U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 040-08948/93001(DRSS)

Docket No. 040-08948 License No. SMB-1507

Facility: Shieldalloy Metallurgical Corporation
Route 209 South
Cambridge, OH 43725

Inspection Conducted: October 6, 1993 through January 13, 1994

Inspectors: Donald Sreniawski — January 26, 1994
Senior Radiation Specialist — Date

Chad Glenn — January 26, 1994
Project Manager — Date

Raymant L. Glinski — January 26, 1994
Radiation Specialist — Date

George M. McCann, Chief — January 26, 1994
Fuel Facilities and Decommissioning Section — Date

Approved: Gary L. Shear — February 2, 1994
Gary L. Shear, Chief — Date
Fuel Cycle and Decommissioning Branch

Inspection Summary

Inspection on October 6 through January 13, 1994 (Report No. 040-08948/93001(DRSS))
Areas Inspected: This was an announced, limited scope safety inspection to evaluate the licensee's: (1) physical security and posting measures; (2) potential for release of licensed materials into the environment and the licensee's program to monitor for environmental releases; and (3) potential release of licensed materials off site. On December 13, 1993, NRC

inspectors obtained additional information regarding the licensee's thermoluminescent dosimetry (TLD) monitoring program, and the status of the groundwater and surface water monitoring program. The NRC inspectors performed direct radiation measurements, collected soil/sediment and water samples from around the immediate perimeter of the slag piles, Chapman Run (stream sample) and the Chapman Reservoir (source of Cambridge, Ohio's public water supply.) The NRC inspectors also visited offsite locations to perform radiation measurements and collect samples.

Results: Of the areas inspected, two violations of NRC requirements were identified:

1. Failure to adequately control access to licensed material(s) located in an unrestricted area, 10 CFR Part 20.207(a) and (b) [Section 4].

2. Failure to adequately post an area with "Caution Radioactive Material(s)" signs, 10 CFR Part 20.203(e) [Section 4].

Three areas of concern were also identified during the inspection as follows:

1. Contaminated slag may have been used offsite as fill material [Section 3].

2. Licensee's delay in implementing its "Groundwater and Surface Water Monitoring Program for the East and West Slag Piles at the Shieldalloy Metallurgical Corporation" plan as indicated in a 1992 letter to the NRC [Section 4].

3. Failure to maintain the West Slag Pile cover in order to prevent its deterioration [Section 4].

DETAILS

1. Persons Contacted

*# James Valenti, Shieldalloy Metallurgical Corporation (SMC), Environmental Manager and Radiation Safety Officer (RSO)
*#@Scott Eves, SMC, Vice-President, Environmental Services
*# Charles E. Montague, Plant Manager, SMC
* Jon W. Sedor, President, Local 5050, United Steel Workers of America
* Dwain C. Baer, Ohio Department of Health (ODH)
* Tom Matthews, SMC
# Carol Berger, IT Corporation, Consultant to SMC

A State of Ohio Health Official also assisted in surveying and collecting samples from the East and West slag piles and offsite locations. NRC inspectors visited and interviewed representatives of the Cambridge Water Treatment Plant, who provided radiological data on water samples of the public drinking water. Additionally, the NRC inspectors interviewed several SMC employees who had been employed by Foote Mineral.

*Denotes individuals present during the exit meeting on October 8, 1993.

#Denotes individuals present during the exit meeting on December 13, 1993.

@Denotes individual contacted by phone on January 20, 1994.

2. Background

Shieldalloy Metallurgical Corporation (SMC) assumed license responsibility from its predecessor, Vanadium Corporation of America (Foote Mineral (SMB-00850)) in 1987. The 120 acre (20 acres are developed) site is located south of Cambridge, Ohio. The previous owners of the site had processed licensable quantities of uranium and thorium (6.9×10^3 pounds [3.1×10^3 kilogram (Kg)], license possession limit) contained in columbium* ores. The ores were used to produce ferrocolumbium alloys. The radionuclides from the ores became incorporated into waste slag and are stored in two separate piles (west and east) on the site. SMC representatives indicated that ferrocolumbium production started approximately in 1957 and ended approximately in 1972. The approximate concentrations of source material in the columbium ores were 0.04% uranium and 2% thorium. SMC has decontaminated the manufacturing facilities and the adjoining areas. The only significant contamination remaining is that contained in the two slag piles. Attachment A is a map of the SMC site.

---

*Columbium is a commercial name for niobium.

3. Description of Radioactive Slag Waste Piles

a. West Pile:

This pile originally consisted of approximately 3.0×10^5 tons (3.0×10^{08} kgs) of slag and soil covering 7.6 acres with an average concentration of thorium-232 (Th-232), uranium-238 (U-238) and radium-226 (Ra-226) of 1.4 picocuries per gram (pCi/g) {52.0 millibecquerels per gram (mBq/g)}, 3 pCi/g {111 mBq/g}, and 2.4 pCi/g {89.0 mBq/g}, respectively. Following decontamination of the manufacturing facilities and adjoining areas, an additional 1.4×10^5 tons (1.4×10^{08} kgs) of higher concentration slag was added to the West Pile. The additional material had an average concentration of Th-232, U-238, and Ra-226 of 42 pCi/g {1.6×10^3 mBq/g}, 54 pCi/g {2.0×10^3 mBq/g}, and 42 pCi/g {1.6×10^3 mBq/g}, respectively. The top of the pile, according to SMC employees, is composed of at least 6-8 feet of cover material consisting of Chemfix (a clay-like material), a geotextile cover material, and approximately 6-8 inches of sand. This covers the top of the slag pile only. The shoulders of the piles are not covered and the slag is exposed. The licensee indicated during the December 13, 1993 exit meeting that it had planned to put a similar cover over the shoulder and then cover the entire pile with another 2 feet of soil and seeding. However, the licensee delayed this phase in 1991 when it failed to obtain final NRC approval for the containment request. Attachment B is a picture of the construction of the Chemfix cover.

