IEM

Integrated Environmental Management, Inc.

Soil Sampling/Survey of Storage Yard After Remediation

Shieldalloy Metallurgical Corporation

Report No. 94005/G-18198

Soil Sampling/Survey of Storage Yard After Remediation

Submitted to:

Shieldalloy Metallurgical Corporation
12 West Boulevard
Newfield, New Jersey 08344
(856) 692-3270

by:

Integrated Environmental Management, Inc.
9040 Executive Park Drive, Suite 205
Knoxville, Tennessee 37923
(423) 531-9140

Report No. 94005/G-18198
January 20, 2000

TABLE OF CONTENTS

INTRODUCTION 1
Purpose and Scope 1

FACILITY INFORMATION 2
Contaminants of Concern 2
Release Criteria 2

SURVEY METHODOLOGY 3
Project Organization 3
Radiation Safety Procedures 3
Detection Limits 3
Survey Protocol 4
Reference Grid System for Survey Measurements 5
Data Conversion 5
Sampling Objectives 5
Sampling Protocol 6

RESULTS 7
Remedial Actions/Survey Results 7
Analytical Results 8
Comparison of Results 8

SUMMARY AND CONCLUSIONS 9

TABLES 10
Table 1 - Site-specific Release Criteria 11
Table 2 - Survey Instrumentation 12
Table 3 - Background Concentrations at the SMC Newfield, NJ Facility 13

FIGURES 14
Figure 1 - Newfield Facility Showing Storage Yard 15

APPENDICES 16
Appendix A - Personnel Qualifications 17
Appendix B - Instrument Calibration Sheets 32
Appendix C - Daily Instrument Check Sheets and Field Logs 33
Appendix D - Survey and Sample Collection Maps 34
Appendix E - Analytical Results for Soil Samples Collected 35
Appendix F - Wilcoxon Rank Sum Tests for Uranium and Thorium Results 36

INTRODUCTION

Shieldalloy Metallurgical Corporation (SMC) operates a facility located in Newfield, New Jersey. This facility manufactures or has manufactured specialty steel and super alloy additives, primary aluminum master alloys, metal carbides, powdered metals, and optical surfacing products. Raw materials currently used at the facility include beneficiated ores which contain oxides of columbium (niobium), vanadium, aluminum metal, titanium metal, strontium metal, zirconium metal, and fluoride (titanium and boron) salts. During the manufacturing process, the facility generates a variety of byproducts that have commercial application.

SMC is licensed by the U. S. Nuclear Regulatory Commission (USNRC) to ship, receive, possess, use, and store source material pursuant to License No. SMB-743. The primary forms of source material currently present at the site include ores used as feed to metallurgical operations, byproduct slag, and baghouse dust. The byproduct slag is being marketed to the steel industry as a synthetic slag fluidizer.

Purpose and Scope

A large area on the east side of SMC's Newfield facility, called the Storage Yard, has been used to store slags generated by its ferrocolumbium and ferrovanadium operations. The extreme eastern edge of the Storage Yard, adjacent to the current ferrocolumbium slag storage area, was determined to be no longer required to complete SMC's immediate mission and, as part of a state-administered remedial action, will be subject to re-forestation and deed restriction. Figure 1 shows the location of this area with respect to the remainder of the Storage yard.

Between March and May of 1999, an excavation contractor to SMC removed the soil and residual slag from the area in question to a depth of between one (1) and five (5) feet. All material removed was transferred to the west side of the Storage Yard. At the completion of the remedial actions, gamma walkover surveys were performed and soil samples were collected from within the remediated remediated area. The purpose of this effort was to demonstrate that the area in question contained no residual ferrocolumbium slag above the applicable release criteria.

This report contains the findings of the survey and sampling effort. Included herein is a brief description of the contaminants of concern and the applicable release criteria, a summary of the survey and sampling methodology, and the results obtained. SMC was given an opportunity to review and comment on a draft before this final report was issued.

FACILITY INFORMATION

Contaminants of Concern

SMC is licensed to possess uranium and thorium in any form suitable for transport under Department of Transportation regulations. Previous studies of the radionuclide content of the materials typically found at the site are indicative of a natural distribution of the radioactive progeny of these series radionuclides. Therefore, the contaminants of concern for this final status survey include ^{232}Th plus progeny in equilibrium and ^{238}U plus progeny in equilibrium.

Release Criteria

Radiation Safety Procedure No. RSP-009, "Contamination Control" contains the release criteria for the Newfield facility. These criteria are also shown in Table 1.

For the walk-over survey, a screening level of 15 microR per hour above background at a distance of two (2) cm from the soil surface was used.[1] To ensure that the remedial action was comprehensive, however, any location that exhibited an exposure rate that could be distinguished from background was subject to additional remedial action prior to resurvey.

[1] Berger, C.D., Integrated Environmental Management, Inc., "Screening Criteria for Soils", written communication to David R. Smith, Shieldalloy Metallurgical Corporation, September 1, 1998.

SURVEY METHODOLOGY

Project Organization

The field work for this effort was performed under the direction of Mr. Alan Duff, R.R.P.T., an employee of Integrated Environmental Management, Inc. (IEM). During performance of the Storage Yard survey/sampling, Mr. Duff was responsible for directing the work of other support staff, performing survey activities, and assisting in the compilation of this report.

Technical oversight for the project was the responsibility of Ms. Carol Berger, C.H.P., and Mr. Brian A. Kelly, C.H.P., P.E., employees of IEM. Ms. Berger reviewed and approved all project plans, assisted in the review of the quality of data collected and this report, and provided an interface between SMC and project personnel. Mr. Kelly assisted in the preparation of this report.

The field team was comprised of two health physics technicians who were qualified as "Radiation Surveyors" pursuant to Shieldalloy Metallurgical Corporation Radiation Safety Procedure No. RSP-006, "Training and Qualification of Radiation Personnel". Mr. Duff served a dual role as both health physics technician and field manager. Mr. Craig Brune served as the other health physics technician.

Appendix A contains a summary of the qualifications of all project survey personnel. Representatives of SMC observed some or all of the survey activities while they were on-going. In addition, a U. S. Nuclear Regulatory Commission inspector observed portions of the post-remediation survey conducted on September 9, 1999.[2]

Radiation Safety Procedures

Health and safety provisions were established to permit the survey and sampling activities to be conducted without adverse impacts on worker health and safety. These provisions complied with all applicable provisions of License No. SMB-743, the SMC Radiation Safety Procedures and, as necessary, IEM's Radiation Safety Procedures. The topics applicable included work area entry, control of work, training, emergency procedures, ALARA, and non-radiological hazards.

Detection Limits

To ensure that walkover surveys were sufficiently sensitive, the minimum detectible concentration (MDC) was calculated in accordance with Section 6.7.2.1 of MARSSIM (Scanning for Beta and Gamma Emitters - Scan MDCs for Land Areas). The Microshield computer code was used to determine the exposure rate for a one-inch diameter piece of ferrocolumbium slag, which was buried under one inch of soil. The results of this analysis showed that the exposure rate for a

[2] The inspector who observed the surveys was Ms. Marie Miller, U. S. Nuclear Regulatory Commission, Region I, King of Prussia, PA.

piece of slag would be in the range 3.9 to 5.8 μR/hour, depending on whether the soil was covered with water or not.[3]

Using the same size for the slag piece to be detected, the minimum detectible count rate (MDCR) for a surveyor using a two-inch by two-inch sodium iodide detector was calculated. For a surveyor scanning at a speed of 1.0 foot/second with a background of 5,000 cpm, the MDCR was determined to be 690 counts per minute, assuming an index of sensitivity of 1.38 (consistent with a false positive proportion of 0.6 and a true positive proportion of 0.95) and a surveyor efficiency (p) of 0.5:

$$MDCR_{surveyor} = \frac{1.38 * \sqrt{5{,}000\ cpm * \frac{m}{60s} * 0.417\ s * \frac{60s}{m}}}{\sqrt{0.5}}$$

Converting the MDCR to an exposure rate using the detection sensitivity in Table 2, the surveyor was thus capable of achieving a scan MDC of 0.8 μR/hour above background. Since this value is well-below the target exposure rate range established with the Microshield code, the walkover surveys provided an adequate means of detecting the presence of residual slag even if buried.

