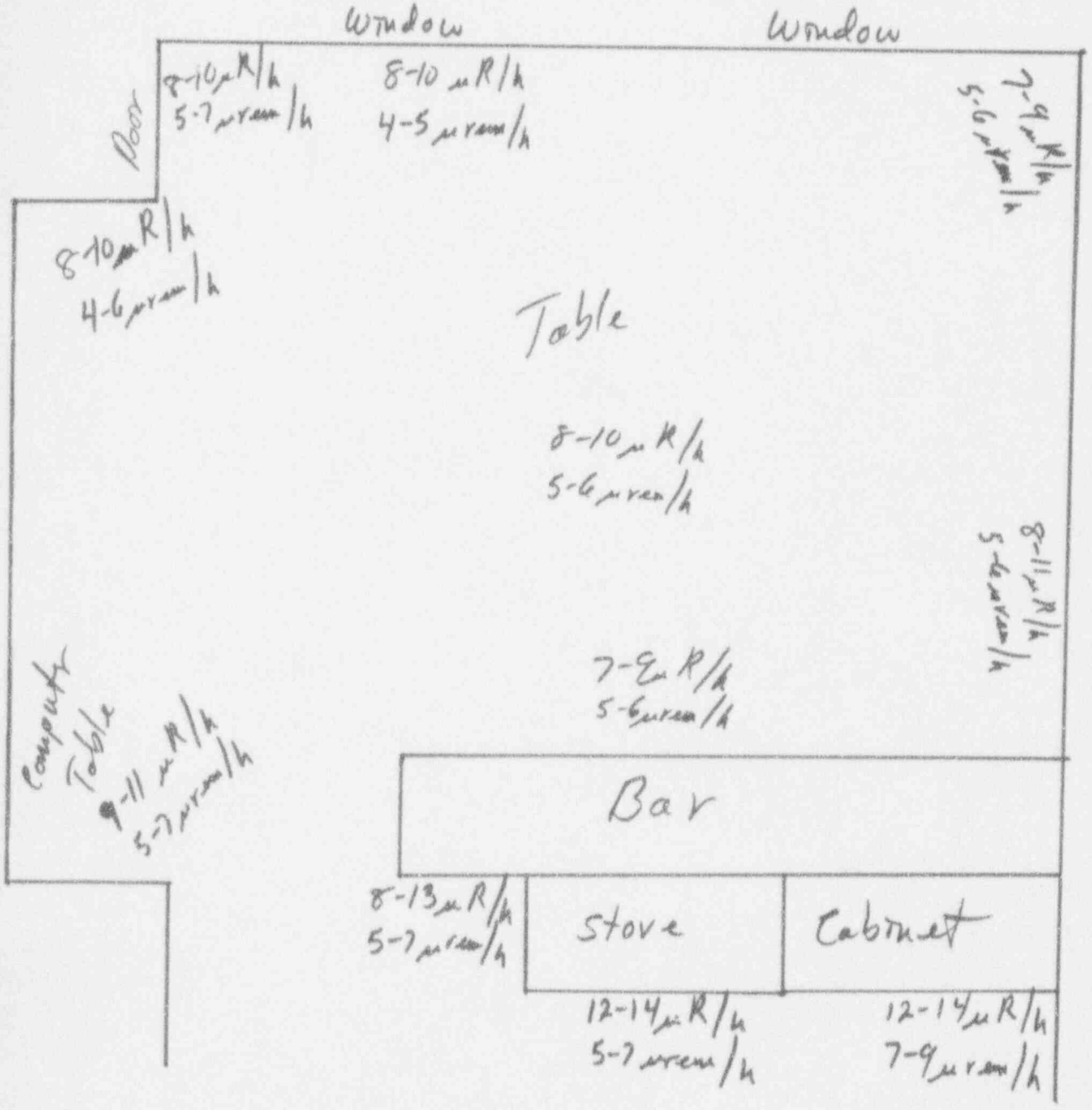
Schematic of Addition

14' x 16' 3"-4" Concrete Slab Floor

All measurements at Floor Level



ATTACHMENT B

RESRAD Analysis