b. East Pile:

This pile is uncovered and consists of approximately 9.0×10^4 tons {9.1×10^7 kgs} of slag covering 2.6 acres with an average concentration of Th-232 of 4 pCi/g {1.5×10^2 mBq/g}, U-238 of 21 pCi/g {7.8×10^2 mBq/g} and Ra-226 of 66 pCi/g {2.4×10^3 mBq/g}.

c. Remainder of Site:

Shieldalloy has decontaminated all of the site to below Option 1 levels, except for the slag piles. Confirmatory surveys have been performed by Oak Ridge Associated Universities (ORAU) on the decontaminated areas.

d. Release of Slag to Off Site Locations:

Discussions with former Foote Mineral employees indicated that slag had been released off site. However, they were not aware of any differentiation as to whether it was ferrocolumbium slag or ferrovanadium slag (non-radiological residual from current metal smelting). SMC emphasized during these discussions, that after it assumed control of the plant, no columbium ores were used in the production of alloys. Some ferrovanadium slag was sold or given

away beginning in approximately 1980. The hot ferrovanadium slag was dumped into onsite ponds where it became gravel like. This gravel-like slag increased the utility of this material for capping, road-fill, and other industrial uses. It was also determined that Foote Mineral stopped using columbium ores during the early 1970s.

The use of potentially contaminated slag as fill at offsite locations is of concern to the NRC.

No violations of NRC requirements were identified. One area of concern was identified.

4. Licensee's Radiological and Security Controls

a. Direct Radiation Measurements

SMC initiated a thermoluminescent dosimetry (TLD) monitoring program on March 27, 1992. The TLDs are processed by a NVLAP approved vendor, which provides the TLD monitors and analyzes the badges for the licensee at quarterly intervals. The monitors are approximately 3 feet (one meter) above the ground. One badge is kept in the plant manager's office as a quality control. Four badges are located on the East Pile Fence, eight are in the vicinity of the West Pile, and two are used to establish environmental backgrounds. One background TLD is placed near the plant entrance and one at a residence across the road from the plant. Approximate locations of the TLD monitoring stations are indicated on Attachment C. The inspectors reviewed the TLD monitoring reports for the quarters between March 27, 1992 and July 1, 1993. A summary of the TLD data is outlined in Attachment D.

Review of the licensee's data indicates that the direct exposure from licensed materials in the West Slag Pile would not exceed the limits for an unrestricted area as specified in 10 CFR Part 20.1301, "Dose Limit for Individual Members of the Public." The total effective dose equivalent limit is 0.1 rem (1mSv) in a year and the external dose limit is 0.002 rem (0.02 mSv) in any one hour. The inspectors also determined that the exposure outside the security fence around the perimeter of the East Slag Pile would not exceed the 10 CFR Part 20.1301 limits.

SMC does not have a routine program for performing direct radiation survey measurements other than the TLDs. No records of licensee surveys were reviewed during this inspection.

b. Environmental Monitoring Program

Interviews of SMC staff determined that no routine environmental water sampling has been done by SMC to date. In a letter dated March 11, 1992, the Region III office asked SMC what its intentions were for conducting a routine sampling program. In a July 7, 1992 letter responding to the Region's letter, SMC indicated that it would implement a monitoring program in the fall of 1992. SMC submitted its proposed program, "Groundwater and Surface Water Monitoring Program for the East and West Slag Piles at Shieldalloy Metallurgical Corporation, Cambridge, Ohio" for NRC review. In a August 12, 1992 letter, the NRC stated, "Based on our review, the proposed program appears to be adequate to more fully characterize site geology, hydrogeology and groundwater quality, and to establish an appropriate ongoing monitoring program. The proposed program should also provide sufficient data for analysis of potential groundwater and surface water impacts from the decommissioning options that will be assessed in Shieldalloy Metallurgical Corporation's (SMC's) "Technical Basis Document."

During the inspection on December 13, 1993, the licensee's staff indicated that four new wells for monitoring groundwater had been installed. This will bring the total number of groundwater monitoring wells on the site to 18. The locations of these monitoring wells are indicated on Attachment E. Also, licensee representatives indicated that a routine water sampling program had not been initiated due to previous water sampling problems associated with groundwater flow patterns and the potential for mixing of surface and groundwater. It was also indicated that funding for the monitoring program had been delayed, due to SMC's bankruptcy proceedings. SMC's staff indicated that there would be two initial sampling phases conducted before the routine program would be implemented. Licensee representatives indicated that the first phase would be started on December 14, 1993. The second phase is planned for the Spring of 1994, with implementation of the routine program in the fall of 1994. The inspectors discussed the licensee's July 7, 1992 letter which stated, "SMC has provided the NRC, EPA and Ohio EPA a copy of the Groundwater and Surface Water Monitoring Program, which will be implemented during the fall of this year." The NRC inspectors expressed their concern regarding SMC's failure to advise the Commission of its decision to delay its sampling program.

<u>The licensee's failure to implement its ground/surface water monitoring program and its failure to notify the NRC of this change in plans, is an area concern.</u>

c. Security/Posting

(1) East Pile

The East pile is enclosed with an eight foot high steel fence and is posted "Caution Radioactive Materials." The access gate to this pile is locked. The entire area of the East pile is, for the most part, easily observed from the roadway into the plant and from the plant itself. No indication of unauthorized access to this pile was noted during the inspectors walk around of the area.