Survey Protocol

Instrumentation used to acquire measurement data was appropriate for the type of radiation expected, of sufficient sensitivity and accuracy to detect the radioactive materials found at the SMC facility, and of sufficient quantity to support the activities. Each instrument was labeled with a unique identifier (e.g., serial number of detector and rate meter) to enable traceability between instrument and survey records. Table 2 contains a listing of each instrument type, its use during performance of the survey, and its nominal background response, detection efficiency and detection sensitivity. Additional details on the type, calibration and use of the instruments may be found in Appendix B. Copies of the daily instrument check forms are located in Appendix C.

The walk-over survey was conducted by walking over 100% of the surface to be monitored and moving the detector in a serpentine pattern with the detector in close proximity to the ground (i.e., less than two centimeters from the soil surface). When the health physics technician detected elevated activity in a particular location, he would pause and obtain a count rate in that area. Any area exhibiting residual radioactivity that was distinguishable from background was identified with a flag, eventually remediated, and the survey was repeated.

After the initial remedial action by the excavation contractor, four (4) separate site visits were made to perform and document walkover surveys and to collect soil samples. These occurred on May 17 through May 20, September 9, September 30 through October 1, and December 13, 1999. Additional remedial actions were performed between the site visits in response to findings.

---

[3] Microshield Version 5.01, Grove Engineering, 1996.

The walkover survey and soil sample collection were performed pursuant to the guidance contained in NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM). The effort included a walkover survey of all excavated areas and the land area immediately adjacent to the excavated areas, as well as collection of an appropriate number of soil samples as described in the following subsections.

Reference Grid System for Survey Measurements

A grid system was not established as part of this survey effort. Instead, survey and sample collection points were referenced to sections of the chain link fence that surrounds the Storage Yard. Each fence section spanned approximately 10 linear feet. This reference system was recorded on survey maps and is shown in Appendix D.

Data Conversion

Ambient gamma exposure rates from the walk-over survey were converted to units of net exposure rate by the following methodology:

$$R_{net} = (R_{gross} - BKG_{ave}) \times CF$$

where R_{net} = the net measured exposure rate (cpm), R_{gross} = the gross measured exposure rate (μR/hr or cpm), BKG_{ave} = the mean background exposure rate applicable to the survey (μR/hr or cpm), and CF = an optional conversion factor to convert count rate instrument readings into units of "μR/hr" if instrument read-outs were in "counts per minute".

Sampling Objectives

To ensure that an adequate number of samples was collected, the procedure specified in Section 5.5.2.2 of MARSSIM was utilized. The derived concentration guideline level (DCGL) was selected to be 2.5 pCi/g for either uranium or thorium, consistent with the site-specific release criteria captured in RSP-009 and Table 1. The lower bound of the gray region (LBGR) was selected to be the larger of the mean of ten background measurements shown in Table 3 for Thorium-232 and Uranium-238 (0.97 pCi/g for Thorium-232). In a similar manner, the standard deviation was selected to be that for Thorium-232 (0.47 pCi/g). Using these values, a relative shift of 3.25 was calculated.

From Table 5 of MARSSIM, a relative shift of three (3) and a conservative selection of confidence levels (α = 0.05, β = 0.05) results in the need for ten samples in order to make an adequate comparison of data. Since ten data points were already available in the background data set for the Newfield site, no additional background sampling was required. Thus a minimum of 10 samples were required from the remediated area of the Storage Yard.

Sampling Protocol

The selection of the sampling locations was designed to ensure even coverage over the entire area of interest in the Storage Yard. The location strategy utilized a stratified systematic unaligned sampling protocol.[4] This protocol was implemented as follows:

- As with the walkover surveys, a reference system was established using the fence posts on the east side of the Storage Yard. Each node of the reference system was associated with three fence posts. A total of fifteen reference squares were established in this manner.
- Each sample location was selected at random within each reference square.
- One kilogram (approximate) of soil was collected to a depth of six inches (15 cm).

On October 1, 1999, a total of 15 soil samples were obtained in this manner from the remediated area of the Storage Yard. These were forwarded to a commercial analytical laboratory for radiological analysis by the methodology of gamma spectroscopy.[5] The radionuclide concentrations were reported in units of "picocuries per gram". The locations of the soil samples from the survey area and the background soil sample locations are shown on maps located in Appendix D.

---

[4] Toohey R.E., Brown W., and Stebbings J.H., "Random Geographic Sampling with UTM Coordinates," Argonne National Laboratory, 1987.

[5] Pursuant to MARSSIM, only 10 samples from the affected area and 10 samples from background locations were required in order to compare survey results to release criteria. However, ten background soil samples that were collected on August 3, 1998 for another purpose and subsequently analyzed by gamma spectroscopy satisfied the background sample requirements. The additional affected area samples (15 vs. 10) were collected to ensure adequate coverage of the area.

RESULTS

Remedial Actions/Survey Results

The remediated area of the Storage Yard is in close proximity to the ferrocolumbium slag stockpile, which exhibits elevated ambient gamma exposure rates, thus complicating the performance of the walk-over surveys in this area. On March 10, 1999, an initial gamma radiation survey was conducted to determine whether radioactive slag above the pre-determined release criteria could be detected by walk-over surveys. During this preliminary survey, dose rates measured with a Bicron MicroRem meter held at approximately three (3) meters from the soil surface (waist high) varied from 80 to 140 microrem/hour over the survey area, with the dose rates increasing as one traveled from the east side of the survey area towards the west (i.e., towards the ferrocolumbium slag stockpile). In spite of these exposure rates, residual radioactive slag could still be identified by holding a gamma scintillation detector (an Eberline ESP-1 with a SPA-3 sodium iodide detector) in close proximity to the soil surface. Therefore, these scans were used in the initial determination of sites to be remediated.

The initial excavation of the survey area took place between March and May of 1999. A 100% coverage gamma walkover survey of the remediated area was performed between May 17 and May 20, 1999.[6] The ambient gamma exposure rates measured at this time were significantly lower that those observed during the March 10th preliminary survey. Any locations that exhibited exposure rates that were distinguishable from background were marked with survey flags and were subject to additional remedial action. Several locations (i.e., more than 50) were indeed identified as being "above background".

After the additional remedial actions were completed, additional walk-over surveys were performed on September 9, 1999. During the second survey campaign, remediated areas that could no longer be distinguished from background had their flags removed. However, several areas were identified that still required further remediation.

On September 30 and October 1, 1999, additional remedial actions were completed and the walk-over surveys were repeated. At the completion of this campaign, it was clear that, with one exception, the remedial actions were effective. The exception was the southeast corner of the survey area that was under standing water at the time of the survey. A final follow up exposure rate survey was conducted on December 13, 1999 to ensure the area under standing water was indistinguishable from background.[7] Appendix D contains the survey maps from the survey efforts.

---

[6] To account for the wide range of background values across the survey area, a localized background was determined every few yards as the surveyor moved in an east to west direction. These measured values ranged from 24 to 120 uR/hour using a Ludlum Model 2241 with 44-10 detector.

[7] During the December survey, one location of elevated exposure rate was noted. It was flagged subsequently remediated.

Analytical Results

Appendix E contains the analytical results from the 15 soil samples collected on October 1, 1999. The thorium concentrations in the samples ranged from 0.32 to 0.95 pCi/g, based upon the reported results for Actinium-228. The uranium concentrations, based upon the results from Bismuth-214, ranged from 0.23 to 0.65 pCi/g. In all cases, the results were well-below the site-specific release criteria shown in Table 1.