(2) West Pile

(A) Posting

Most of the West Pile can be accessed from adjoining properties from almost any direction. This pile can be easily accessed via Vanadium Road. There is no fencing around the pile, but there is a synthetic barrier around a portion of the pile to hold back silt run-off.

On October 6-8, 1993, the inspectors observed that the west pile perimeter had one "Caution Radioactive Materials" (CRM) sign posted on the steel fence leading from the main plant area. No other CRM signs were posted around this pile. "No Trespassing" signs were posted prominently around the pile. Evidence of human activity was noted in several areas adjoining this slag pile, such as shotgun shells in a dry creek bed on the west side of the pile and waste building material dumped on the north side.

On December 13, 1993, the inspectors observed the licensee had placed 5 more CRM signs around the perimeter of the pile. However, the inspectors noted that the curvature of the West Slag Pile makes it possible to access this pile without observing a CRM sign. In addition, the inspectors inquired regarding the licensee's policy and procedure for maintaining caution and warning signs (CRM and "No Trespassing"). The licensee indicated that an employee checks the piles approximately monthly. However, there was no formal policy or procedure to detect torn, defaced or missing signs.

10 CFR 20.203(e)(2) requires, in part, that each area in which natural uranium or natural thorium is stored in any amount exceeding one hundred times the quantity specified in Appendix C be conspicuously posted with signs bearing the radiation caution symbol and the

words: CAUTION RADIOACTIVE MATERIALS. The Appendix C quantity specified for natural uranium and natural thorium is 100 microcuries.

The failure to conspicuously post sufficient CRM signs, such that person(s) approaching this slag pile would be alerted to the presence of radioactive materials is a violation of 10 CFR Part 20.203(e)(2).

(B) Security

The West Pile can be accessed from adjoining properties from almost any direction. This pile can be easily accessed via Vanadium Road. There is no fencing around the pile, but there is a synthetic barrier around a portion of the pile to hold back silt run-off. The top portion of the 7.6 acre pile is covered with a multi-layer clay/sand cap approximately 6-8 feet (1.9-2.5 meters) thick. The inspectors noted that some of the signs were torn. The inspectors also inquired about policies to prevent unauthorized access or intrusion into the piles and maintenance of the silt barrier. Licensee representatives indicated that an employee visits the pile approximately once a month, primarily to check or replace the TLD monitors.

SMC uses a guard service on weekends from 11:00 p.m. Friday to 11:00 p.m. Sunday and on holidays. This guard stays primarily in the general plant area and the guard's main duties are fire detection and access control to main plant buildings. The inspectors determined during discussions with the licensee's staff that the security guards duties did not include checking the slag piles for intrusion or conditions of signs, etc.

10 CFR 20.207 (a) and (b) state, in part, that licensed materials stored in unrestricted areas be secured from unauthorized removal and that licensed material in an unrestricted area be under constant surveillance and immediate control of the licensee.

The failure to have a program to assure adequate surveillance and immediate control of licensed materials or physical barriers to prevent access to licensed materials stored in an unrestricted area, is a violation of 10 CFR 20.207(a) and (b). The failure to prevent access is also contrary to License Condition No. 13 which states, "The licensee shall prevent access to contaminated areas until they are suitable for release for unrestricted use".

d. West Pile Cover Maintenance

On October 6-8, 1993, the inspectors observed that the cap was in adequate condition with the exception of one 5 x 50 foot (approximately 1.5 x 15.4 meters) gully where the geotextile material was exposed. Even though the sand portion of the capped area had eroded down to the geotextile layer, more than 6-8 feet (1.9-2.5 meters) of non-radioactive material covers the majority of the contaminated slag. On December 13, 1993, during the walk-over of the pile top, it was determined that the licensee had repaired the previously noted eroded area. However, several small eroded areas, approximately 5-12 inches (12.7-30.5 cm) in width were noted.

Maintenance of the capped West Pile was discussed with the licensee and it was determined that SMC has no routine program for upkeep of the sand cover. The purpose of the sand cover is to protect the geotextile barrier, which is subject to deterioration when exposed to weather. The geotextile cover is considered an important component of the cover system, therefore protection and maintenance of the sand cover to prevent its deterioration is important.

The failure to prevent deterioration of and to maintain the West Slag Pile cover is an area of concern to the NRC.

Two violations of NRC requirements were identified. Also, two areas of concern were identified.

5. NRC Surveys Conducted

Direct radiation surveys were performed and samples collected at the locations described below:

a. East Pile:

(1) A number of surface count rate and 1 meter exposure rate measurements were taken. The measurements ranged from approximately 120 counts per minute (cpm) to 800 cpm and 20 microreontgens per hour (μR/h) [5.16 nanocoulomb per kilogram per hour [nC/kg/h]] to 150 μR/h [38.7 nC/kg/h]. The average gamma radiation level was 10 μR/h (2.58 nC/kg/h). The survey results are documented in Attachment F and the locations of the measurements are indicated on the Attachment G. Natural background radiation levels for the site were approximately 75 cpm and 10 μR/h (2.58 nC/kg/h).

(2) A number of soil samples were collected from around the perimeter of this pile. The locations of these samples are indicated on Attachment G. The railroad and entrance road to the plant form an embankment on the south and east side of the East Slag Pile. The direct exposure rate

measurements (cpm) at the soil sample locations around the East Slag Pile and gamma spectroscopic analysis of the samples are listed in Attachment H. Analysis of the soil samples determined that the total activity for each sample collected was well below the NRC unrestricted use guideline value of 10 pCi/g (370 mBq/g) for natural thorium and uranium.

b. West Pile

(1) Direct radiation measurements were performed over the top and sides of the pile. The direct radiation exposure rates on top of the pile were 9-12 μR/h (2.3-3.1 nC/kg/h) at the surface. The exposure rates on the sides ranged from 10-35 μR/h (2.58-9.03 nC/kg/h) at the surface, with a general reading of 10 μR/h (2.58 nC/kg/h).

(2) Biased (area of most likely concentration) soil and surface water samples were collected from around the West Slag Pile to detect any evidence of radiological contamination. The sample locations, exposure rate measurements and soil analysis results are presented in Attachment I.

The water samples were sent to the Oak Ridge Institute for Science and Education (ORISE) laboratory for analysis. The water samples collected from free running water supplies, (i.e., the stream by the Railroad Crossing (onsite), Cambridge Reservoir (offsite) and Chapman Run (two samples, one onsite and one offsite)) were below the U.S. Environmental Protection Agency (EPA) Public Drinking Water Limits for gross alpha and gross beta particle activity of 15 and 50 pCi/l (555-1,850 mBq), respectively. The results are presented in Attachment J. These samples averaged less than 3 pCi/l alpha (111 mBq/l) and had a range of beta activity of 3 pCi/l to 22 pCi/l (111-814 mBq/l). The water samples taken around the pile had elevated beta measurements ranging from 52 pCi/l to a maximum 270 pCi/l (1,924-9,990 mBq/l). Based on the ORISE gamma isotopic analysis (Attachment K), it appears that these elevated levels of gross beta are due to high concentrations of naturally occurring potassium-40 (ranging up to 184±83 pCi/l) [6,800±3100 mBq/l]. Further, on the day the samples were collected, the sanitary lift station had malfunctioned and was pumping large quantities of sewage into the area.

None of the soil/sediment samples collected by the NRC exceeded the guideline values of 10 pCi/g (370 mBq/g) for natural uranium and natural thorium.

c. Public Water Supply

NRC inspectors visited the Water Treatment Plant for the City of Cambridge because of the proximity of the city's drinking water intake to the SMC site. Surface water at the SMC site flows generally to the north and west toward Chapman Run and ultimately to Wills Creek. The city of Cambridge draws its drinking water from Wills Creek approximately 2 miles downstream from the SMC site and this water is pumped to Cambridge Reservoir. Water from Cambridge Reservoir is gravity fed to the Cambridge Water Department where fluoride, lime, aluminum sulfate are added and the water is then run through sand filters before being discharged to the public drinking water system.

A substantial amount of information was available on the quality of drinking water for the city of Cambridge due to the routine water testing and analysis conducted by the city. Water Treatment Plant employees invited NRC staff to look over these water analysis reports. These reports provide water analysis information for a number of water contaminants, including radiological parameters. Eleven randomly selected reports spanning a period of time from February 1980 to February 1993 were reviewed. The gross alpha and gross beta concentrations averaged approximately 3 pCi/l and 4 pCi/l (111 and 148 mBq/l), respectively

The NRC inspectors obtained a water sample from Wills Creek at the intake point for the city of Cambridge drinking water (offsite). A water sample was also taken just east of SMC's East Slag Pile where an unnamed drainage ditch passes under the railroad tracks (onsite). One final water sample was obtained from Chapman Run where the creek intersects with Route 209 a short distance east of the entrance to SMC (offsite). The results are presented in Attachment J.

d. Slag and Sand Samples

Two slag samples were collected from SMC's current ferrovanadium slag pile adjacent to the Mill Building. Radiation count rates at these two sampling points were 60-80 cpm beta-gamma (background is 50-60 cpm). A sample of zirconium sand which was used in the past production of an alloy which resulted in a "Grainol" slag was collected. Radiation measurements at this sampling point were in the range of 70-90 cpm. The licensee possesses approximately 6.0×10^3 pounds (2.7×10^3 kg) of this material. The analytical results of these samples are presented in Attachment L. Review of these data indicates that the current slag materials are well below the NRC guidelines for unrestricted use.

6. Radiation Detection Instrumentation

The following radiation detection instrumentation was used during the inspection:

a. Ludlum Model 14C, with an Eberline model H-260 "pancake" probe attached, calibrated August 10, 1993.

b. Ludlum Model 19, MircoR Meter, NRC Tag Number 11021, calibrated May 8, 1993

All meters were checked for constancy and operability with radioactive check sources prior to use.

7. Exit

At the conclusion of the onsite inspections on October 8 and December 13, 1993, the inspectors met with those individuals identified in Section 1 of this report. A summary of those areas inspected, the violations, areas of concern, and the forthcoming letter were discussed. The licensee did not identify any information provided during the inspection as proprietary.

Attachments:
A. SMC Site map
B. Picture of SMC Chemfix Cap under construction (West Pile)
C. SMC Site Map (TLD Monitoring Station)
D. SMC TLD Data Summary
E. SMC Site Map (Water Monitoring Wells Locations)
F. Radiation Survey Measurements East Pile
G. RMT Map of the SMC Site
H. Soil Analysis Results - East Pile
I. Soil Analysis Results - West Pile
J. ORISE Water Gross Alpha/Beta Analysis Results
K. ORISE Water K-40 Analysis Results
L. Analytical Results for Ferrovan Slag and Zircon Sand