Comparison of Results

Even though all of the soil sampling results were well-below the site-specific release criteria, the Wilcoxon Rank Sum test, as specified in Section 8.4.2 of MARSSIM was used to evaluate the analytical data. The critical value selected for the comparison of the summed ranks of the two data sets was taken from Table I.4 of MARSSIM, using a Type I decision error of $\alpha = 0.01$.

The data sheets from the statistical tests for each radionuclide are contained in Appendix F. These show that for the soils collected from the remediated area of the Storage Yard, the null hypothesis was rejected. Consequently, one may conclude that the residual radioactivity in the remediated area is indistinguishable from background.

SUMMARY AND CONCLUSIONS

The eastern end of the SMC Storage Yard was remediated in preparation for re-forestation. Following the remedial actions, walk-over surveys and soil sampling was performed pursuant to the guidance contained in MARSSIM. The results of these efforts indicate that the remediated area meets the criteria for release. Once a validation survey has been performed by the regulatory agency, if so required, the remediated area may be back-filled and reforested.

TABLES

Table 1 - Site-specific Release Criteria

TYPE	NUCLIDE[1]	REMOVABLE[2,4]	TOTAL[2,3] (FIXED PLUS REMOVABLE)	CONCENTRATION[6, 7]
Surface	U-nat, U-235, U-238 and associated decay products	1,000 dpm α/100 cm^2 above background	5,000 dpm α/100 cm^2 above background	--
Surface	Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200 dpm/100 cm^2 above background	1,000 dpm α/100 cm^2 above background	--
Surface	Mixture of U-nat and Th-nat	--	600 dpm α/100 cm^2 by *direct frisk* above background[5]	--
Soil Volume	U-238 and U-234 with progeny in equilibrium	--	--	2.5 pCi/g each above background, averaged over the volume of interest
Soil Volume	Th-232 and Th-228 with progeny in equilibrium	--	--	2.5 pCi/g each above background averaged over the volume of interest
Soil Volume	Mixture of U-nat and Th-nat	--	--	15 microR per hour above background[8]

[1] Where surface contamination by both α and β-gamma-emitting radionuclides exists, the limits established for α and β-gamma-emitting radionuclides should apply independently.

[2] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[3] The levels may be averaged over 1 m^2, provided the maximum surface activity in any area of 100 cm^2 is less than three times the guide values. For purposes of averaging, any square meter of surface shall be considered to be above the activity guide G if: (1) from measurements of a representative number (n) of sections it is determined that $1/n \sum_n S_i \geq G$, where S_i is the dis/min-100 cm^2 determined from measurement of section I; or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm^2 area exceeds 3G.

[4] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. (Note - The use of dry material may not be appropriate for tritium.) When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. Except for transuranics and Ra-226, Ra-228, Ac-227, Th-228, Th-230, and Pa-231 α emitters, it is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.

[5] Assumes removable activity is the limiting value.

[6] Taken from (reference) BTP.

[7] Concentrations may be averaged over the soil volume of interest as described in (reference) FSTP.

[8] Assumes 2.5 pCi/g each of Th-232, Th-228, U-238, and U-234 (plus progeny in equilibrium) evenly distributed throughout the soil volume to a depth of 15 cm, with measurements made at a height of less than three (3) cm above the soil surface. Taken from (reference) IEM.

Table 2 - Survey Instrumentation

INSTRUMENT MODEL	DETECTOR	USE	NOMINAL BACKGROUND	DETECTION EFFICIENCY	DETECTION SENSITIVITY
Eberline ESP-1	Eberline SPA-3	Walkover gamma survey	5000-8000 cpm	N/A	1.20 Mcpm/mR/hr
Victoreen Model 490	Victoreen Model 489-55	Walkover gamma survey	5000-8000 cpm	N/A	Unknown
Ludlum Model 2241 scaler/ratemeter	Ludlum Model 44-10 Nal	Walkover gamma survey	5000-8000 cpm	N/A	900 cpm/uR/hr

Table 3 - Background Concentrations at the SMC Newfield, NJ Facility

Sample Number	Th-232 Concentration (pCi/g)	U-238 Concentration (pCi/g)
980715-15	0.9	0.5
980715-16	0.3	0.2
091898-01	1.8	1.7
091898-02	1.4	1.0
091898-03	0.9	0.8
091898-04	1.4	0.6
091898-05	0.6	0.6
091898-06	0.6	0.5
091898-07	1.2	0.5
091898-08	0.6	0.9
MEAN	**0.97**	**0.73**
STANDARD DEVIATION	**0.47**	**0.41**

FIGURES

1

Figure 1 - Newfield Facility Showing Storage Yard

APPENDICES

Appendix A - Personnel Qualifications

R. Alan Duff - Project Manager and HP Technician

Professional Qualifications

Mr. Duff has over twenty years of experience in nuclear and hazardous materials project management, design support, surveillance, operational health physics, training, and decommissioning activities. He has prepared numerous plans, procedures, and license documents for U. S. Department of Energy facilities, U. S. Department of Defense facilities, U. S. Nuclear Regulatory Commission licensees, and commercial client facilities that are regulated by agreement states. Mr. Duff is well versed in the area of civilian and government radioactive and mixed waste transport and disposal requirements. He is registered by the National Registry of Radiation Protection Technologists (NRRPT).

Education

Confined Space Entry Training, 1998
CNSI Advanced Radioactive Material Transportation and Disposal Class, 1989 and 1993
IT Corporation Project Management Course (40 hours), 1992.
40-Hour OSHA HAZWOPER (29 CFR 1910.120) Training, 1987.
Eight-hour Supervisor Training, 1990
Eight-hour OSHA Annual Refresher (29 CFR 1910.120), 1997.
Canberra Multichannel Analyzer Operations Class, 1988.
Operational Water Chemistry and Radiological Controls, U.S. Navy, 1982
Engineering Laboratory Technician School, U.S. Navy, 1980.
Nuclear Power Training Unit (prototype), U.S. Navy, 1980.
Naval Nuclear Power School, U.S. Navy, 1978.

Registrations/Certifications

Registered Radiation Protection Technologist (RRPT), National Registry of Radiation Protection Technologists

Experience and Background

1995 - Present *Project Manager, Integrated Environmental Management, Inc., Knoxville, Tennessee.* Provides high-quality project management and remediation services to commercial and government clients. As a member of the client's response team, works with clients to: Develop scopes-of-work and bid packages for specialty subcontractors handling highly focused assignments; identify those subcontractors who will provide the greatest value to the client; manage teams of specialty subcontractors to ensure that the client's goals and expectations (technical, regulatory, and financial) are met from the beginning until project completion; provide insights into future regulatory issues and their impact as input to the client's long-range business planning and cost forecasting process; provide site remediation/decommissioning services for radioactive and hazardous materials; advise and train clients on waste transportation and disposal issues; and develop project

specific plans and procedures to conduct on site activities. Mr. Duff also serves as the Radiation Safety Officer (RSO) for IEM operations.

1994 - 1995 *Senior Environmental Specialist, AWK Consulting Engineers, Inc., Pittsburgh, Pennsylvania* While assigned to the Oak Ridge, Tennessee office, was responsible for performing technical and administrative duties required to satisfy customer needs on site characterization and pre-remedial design support projects and for all aspects of D&D projects. Responsible for preparing project plans, project work plans, task specific Health & Safety Plans, and budgets/schedules for these projects. Also responsible for identifying and implementing decommissioning and decontamination methods for these projects.

1987 - 1994 *Project Manager, Health Physics Supervisor, Nuclear/Mixed Waste Engineering Services, IT Corporation, Knoxville, Tennessee.* Provided project management and health physics support services for nuclear and mixed waste projects throughout the United States.

1978 - 1987 *Engineering Laboratory Technician (ELT), Leading Petty Officer, Radiological Controls Shift Supervisor*, United States Navy Supervised a division of 40 personnel, provided support for nuclear powered submarines, and performed over 250 error-free shipments of radioactive materials. Served as Leading ELT and Engine Room Supervisor on the USS Grayling, SSN 646.

Professional Society Memberships

Health Physics Society (Plenary Member)
American Nuclear Society
Conference of Radiation Control Program Directors (Advisor to the Radioactive Waste Management Committee E-5 and to the D&D Committee E-24)
International Society of Decontamination and Decommissioning Professionals

Awards

Navy Achievement Medal for conducting the first Trident Class submarine ion exchange resin discharge and solidification.
IT Corporation *Project Management Associate*

Example Project Descriptions

- Project Manager for escalated decommissioning a State-licensed site that manufactured, tested, and distributed gauging devices in anticipation of the sale of the company and the possibility of its moving its operations to another location. Responsible for preparation of work plans, negotiations with regulatory agencies, decontamination of indoor and outdoor areas, performance and documentation of a final status survey, shipment of waste, and project-specific health and safety.

- Project Manager and health physicist for the remediation of a building foundation drainage system and the processing of over 100,000 gallons of water contaminated with cobalt-60 up to levels of one (1) μCi per liter for a commercial client. Responsible for coordination of a water processing subcontractor, an excavation subcontractor, and off-site analytical laboratory activities. Also interfaced with on-site U. S. Nuclear Regulatory Commission, U. S. Environmental Protection Agency, and a variety of state and local agencies.

- Technical writer for the development of a logic flow diagram for identifying radioactive and mixed wastes at the U. S. Department of Energy's Portsmouth (Ohio) Gaseous Diffusion Plant.

- Technical writer for the Fernald Remedial Investigation/Feasibility Study (RI/FS). Provided technical guidance to engineering staff, generated reports on radioactive and mixed waste packaging, transport, and disposal.

- Site Manager for the characterization survey of an EPA Superfund site three story warehouse that had been used in the past as a lantern mantle manufacturing facility and had been contaminated with thorium. Assisted in the development of project plans and final reports, supervised a crew of Health Physics technicians performing characterization surveys, interfaced with the facility owner and EPA personnel while on site.

- Project Manager for the decommissioning and decontamination of three facilities at Sandia National Laboratory contaminated with radioactive and mixed waste. Responsible for the coordination of resources for the development of project plans, development of Project Work Plan, and maintaining project budget and schedule commitments.

- Health Physics Supervisor for a transuranic (TRU) waste repackaging project. Supervised the characterization, repackaging and shipment of 130 containers of high-activity americium-241 and plutonium-238 hot cell waste. The waste was packaged to meet the WIPP waste acceptance criteria and was transported (highway route controlled quantity) to the Idaho National Engineering Laboratory (INEL) for storage.

- Project Manager for the excavation and disposal of radium waste cells for the Corps of Engineers at Bergstrom Air Force Base in Austin, TX. Developed all project plans, supervised field efforts, and coordinated waste transport and disposal activities.

- Project Manager for the decontamination and final release survey of a 70,000 ft^2 facility that manufactured cesium-137 level gauges. Decontamination efforts

involved overhead areas, work area concrete floors, and removal of soil under the floor slab. Facility was released from their license following a verification survey by the state radiological licensing agency. Developed state approved decommissioning plan and final status survey report.

- Project Manager for the packaging and disposal of 55,000 Curies of cobalt-60 teletherapy sources. Sources were loaded into cask liners in the facility hot cell and loaded into Type B casks for shipment for disposal. Also supported the packaging and disposal of several low level waste drums and HEPA filters that required the use of shielded Type A and B shipping containers.

- Project Manager for the decommissioning and decontamination of IT's Oak Ridge Mixed Waste Analytical Laboratory. Developed the decommissioning and decontamination plan that was approved by the State of Tennessee. Also supervised the field crew during final surveys of facility.

- Project Manager for the decommissioning and decontamination of a magnesium-thorium waterfall grinding booth at Tinker Air Force Base in Oklahoma. Responsible for the development of project plans, schedule and budget management, and disposal of radioactive and mixed wastes.

- Project Manager for the decommissioning of a commercial facility which had previously processed ores containing uranium and thorium. Generated the decommissioning plan submitted to and approved by the U. S. Nuclear Regulatory Commission, and was responsible for schedule, budget, and on site activities.

- Project Manager for the removal of a 22 MeV particle accelerator from a major university medical center. Developed State-approved decommissioning and decontamination plans, arranged for waste disposal and transfer of the accelerator to a university in Beijing, China, and was responsible for budget, schedule and all on site activities.

- Project Manager for the decommissioning and decontamination of two radioactive source manufacturing laboratories at Chevron Research and Technology. The laboratories housed a neutron generator and were contaminated with tritium, carbon-14, cesium-134, and cobalt-60. Negotiated plan approvals with the State agency, and was responsible for budget, schedule, and all on site activities including waste transport and disposal.

- Project Manager for the routine quarterly surveillance and special radiological projects at a metallurgical facility licensed by the NRC. Conducted radiation, contamination, and airborne radioactivity surveys as well as personnel bioassay and dosimetry program and environmental monitoring program each quarter.

Provided health physics coverage for non-routine activities such as baghouse and stack testing, heats of specialty materials, final release surveys of an excavated road area and a warehouse formerly used for storage of radioactive materials, and recovery of radioactively contaminated equipment improperly released from site. Responsible for the generation of quarterly surveillance reports.

- Project Manager for the development of a conceptual decommissioning plan for a maintenance facility located in South Carolina. The plan was generated to provide support for the facility's decommissioning funding plan.

- Health and Safety Manager/Project Manager at the U. S. Department of Energy's Fernald site thorium silo and bins decommissioning and decontamination project. Developed the project-specific health and safety plan, and interfaced with the client on health physics and health/safety issues. This project received safety and quality awards from the client.

- Health Physics Supervisor responsible for the sampling of underground storage tanks with radioactive and mixed wastes at Brookhaven National Laboratory.

- Health and Safety Manager for the U. S. Department of Energy's Fernald Plant K-65 Silo sampling project. Developed the health/safety and sampling plans. The silos contained up to 0.5 μCi of Radium-226 per gram and were the largest single source of radon gas in the U.S.

- D&D Technical Manager for the decommissioning of the U. S. Department of Energy's LEHR facility at the University of California at Davis. Developed project decommissioning and decontamination plans and field procedures.

- Health Physics Supervisor for the excavation of waste materials which included mixtures of uranium and explosives.

- Proposal Coordinator for over 40 business proposals for nuclear decommissioning and decontamination projects including job walk downs, cost estimation, scheduling, and technical content of proposals.

- While in the US Navy, acted as radioactive materials shipper for the Trident Submarine Refit Facility. Performed over 250 error-free shipments of radioactive materials including Type B quantity radiography source shipments and radioactive waste shipments to the naval shipyard.

Craig L. Brune - HP Technician

Professional Qualifications

Mr. Brune is an environmental scientist with field sampling, compliance monitoring, and report preparation experience. He performs compliance monitoring and sampling, tank and hydraulic lift removal assessments, Phase I property assessments, well abandonment, monitoring well installation, and direct-push sampling.

Education

Davis and Elkins College - BA, Environmental Science, 1992.
OSHA 1910.120, 40-hour training and Annual Refreshers.

Experience and Background

September, 1999 - Present - Health Physics Technician, Integrated Environmental Management, Inc. (Rockville, Maryland) - Duties include surveillance activities, instrumentation usage/control, site characterization, documentation, and other general health physics duties. Partially qualified as a Health Physics Technician pursuant to Radiation Safety Procedure No. RSP-006, "Training and Qualification of Radiation Protection Personnel".

1998 - Present, Environmental Scientist, Quality Environmental Solutions, Inc. (Annapolis, Maryland) - Duties include site supervision of underground storage tank and hydraulic lift removal assessments, regulatory agency liaison, contractor oversight, documentation, soil and water sampling, and report preparation..

1996 - 1998 - Environmental Scientist, Fluor Daniel GTI, Inc.