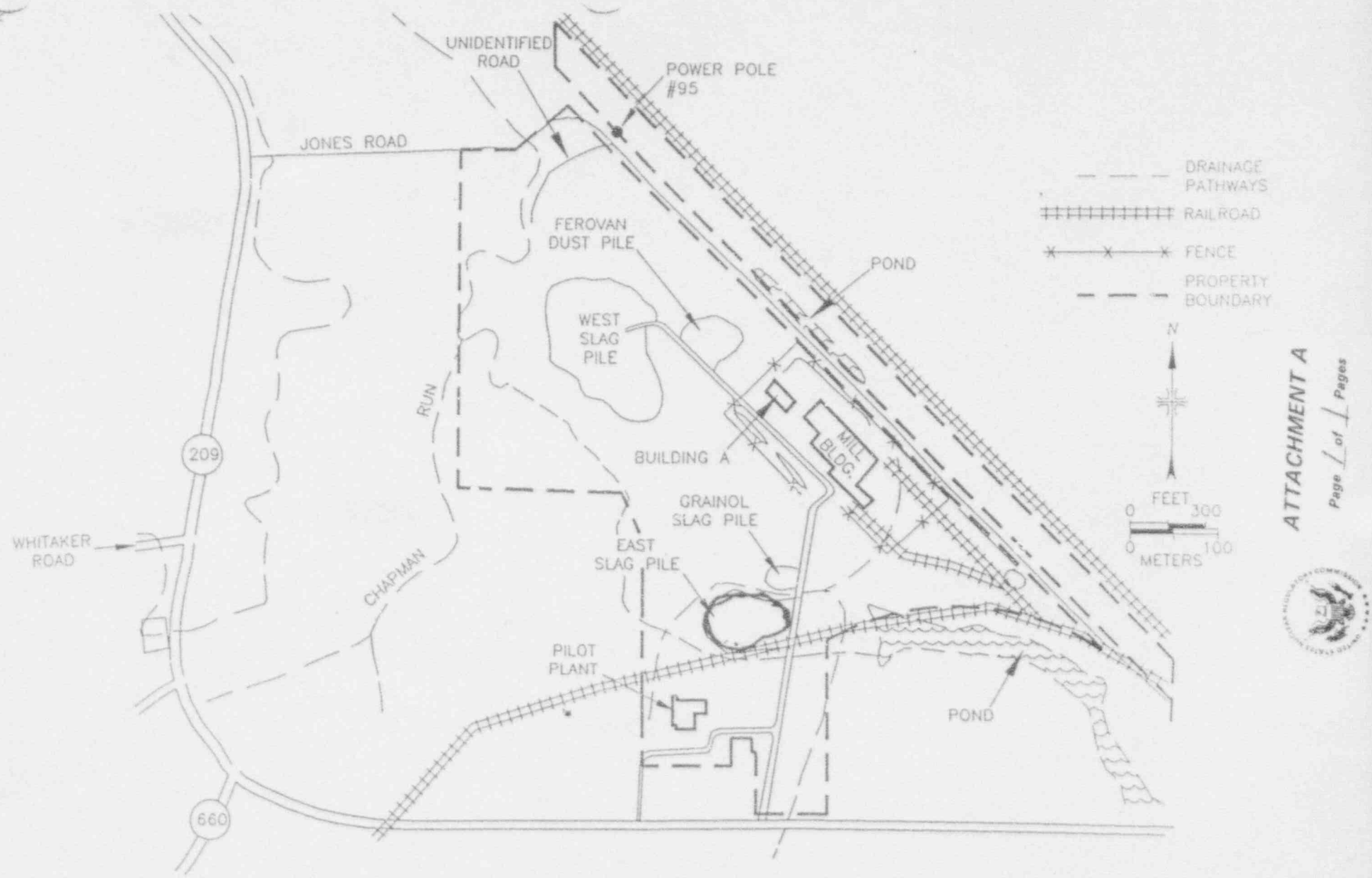
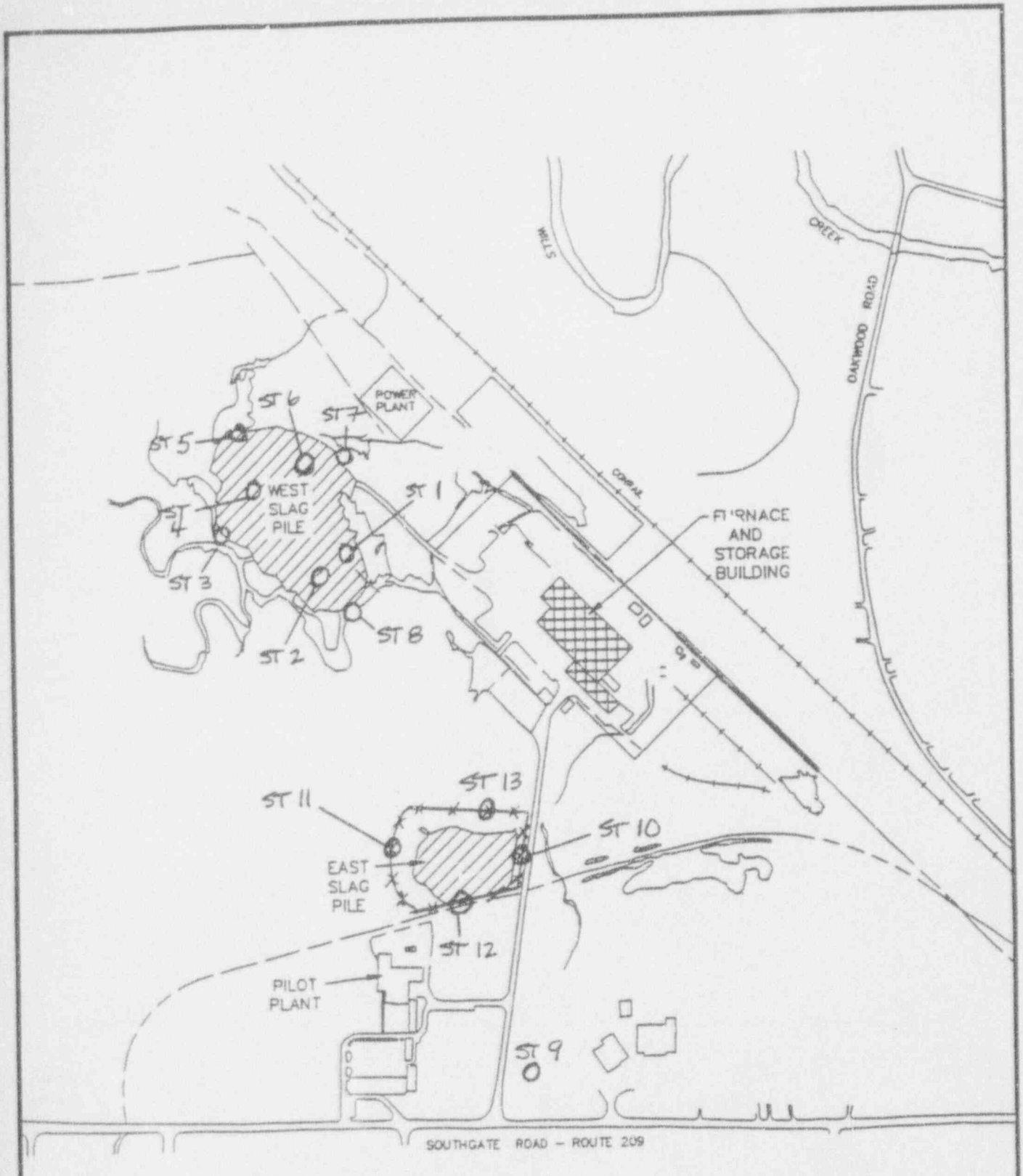


FIGURE 2: Shieldalloy Corporation, Cambridge, Ohio Plant
Property Layout Indicating Prominent Surface Features

ATTACHMENT A
Page 1 of 1 Pages

ATTACHMENT B

Page 1 of 1 Pages



ENSR CONSULTING & ENGINEERING

FIGURE 1-1
SITE MAP
SHIELDALLOY METALLURGICAL CORP.
CAMBRIDGE, OHIO PLANT

DRAWN BY:	DATE:	PROJECT NO.
KLU	5/90	5990-001

ATTACHMENT C
Page 1 of 1 Pages

0222A

ATTACHMENT D

SHIELDALLOY METALLURGICAL CORPORATION

ENVIRONMENTAL TLD DATA SUMMARY

- Average mrem/month - annualized, for control badge, 3.0 mrem - 36 mrem/year.
- Average mrem/month - annualized, for background badge located at the plant entrance, 3.0 mrem - 36.0 mrem/year.*
- Average mrem/month - annualized, for background badge located at the TAM building, 4.0 mrem - 48.0 mrem/year*
- Average mrem/month - annualized, for the West Slag Pile, 2.0 mrem - 24.0 mrem/year.*
- Maximum mrem/month - annualized, for the West Slag Pile, 5.5 mrem - 66 mrem/year.*
- Average mrem/month - annualized, for the East Slag Pile, 18.7 mrem - 224 mrem/year.*
- Maximum mrem/month - annualized, for the East Slag Pile, 22.4 mrem - 418 mrem/year.* The highest TLD values were consistently those place at the southern portion of the East Slag Pile, Station 12.