1193 - 1996 - Customer Service Representative, Alex Brown & Sons, Inc.

1989 - 1991 - Public Health Scientist, Maryland Department of the Environment

Representative Experience

Permitted discharge sampling at industrial facilities, including QA/QC Plan development, sample collection, and preparation of discharge Monitoring Reports (DMRs).

Supervision of subsurface investigations utilizing direct-push methodology. Responsibilities include utility clearance, customer liaison, drilling supervision, sample collection, and report preparation.

Supervision of subsurface site assessments including monitoring well installation, sensitive receptor survey, well survey, soil and ground-water sampling, data entry, and report preparation.

Calibration and use of various field instruments for the monitoring of environmental constituents in air, soil and water.

Supervision of the abandonment of monitoring wells.

Completion of Phase I environmental assessments in accordance with ASTM guidelines.

Brian A. Kelly - Report Preparation

Professional Qualifications

Mr. Kelly has twenty-four years of experience in hazardous and radioactive material problems (air, water, and solid media) in both project and line management roles. He has managed projects with budgets that exceeded $29 million, and managed a staff of over thirty radiation safety and risk assessment professionals in the areas of radiation safety and risk assessment. He is experienced in both assessing the extent of contamination at sites that have used radioactivity and developing cost-effective solutions for their decontamination/remediation. Mr. Kelly is a Past President of the East Tennessee Chapter of the Health Physics Society. As a co-founder of **IEM**, Inc., he offers a broad range of experience in hazardous and radioactive waste issues, project management, and communications with clients. He has provided expert assistance in litigations (acting for either the plaintiff or the defendant) in the assessment of potential and actual radiation exposures. Mr. Kelly brings a long and distinguished track record of technical excellence, cost and schedule control, and innovation in solving clients' environmental and health/safety problems.

Education

M.B.A., Vanderbilt University, Nashville, Tennessee; 1987
M.S., Environmental Engineering, Rensselaer Polytechnic Institute, Troy, New York; 1974
B.S., Physics, University of Notre Dame, Notre Dame, Indiana; 1972
29 CFR 1910.120 OSHA Training for Operations in Hazardous Waste Sites, IT Corporation; 1989 (updated through 1999)

Registrations/Certifications

Registered Professional Engineer; Tennessee
Comprehensive Certification, American Board of Health Physics (recertified through 2002)

Experience and Background

1994 - Present *Founder, Integrated Environmental Management, Inc., Knoxville, Tennessee.* Provides high-quality strategic environmental management services to commercial and government clients. As a member of the client's response team, has worked with clients to:

- Conduct a remedial investigation/feasibility study using MARSSIM methodology for a warehouse in New Jersey listed on the National Priorities List because of thorium contamination caused by lantern mantle production.

- Design a characterization survey using MARSSIM methodology for a former fuel fabrication facility in Connecticut contaminated with highly enriched uranium that is undergoing remediation by the U. S. Army Corps of Engineers under the Formerly Utilized Sites Remedial Action Program (FUSRAP).

- Provide the radiological input into a remedial investigation/feasibility study at a metals manufacturing facility with source material issues, including the development of work plans and health & safety plans, support of field sampling operations, and preparation of the radiological risk assessment.

- Assess the potential impact of airborne emissions from a federally-owned analytical laboratory to demonstrate compliance with EPA National Emission Standards for Hazardous Air Pollutants regarding radioactivity.

- Develop the radiation protection program and radioactive materials license application for a new waste processing facility for U.S. Department of Energy and commercial wastes.

- Perform an As Low As Reasonably Achievable (ALARA) reviews of a new waste processing facility handling ion exchange resins from nuclear power plants and a facility processing transuranic wastes.

- Train oil company representatives on the subject of naturally-occurring radioactive material (NORM) and how it relates to their exploration/production operations.

- Assist oil company representatives in the preparation of draft regulations on the management of NORM at their exploration/production sites.

- Coordinate the delivery of specialty services to solve client problems, including water treatment, emissions testing, sampling and processing equipment procurement, tritium monitoring, and radon monitoring.

- Support innovative waste treatment and disposal technologies through the preparation of safety analysis reports, collection of field data, and support of export license applications.

- Prepare dose/risk assessments in support of clients being litigated by people claiming injury from the use of radioactive materials in the workplace.

- Establish statistically-based protocols for the characterization of sites contaminated with thorium and uranium.

1989 - 1994 *Senior Health Physicist, Nuclear Sciences, IT Corporation, Knoxville, Tennessee.* Performed health physics consulting in the areas of environmental monitoring, applied health physics, dose/risk assessments, radiation protection program/procedure development, and site assessments. In addition:

- Prepared a detailed action plan for the decontamination of three areas at Sandia National Laboratory contaminated with radionuclides and hazardous materials.

- Developed the dose and risk assessment sections of the work plan for facility decommissioning (Operable Unit # 3) at the Fernald Environmental Management Project.

- Designed a portable shield for a radiation meter to use in surveying soil for uranium contamination at the Fernald Environmental Management Project.

- Conducted program assessments at Sandia and Lawrence Livermore National Laboratories (radiation protection), Oak Ridge National Laboratory (waste management), and Stanford Linear Accelerator Center (emergency preparedness), including preparation of the assessment plans.

- Co-authored the technical basis document for the new external dosimetry system at Oak Ridge National Laboratory.

- Prepared the Quality Assurance Plan for NEPA Compliance Group at Oak Ridge National Laboratory to demonstrate compliance with ASME NQA-1-1989.

- Developed the technical basis for installing HEPA filters at the Oak Ridge Y-12 Plant.

- Conducted evaluations of emissions from the Oak Ridge K-25 Plant to determine compliance with EPA's NESHAP regulations.

- Performed dose and risk assessments for transuranic emissions from the Waste Isolation Pilot Plant (chronic and accidental) and for uranium emissions from the former Feed Materials Production Center (accidental).

- Developed procedures for external dosimeter control and exchange and for assessment of radiation dose to an individual with a lost or missing dosimeter.

1984 - 1989 *Project Manager, Y-12 Plant, Martin Marietta Energy Systems, Oak Ridge, Tennessee.* Project manager in the Central Engineering Division. Managed three project engineers with over $90 million of project work. In addition:

- Installed new emission control systems for sources handling enriched uranium, including source modifications to reduce the volume of gases emitted.
- Reduced the amount of mercury discharged by the plant, including removal, clean-out, and lining of contaminated pipe and the installation of a treatment system for dewatering sludge containing mercury, uranium, and thorium.
- Provided support for processing equipment improvements to enhance radiation protection. Participated on the Y-12 ALARA Committee and developed procedures for improved waste management and criticality safety.

1979 - 1984 *Group Leader, Oak Ridge National Laboratory, Union Carbide Corporation, Oak Ridge, Tennessee.* Directed environmental impact reviews for proposed projects. In addition:

- Coordinated installation of a new meteorological tower system, a state-of-the-art air monitoring station, and a new perimeter air monitoring network.
- Developed criteria for new environmental and effluent monitoring stations and for water treatment systems to address sanitary sewage and coal yard runoff.
- Assisted in monitoring of residual radioactivity levels around inactive facilities in preparation for their decontamination and decommissioning.
- Provided environmental compliance criteria and design reviews for all proposed projects at ORNL.

1974 - 1979 *Project Engineer, Clinch River Breeder Reactor, Burns and Roe, Inc., Oradell, New Jersey.* Coordinated company's input to the project's Environmental and Preliminary Safety Analysis Reports, disseminated NRC technical positions on nuclear power plant design to affected design disciplines; collected data and coordinated preparation for required permits (Corps of Engineers, State of Tennessee); and coordinated interfaces with client and Nuclear Steam Supply System supplier in the areas of radiological and industrial safety.

Bibliography

Mr. Kelly has coauthored a number of papers and has developed/presented training courses in the field of health physics. A list of these publications is available.