* Background subtracted

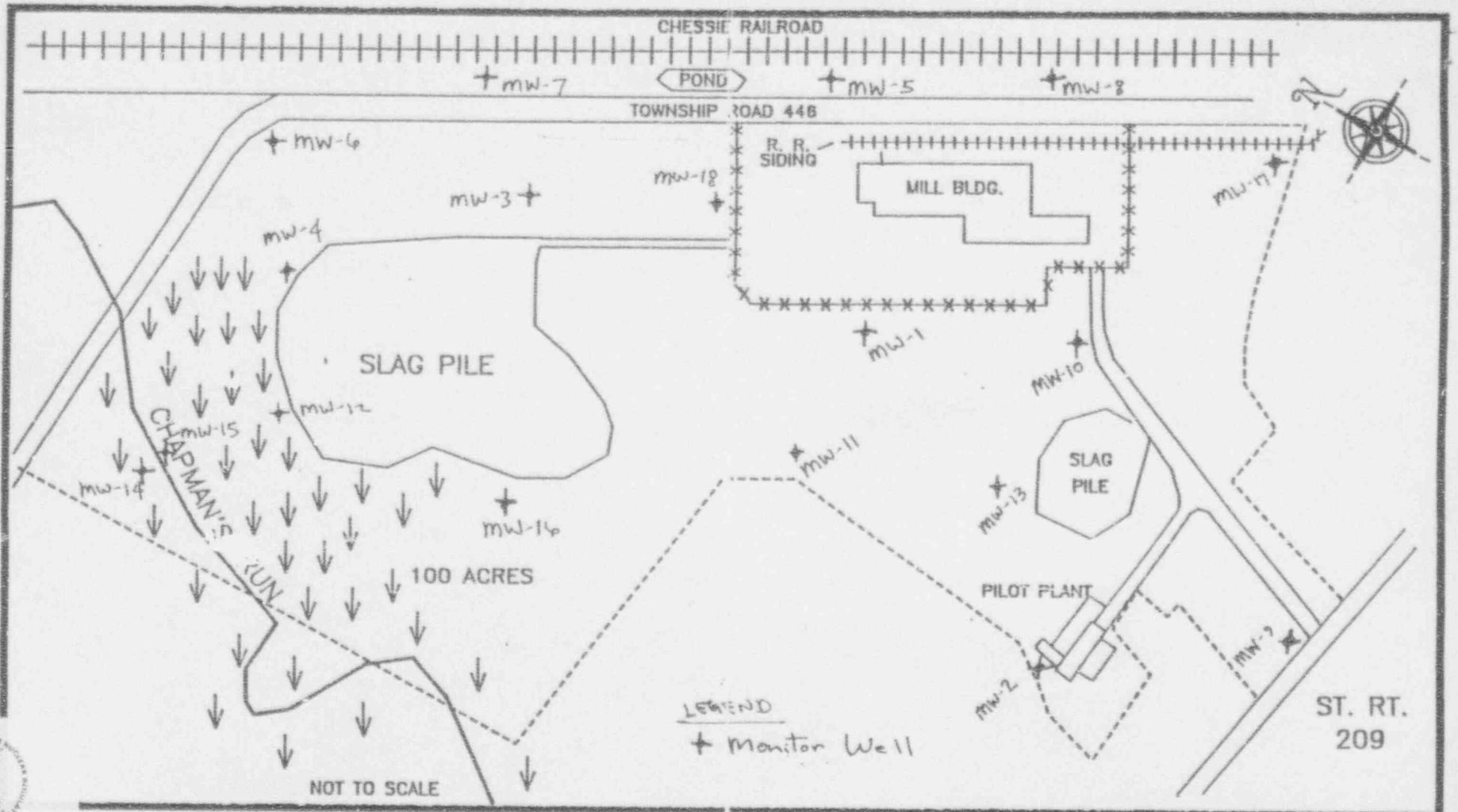


FIGURE 2
DETAILED SITE MAP
HIELDALLOY METALLURGICAL CORPORATION
CAMBRIDGE, GUERNSEY COUNTY, OHIO

LEGEND

MARSH AREA | PROPERTY BOUNDARY | FENCE | RAILROAD TRACKS

WESTON MANAGERS DESIGNERS/CONSULTANTS
MAJOR PROGRAMS DIVISION
REGION V TECHNICAL ASSISTANCE TEAM

DRAWN BY	DATE	PCS #
S.L. BASHAM	01-23-90	2270
APPROVED BY	DATE	TDD #
L.R. MENCIN	01-23-90	5-8907-01

ATTACHMENT 3

Page 1 of 1 Pages

ATTACHMENT F

SHIELDALLOY METALLURGICAL CORPORATION

Radiation Survey Measurements East Pile

The following radiation measurements on the East Slag Pile are keyed to numbered locations on NRC Inspector's site map, Attachment G:

(1) 1,600 counts per minute (cpm) (surface), 100 microreontgen per hour (μR/h) (waist)*;

(2) 400 cpm (surface), 45 μR/h (waist);

(3) 600 cpm (surface), 95 μR/h (waist);

(4) 700 cpm (surface), 85 μR/h (waist);

(5) 700 cpm (surface), 105 μR/h (waist);

(6) 700 cpm (surface), 70 μR/h; (waist)

(7) 700 cpm (surface), 130 μR/h (waist);

(8) 600 cpm (surface), 135 μR/h (waist);

(9) 600 cpm (surface), 125 μR/h (waist);

(10) 800 cpm (surface), 120 μR/h (waist);

(11) 700 cpm (waist), 150 μR/h (waist);

(12) 700 cpm (surface), 70 μR/h (waist);

(13) 800 cpm (surface), 150 μR/h (waist);

(14) 400 cpm (surface), 25 μR/h (waist);

(15) 120 cpm (surface), 20 μR/h (waist);

(16) 250 cpm (surface), 25 μR/h (waist).

10μR/h is approximately equal to 2.58 nanocoulomb per kilograms per hour(nC/kg/h)

ATTACHMENT H

SHIELDALLOY METALLURGICAL CORPORATION

			Analysis of the soil/ sediment samples	Surface Measurements cpm
	EAST SLAG PILE		pCi/g	
1.	Sample #7 (North)	Ra-226	0.9 ± 0.04	110
		Th-232	1.6 ± 0.03	
		U-238	<1.0	
2.	East Pile-8.5	Ra-226	1.5 ± 0.04	140
		Th-232	1.3 ± 0.04	
		U-238	<0.8	
3.	East Pile (North #15)	Ra-226	0.7 ± 0.04	60
		Th-232	1.4 ± 0.03	
		U-238	<1.0	
4.	East Pile (#21)	Ra-226	1.1 ± 0.03	100
		Th-232	1.0 ± 0.02	
		U-238	<0.5	
5.	East Pile (West #10)	Ra-226	0.5 ± 0.03	100
		Th-232	0.4 ± 0.02	
		U-238	<0.5	
6.	East Pile (South #10)	Ra-226	1.3 ± 0.04	180
		Th-232	1.8 ± 0.08	
		U-238	<0.9	
7.	East Pile (South #25)	Ra-226	1.5 ± 0.06	300
		Th-232	1.9 ± 0.08	
		U-238	<1.0	
		Environmental Background values		
		Ra-226	1.1 ± 0.04	
		Th-232	1.4 ± 0.03	
		U-238	<0.9	


WET AREA
WET AREA
CHAPMAN RUN
EAST SLAG PILE
RAILROAD TRACKS
PILOT PLANT
SOUTHGATE ROAD – ROUTE 209
EXPOSURE RATES
1. 100 μR/h(w); 400 CPM(s)
2. 45 μR/h(w); 400 CPM(s)
3. 95 μR/h(w); 600 CPM(s)
4. 85 μR/h(w); 700 CPM(s)
5. 105 μR/h(w); 700 CPM(s)
6. 70 μR/h(w); 700 CPM(s)
7. 130 μR/h(w); 700 CPM(s)
8. 135 μR/h(w); 600 CPM(s)
9. 125 μR/h(w); 600 CPM(s)
10. 160 μR/h(w); 800 CPM(s)
11. 150 μR/h(w); 700 CPM(s)
12. 70 μR/h(w); 700 CPM(s)
13. 150 μR/h(w); 800 CPM(s)
14. 45 μR/h(w); 400 CPM(s)
15. 20 μR/h(w); 120 CPM(s)
16. 25 μR/h(w); 250 CPM(s)
SOIL SAMPLES
E 85 190 CPM
E 21 100 CPM
N 7 110 CPM
N 15 60 CPM
S 10 180 CPM
S 25 300 CPM
W 10 100 CPM


E 16750
E 17000
E 17250
E 17500
E 17750
E 18000
E 18250
E 18500
E 18750
E 19000
E 19250
E 19500
E 19750
E 20000
NOTE SAMPLE LOCATION NO. 8 CONFLUENCE OF CHAPMAN RUN AND WILLS CREEK AT I-70
- LOCATION NO. 9 CITY OF CAMBRIDGE WATER PLANT (ON WILLS CREEK)
TO WILLS CREEK
SEWER PUMP STATION
ROAD
CONRAIL
POWER PLANT
12" CMP OVERFLOW
CULVERT
FIRE POND
PUMP HOUSE
WEST SLAG PILE
WILLS
CHAP. SPL.
W2 7-80
W3 7-80
X= WATER SPL.
⊙= Soil SPL.

ATTACHMENT I

SHIELDALLOY METALLURGICAL CORPORATION

			Soil/sediment Sample Analysis pCi/g	Surface Measurements cpm
WEST PILE SAMPLES				
1.	Sample #1	Ra-226	0.4 ± 0.03	60
		Th-232	0.6 ± 0.02	
		U-238	3.0 ± 2.5	
2.	Sample #2	Ra-226	0.6 ± 0.04	70-80
		Th-232	0.9 ± 0.03	
		U-238	<0.6	
3.	Sample #3	Ra-226	1.1 ± 0.08	70
		Th-232	1.4 ± 0.05	
		U-238	<0.6	
4.	Sample #4	Ra-226	0.6 ± 0.03	80
		Th-232	0.8 ± 0.02	
		U-238	<0.6	
5.	Sample #5	Ra-226	0.8 ± 0.07	70
		Th-232	1.3 ± 0.05	
		U-238	<1.0	
6.	Sample #6	Ra-226	0.7 ± 0.04	100
		Th-232	0.03 ± 0.03	
		U-238	<0.5	

RADIONUCLIDE CONCENTRATION IN SOIL AND SLAG
SAMPLES FROM SHIELDALLOY
CAMBRIDGE, OHIO

ATTACHMENT J

Page 1 of 1 Pages

GROSS ALPHA AND BETA ACTIVITIES IN WATER

Location or Sample I.D.	Activity (pCi/L)[a]	MDA (pCi/L)
Gross Alpha		
#1	-10 ± 7	14
#2	3 ± 13	24
#3	-27 ± 17	37
#4	-1.4 ± 3.9	7.3
Chapman Run	-5.4 ± 3.3	7.1
#6	-1 ± 5	10
Railroad Crossing-East Pile	3.0 ± 1.4	2.1
Cambridge Reservoir	-0.8 ± 2.2	4.1
Chapman Run	-3.8 ± 2.4	5.1
Gross Beta		
#1	81 ± 14	19
#2	270 ± 30	30
#3	220 ± 40	50
#4	52 ± 8	10
Chapman Run	22 ± 6	10
#6	100 ± 11	14
Railroad Crossing-East Pile	11 ± 2	3
Cambridge Reservoir	8.2 ± 3.8	6.1
Chapman Run	3 ± 9	16

[a]Uncertainties represent the 95% confidence level based only on counting statistics.

RADIONUCLIDE CONCENTRATIONS IN WATER
SHIELDALLOY, CAMBRIDGE, OHIO

Water Sample #	pCi/L Determined by Gamma Spectroscopy
	K-40
1	73 ± 96[a]
2	184 ± 83
3	170 ± 110
4	< 130
Chapman Run	< 120
6	70 ± 110
Rail Road Crossing East Pile	< 96
Cambridge Reservoir	25 ± 95
Chapman Run	< 130

[a]Uncertainties represent the 95% confidence level based only on counting statistics.

ATTACHMENT # K

Page 1 of 1 Pages

ATTACHMENT L

SHIELDALLOY METALLURGICAL CORPORATION

Analysis of "Ferrovanadium Slag" and Zircon Sand

NRC Sample	pCi/g
Zircon Sand	
radium-226 (Ra-226)	66.3 ± 0.4
thorium-232 (Th-232)	8.9 ± 0.2
uranium-238 (U-238)	74.4 ± 20.1
Ferrovanadium Slag (dust)	
radium-226 (Ra-226)	1.3 ± 0.07
thorium-232 (Th-232)	1.8 ± 0.05
uranium-238 (U-238)	<0.5
Ferrovandium Slag (slag)	
radium-226 (Ra-226)	1.2 ± 0.03
thorium-232 (Th-232)	1.5 ± 0.02
uranium-238 (U-238)	<0.6

ATTACHMENT L

SHIELDALLOY METALLURGICAL CORPORATION

Analysis of "Ferrovanadium Slag" and Zircon Sand

NRC Sample	pCi/g
Zircon Sand	
radium-226 (Ra-226)	66.3 ± 0.4
thorium-232 (Th-232)	8.9 ± 0.2
uranium-238 (U-238)	74.4 ± 20.1
Ferrovanadium Slag (dust)	
radium-226 (Ra-226)	1.3 ± 0.07
thorium-232 (Th-232)	1.8 ± 0.05
uranium-238 (U-238)	<0.5
Ferrovandium Slag (slag)	
radium-226 (Ra-226)	1.2 ± 0.03
thorium-232 (Th-232)	1.5 ± 0.02
uranium-238 (U-238)	<0.6