Carol D. Berger - Project Oversight

Professional Qualifications

Ms. Berger has over 21 years experience in nuclear and radiological activities with emphasis in strategic planning, radiation dosimetry, instrumentation, and applied health physics. As a co-founder of IEM, Inc., Ms. Berger is actively involved in performance of radiological dose assessments, regulatory interactions, site decommissioning, program evaluations, program development, pathway analyses, risk assessments, dosimetry evaluations, assessment and control of sources of non-ionizing radiations, waste management programs, environmental monitoring programs, and detection and quantification of low-levels of radioactivity.

Education

M.S., Health Physics, San Diego State University, San Diego, California; 1979
M.S., Radiation Physics, San Diego State University, San Diego, California; 1977
B.S., Physics/Chemistry, San Diego State University, San Diego, California; 1972

Certifications

Certified Health Physicist (Comprehensive): American Board of Health Physics, 1983
Re-certified: 1987, 1991, 1995, 1999

Experience and Background

1994 - Present — *Founder, Integrated Environmental Management, Inc., Rockville, Maryland.*
Provides high-quality strategic environmental management services to commercial and government clients. As a member of the client's response team, works with clients to promote an understanding of what is required to achieve and/or maintain compliance in the eyes of all pertinent regulatory agencies, individually or jointly; develop an overall strategy for achieving compliance and reduce liabilities in a technically-sound, legally-defensible, and fiscally-conservative business manner; recommend specific solutions that are compatible with the client's operating philosophy; and provide insights into future regulatory issues and their impact as input to the client's long-range business planning and cost forecasting process.

1989 - 1994 — *Senior Technical Consultant, IT Corporation/Nuclear Sciences, Washington, D.C.*
Performed health physics consulting for government and commercial facilities in Internal and External Dosimetry; Radiation Monitoring; Environmental Monitoring; Instrumentation; Emergency Response and Preparedness; Site Decommissioning; Radioactive Waste Management; Radiation Risk Assessment; Training; Licensing and Regulatory Negotiations; and Non-ionizing Radiation

1986 - 1989 *Senior Health Physicist, IT Radiological Sciences Laboratory, Knoxville, Tennessee* Performed health physics consulting for government and commercial facilities in Internal and External Dosimetry; Radiation Monitoring; Environmental Monitoring; Applied Health Physics; Instrumentation; Radioactive Waste Management; Training; and Non-ionizing Radiation.

1983 - *1986* *Radiation Dosimetry Group Leader, Oak Ridge National Laboratory, Oak Ridge, Tennessee.* Responsible for internal and external dose assessment and programs for ORNL employees, visitors and contractors. Experience included Internal and External Dose Assessment; Monitoring Program Design and Implementation; Instrumentation Development; Site Characterizations; Personnel Management; and Training.

1978 - *1983* *Internal Dose Group Leader, Oak Ridge National Laboratory, Oak Ridge, Tennessee.* Responsible for development of the ORNL Whole Body Counter Facility for detection and quantification of the actinides in-vivo. Experience included: Internal Dose Assessment; Monitoring Program Design and Implementation; Instrumentation Development; Special Studies; Personnel Management; and Training.

1978 - *1986* *Adjunct Faculty, Oak Ridge Associated Universities, Oak Ridge, Tennessee.* Professional training courses and general classes in the following health physics and radiation protection areas: Internal Dose Assessment; In-vivo Monitoring and Bioassay Methodologies; Instrumentation, and Applied Health Physics.

1979 - *1980* *Health Physics and Dosimetry Task Group Member, President's Commission on the Accident at Three Mile Island, Washington, D.C.* Tasks included: Internal Dose Assessment from Whole Body Counting Results; Estimates of Source Term from in-plant Monitoring Systems; Atmospheric Dispersion Modeling and Population Dose Assessment; and Development of Health Physics Sequence of Events.

Professional Society Membership

American Academy of Health Physics (President, 1995; Executive Committee, 1995-1997; Chair of Strategic Planning Committee, 1997)
Health Physics Society
Baltimore-Washington Chapter - Health Physics Society (Treasurer, 1993-1994, Board of Directors, 1998-1999)
American Bar Association, Section of Natural Resources, Energy, and Environmental Law
Environmental Law Institute

Publications

Over 30 professional publications; over 40 oral presentations; over 100 technical reports; more than 15 training courses taught.

Other Appointments/Awards

East Tennessee Chapter - Health Physics Society (President, 1986; President-Elect, 1985; Secretary, 1981-1982)

San Diego Chapter - Health Physics Society (Charter member)

American Board of Health Physics, Comprehensive Panel of Examiners, 1989-1993.

ASTM Task Group E-10.04.27 "Transuranic Wound Analysis"; 1986 to present

ANSI Standards Committee (ANSI N13.41) on Multiple Badging; 1986 to 1996 (Chairman, PlanCo-59 Working Group, 1990 to 1996)

ANSI Standards Committee (ANSI N13.39) on Internal Dosimetry Programs; 1994 to present

Sigma Xi - Scientific Research Society

NCRP Scientific Committee 46-10, "Assessment of Occupational Exposures from Internal Emitters", 1989 to present.

Member of the Health Sciences Advisory Council for the School of Health Sciences, Purdue University, 1995 to 1998.

DOE/IAEA Whole Body Counter Intercalibration Committee (1980-1986)

Consultant to Knoxville Academy of Medicine, Mass Casualty Simulation (1984-1985)

Consultant to the National Cancer Institute to Evaluate Devices and Techniques to Determine Previous Radiation Exposure under Public Law 98-54 (Award for participation presented by Oak Ridge Associated Universities, April, 1988.)

Steering Committee Member, U. S. Department of Energy Task Group on the Education of Future Health Physicists - 1989 to 1991.

Technical reviewer and referee for *Health Physics*, *Nuclear Technology*, and *Radiation Protection Management*

IT Corporation *Distinguished Technical Associate* - June, 1992.

Appendix B - Instrument Calibration Sheets

Designer and Manufacturer of Scientific and Industrial Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CERTIFICATE OF CALIBRATION

CUSTOMER SHIELDALLOY METALLURGICAL CORP ORDER NO. 227720

Mfg. Ludlum Measurements, Inc. Model 19 Serial No. 144771

Mfg. ______ Model ______ Serial No. ______

Cal. Date 14-Jan-99 Cal Due Date 14-Jan-00 Cal. Interval 1 Year Meterface 202-016

Check mark ☑ applies to applicable instr. and/or detector. AW mfg. spec. T. 77 °F RH 42 % Alt 712.8 mm Hg

☐ New Instrument ☐ Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ✓ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☑ F/S Resp. ck. ✓ Reset ck. ☐ Window Operation ✓ Geotropism
☐ Audio ck. ☐ Alarm Setting ck. ✓ Batt. ck. (Min. Volt) 2.2 VDC

☐ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ✓ Calibrated in accordance with LMI SOP 14.9 rev 12/19/89.

Instrument Volt Set 663 V Input Sens. 33 mV Det. Oper. ___ V at ___ mV Threshold Dial Ratio — mV

☐ HV Readout (2 points) Ref./Inst. / V Ref./Inst. / V

COMMENTS:

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
5000	4000R/hr		4000
5000	1000R/hr		1000
500	400R/hr = 73800 cpm		400
500	100R/hr		100
250	200R/hr = 36800 cpm		200
250	100R/hr		100
50	7380 cpm		40
50	1840 cpm		10
25	3680 cpm		20
25	920 cpm		5

*Uncertainty within ± 10% C.F. within ± 20%

50, 25 **Range(s) Calibrated Electronically**

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*		REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout				Log Scale			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO 1963

Reference Instruments and/or Sources:

☐ Cs-137 Gamma S/N 1162 ☐ G112 ☐ 1095 ☐ 720 ☐ 1100 ✓ 1479 E552 E551 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ______ Beta S/N ______ Other ______

✓ m 500 S/N 50800 Oscilloscope S/N ______ ✓ Multimeter S/N 61341135

Calibrated By: *Connie Tomlinson* Date *14 Jan 99*

Reviewed By: *Rhonda Harris* Date *14 Jan 99*

Designer and Manufacturer of Scientific and Industrial Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CERTIFICATE OF CALIBRATION

CUSTOMER SHIELDALLOY METALLURGICAL ORDER NO. 227320/238032

Mfg. Eberline Model ESP-1 Serial No. 0.7047

Mfg. Eberline Model SPA-3 Serial No. 408462

Cal. Date 12-Jan-99 Cal Due Date 12-Jan-00 Cal. Interval 1 Year Meterface DEG.

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 20 % Alt 699.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☐ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☐ F/S Resp. ck ☐ Reset ck. ☐ Window Operation ☐ Geotropism
☑ Audio ck. ☑ Alarm Setting ck. ☐ Batt. ck. (Min. Volt) _____VDC

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 12/19/89.

Instrument Volt Set 1000 V Input Sens. 10 mV Det. Oper. 1000 V at 10 mV Threshold Dial Ratio _____ = _____

☑ HV Readout (2 points) Ref./Inst. 5.34 +02 / 500 V Ref./Inst. 1.95 +03 / 2000 V

COMMENTS:
Deadtime = 7.85 µSec.
Alarm = 1.00 + 06
Cal.Constant = 1.00+00
Ratemeter readings reflect a deadtime of 1µSec.
Instrument calibrated using a 5ft. cable
(Instrument currently set to cps)

Gamma Calbration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
Auto	800kcpm	8.10 +05	8.10 +05
Auto	200kcpm	2.00 +05	2.00 +05
	80kcpm	8.00 +04	8.00 +04
	20kcpm	2.00 +04	2.00 +04
	8kcpm	8.00 +03	8.00 +03
	2kcpm	2.00 +03	2.00 +03
	800cpm	8.01 +02	8.01 +02
	200cpm	2.00 +02	2.00 +02

*Uncertainty within ± 10% C.F. within ± 20% ALL Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*		REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400 Kcpm	3.96 +04	3.96 +04	Log Scale			
	40 Kcpm	3.98 +03	3.98 +03				
	4 Kcpm	3.97 +02	3.97 +02				
	400 cpm	3.99 +01	3.99 +01				
	40 cpm	3.99 +00	3.99 +00				

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1997 State of Texas Calibration License No. LO-196

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ Neutron Am-241 Be S/N T-30

☐ Alpha S/N _____ ☐ Beta S/N _____ ☑ Other Am241~1.6uCi

☑ m 500 S/N 70648 ☐ Oscilloscope S/N _____ ☑ Multimeter S/N 61730074

Calibrated By: Lois Martin Date ~~12-Jan-98~~ 12-Jan-99

Reviewed By: V. Lee Mwaclo Date 17 Jan 99

FORM C22A 09/17/98

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector SPA-3 Serial No. 408462

Customer SHIELDALLOY METALLURGICAL Order #. 227320/238032

Counter ESP-1 Serial No. 03047 Counter Input Sensitivity 10 mV

Count Time 1 min Distance Source to Detector surface

Other

High Voltage	Background	Isotope Am241 Size ≈1.6μ Ci	Isotope Size	Isotope Size	Isotope Size
750	9.07+03	9.30 +04			
800	8.03+03	1.02 +05			
850	8.35+03	1.03 +05			
900	8.40+03	1.02 +05			
950	8.05+03	1.02 +05			
1000	8.60+03	1.03 +05			
1050	8.21+03	1.03 +05			
1100	8.31+03	1.02 +05			
1150	8.35+03	1.03 +05			
1200	8.70+03	1.03+ 05			
1250	9.10 +03	1.02+05			
1300	9.33+03	1.04 +05			

Signature Lori Manley Date 12-Jan-99

FORM C4A 02/23/94

of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER INTEGRATED ENVIRONMENTAL MGNT ORDER NO. 227451/ 238082

Mfg. Ludlum Measurements, Inc. Model 2241 Serial No. 114535

Mfg. Ludlum Measurements, Inc. Model 44-10 Serial No. PR 132520

Cal. Date 14-Jan-99 Cal Due Date 14-Jan-00 Cal. Interval 1 Year Meterface 44-10

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 71 °F RH 20 % Alt 712.8 mm Hg

☐ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☐ Window Operation
☑ Audio ck. ☑ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 2.2 VDC
☐ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 12/19/89.

Instrument Volt Set 1050 V Input Sens. 34 mV Det. Oper. 1050 V at 34 mV Threshold Dial Ratio ____ = ____ mV

COMMENTS:

	Det.1 cpm	Det.2 R/hr
Deadtime:	9 µSec	9 µSec
al Constant:	100e-02	561e+08
Alert:	800kcpm	450R/hr
Alarm:	900kcpm	500R/hr
Firmware:	P-04 05	

verload set at 10mR/hr
nstrument calibrated with 6ft cable

Gamma Calbration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
auto	2 mR/hr	2.18	1.98
auto	1.5 mR/hr	1.58	1.50
	1.0 mR/hr	1.09	1.02
	500 µR/hr	514	504
	200 µR/hr	205	198
	150 µR/hr	155	152
	100 µR/hr	104	103

*Uncertainty within ± 10% C.F. within ± 20% Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Ratemeter Readout	800K cpm	798 kcpm	798 kcpm
	200K cpm	199	199
	80K cpm	79	79
	20K cpm	19.9	19.9
	8K cpm	7.9	7.9
	2K cpm	1.99	1.99
	800 cpm	0.80	0.80
	200 cpm	0.20	0.20

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Scaler Readout	800K cpm	79866 (0)	79866 (0)
	200K cpm	19921	19921
	80K cpm	7987	7987
	20K cpm	1992	1992
	8K cpm	799	799
	2K cpm	199	199
	800 cpm	80	80
	200 cpm	20	20

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1997. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ____ ☐ Beta S/N ____ ☐ Other ____

☑ m 500 S/N 134709 ☐ Oscilloscope S/N ____ ☑ Multimeter S/N 57390613

Calibrated By: Conrad Salinas Date 14 Jan 99

Reviewed By: Jimmie Fleming Date 14 Jan. 99

FORM C22E 09/17/98

Designer and Manufacturer
of
Scientific and Industrial
Instruments

POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 44-10 Serial No. PR 122520

Customer INTEGRATED ENVIRONMENTAL MGNT Order #. 227451/ 238082

Counter 2241 Serial No. 114535 Counter Input Sensitivity 34 mV

Count Time 6 seconds Distance Source to Detector Surface

Other

High Voltage	Background	Isotope Am-241 Size ≈ 1 μCi	Isotope Size	Isotope Size	Isotope Size
900	727	897			
950	803	4270			
1000	835	10715			
1050	865	11123			
1100	892	12261			
1150	889	12395			
1200	916	12557			
1250	1025	12711			

Signature Conrad Salinda Date 14 Jan 99

of Scientific and Industrial Instruments

POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CERTIFICATE OF CALIBRATION

CUSTOMER INTEGRATED ENVIRONMENTAL MGNT ORDER NO. 229961/ 239307

Mfg. Bicron Model MICRO REM Serial No. B296W

Mfg. _____ Model _____ Serial No. _____

Cal. Date 19-Mar-99 Cal Due Date 19-Mar-00 Cal. Interval 1 Year Meterface 0-200 uR/h

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 25 % Alt 710.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☐ F/S Resp. ck ☑ Reset ck. ☐ Window Operation ☐ Geotropism
☐ Audio ck. ☐ Alarm Setting ck. ☐ Batt. ck. (Min. Volt) _____ VDC

☐ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 12/19/89.

Instrument Volt Set _____ V Input Sens. _____ mV Det. Oper. _____ V at _____ mV Threshold Dial Ratio _____ = _____ mV

☐ HV Readout (2 points) Ref./Inst. _____ / _____ V Ref./Inst. _____ / _____ V

COMMENTS:

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1000	150 mR/hr	137	150
x1000	50 mR/hr	45	50
x100	15 mR/hr	140	150
x100	5 mR/hr	47	50
x10	1500 uR/hr	150	150
x10	500 uR/hr	50	50
x1	150 uR/hr	145	150
x1	100 uR/hr	100	100
x0.1	15 uR/hr	15	15
x0.1			

*Uncertainty within ± 10% C.F. within ± 20%

Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout			
Log Scale			

Vacuum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1997

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☑ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☑ E551 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N _____ ☐ Beta S/N _____ ☐ Other _____

☐ m 500 S/N _____ ☐ Oscilloscope S/N _____ ☐ Multimeter S/N _____

Calibrated By: Conrad Salinas Date 19 Mar 99

Reviewed By: Rhonda Harris Date 21 Mar 99

FORM C22A 09/17/98

Designer and Manufacturer of Scientific and Industrial Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CERTIFICATE OF CALIBRATION

CUSTOMER SHIELDALLOY METALLURGICAL ORDER NO. 237639/242992

Mfg. Victoreen Model 490 Serial No. 5279

Mfg. Victoreen Model 489-55 Serial No. 860428-3

Cal. Date 19-Sep-99 Cal Due Date 19-Sep-00 Cal. Interval 1 Year Meterface SCINT

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 39 % Alt 708.8 mm Hg

☐ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☑ F/S Resp. ck ☐ Reset ck. ☐ Window Operation ☐ Geotropism
☐ Audio ck. ☐ Alarm Setting ck. ☐ Batt. ck. (Min. Volt) _____ VDC

☐ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 12/19/89.

Instrument Volt Set 751 V Input Sens. 13 mV Det. Oper. 751 V at 13 mV Threshold Dial Ratio _____ = _____ mV

☐ HV Readout (2 points) Ref./Inst. _____ / _____ V Ref./Inst. _____ / _____ V

COMMENTS:
Operational check source SN n/a reads ≈ 700cpm (9x10) with the front of the probe pressed against the source.

nma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
X 1000	600 cpm	450	550
X 1000	200 cpm	150	200
X 100	600 cpm	520	575
X 100	200 cpm	175	210
X 10	600 cpm	555	610
X 10	200 cpm	200	225
X 1	600 cpm	550	610
X 1	200 cpm	200	225

*Uncertainty within ± 10% C.F. within ± 20% ALL Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital adout			

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Log Scale			

lium Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978 State of Texas Calibration License No. LO-1963

eference Instruments and/or Sources:

s-137 Gamma S/N ☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N _____ ☐ Beta S/N _____ ☐ Other _____

☑ m 500 S/N 54683 ☐ Oscilloscope S/N _____ ☑ Multimeter S/N 70602489

Calibrated By: Duaine Jackson Date 19-Sep-99

Reviewed By: Rhonda Harris Date 23 Sep 99

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CONVERSION CHART

Customer SHIELDALLOY METALLURGICAL Date 19-Sep-99 Order #. 237639/242992

Model 490 Serial No. 5279 Detector Model 489-55 Serial No. 860428-3

Source Cs-137 1.9 mCi High Voltage 751 V

Input Sensitivity 13 mV

Reference Point	"As Found" Readings: Meter Reading	Range/Scale	After Adjustment Readings: Meter Reading	Range/Scale
2000 µR/hr	580	x 1000	580	x 1000
1000 " C "	325	x 1000	325	x 1000
200	725	x 100	725	x 100
100	400	x 100	400	x 100

Signature: Duaine Jackson Date 19-Sep-99

Appendix C - Daily Instrument Check Sheets and Field Logs

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
EXPOSURE RATE SURVEY INSTRUMENT DATA SHEET

Project No. 94005.05	Detector		Meter		
Site Location/Background Location: SMC Newfield Instrument office in lab.	Type:	Serial No.	Type: Ludlum Model 19	Serial No: 144771	~~Operating~~ Batt. Voltage: Check SAT

Check Source Number	Radionuclide:	Calibration Activity and Date:
3788	Cs-137	1.24 uC: 9/12/91

Date	Units	Start of Shift Background				End of Shift Background				Daily Response (μR/hr)	Initials
		1	2	3	Avg.	1	2	3	Ave.		
3/9/99	uR/hr	6	7	7	7	6	6	7	6	370	BM
3/10/99	uR/hr	7	6	6	7	6	6	6	6	380	BM

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
EXPOSURE RATE SURVEY INSTRUMENT DATA SHEET

Project No.	Detector		Meter		
Site Location/Background Location:	Type:	Serial No.	Type:	Serial No:	Operating Voltage:
94005.20 SMC New Field - Instrument office D202	44-10	132520	Ludlum 2241	114535	N/A

Check Source Number	Radionuclide:	Calibration Activity and Date:
3788	Cs-137	1.24 uC: 9/12/91

Date	Units	Start of Shift Background				End of Shift Background				Daily Response (μR/hr)	Initials
		1	2	3	Avg.	1	2	3	Ave.		
5/17/99	uR/hr	7	6	7	7	7	7	7	7	301	MS
5/18/99	"	6	7	7	7	7	6	7	7	295	MS
5/19/99	"	7	7	7	7	7	6	8	7	297	MS
* 5/20/99	uR/hr	6	7	7	7	7	7	6	7	300	MS

* Late Entry by MS, Taken From field notes

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
EXPOSURE RATE SURVEY INSTRUMENT DATA SHEET

Project No. 94005.05	Detector		Meter		
Site Location/Background Location: SMC Newfield, 2ND floor lab, instoffice	Type: N/A	Serial No. N/A	Type: Bicron MicroRem	Serial No: B296W	Operating Voltage: SAT

Check Source Number	Radionuclide:	Calibration Activity and Date:
3788	Cs-137	1.24 uC: 9/12/91

Date	Units	Start of Shift Background				End of Shift Background				Daily Response (μR/hr)	Initials
		1	2	3	Avg.	1	2	3	Ave.		
9/8/99	uRem/hr	4	3	4	4	4	5	5	5	700	BKD
9/9/99	uRem/hr	5	4	4	4	5	4	5	5	700	BKD

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
EXPOSURE RATE SURVEY INSTRUMENT DATA SHEET

Project No. 94005.05	Detector		Meter		
Site Location/Background Location: SMC Newfield, Rad. Prot. office in Lab Bldg.	Type: N/A	Serial No. N/A	Type: Victoreen 490	Serial No: 5279	Operating Voltage: BATT. Check N/A SAT

Check Source Number	Radionuclide:	Calibration Activity and Date:
3788	Cs-137	1.24 uC: 9/12/91

Date	Units	Start of Shift Background				End of Shift Background				Daily Response ~~(cpm)~~ cpm	Initials
		1	2	3	Avg.	1	2	3	Ave.		
12/13/99	cpm	3000	3000	3000	3000	3000	3000	3000	3000	200K	
12/14/99	cpm	3000	3000	3000	3000	3000	3000	3000	3000	200K	
12/15/99	cpm	3000	3000	3000	3000	3000	3000	3000	3000	200K	
12/16/99	cpm	3000	3000	3000	3000	3000	3000	3000	3000	200K	

SHIELDALLOY METALLURGICAL CORPORATION
INSTRUMENT DAILY CHECK FORM
RSP-008

Location: SMC	Probe Type: 44-10	Probe Number PR-151704
Meter Number: 143562	Suggested Operating Voltage: —	Check Source Number: 3354

Number	Date	Location	Battery OK	Operating Voltage	Background cpm	Check Source cpm	Name	Remarks
1	9/30/99	LAB	✓	✓	4.70	274	CRAIG BRUNE	
2	10/1/99	CONFERENCE ROOM	✓	✓	3.80	244	CRAIG BRUNE	
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
FIELD ACTIVITY DAILY LOG

Facility: Shieldalloy, Newfield, NJ		
Date: 3/10/99	Time: 0745	Job/Task Number: 94005.05
Client Name: Shieldalloy Metallurgical Corp.		
Address of Work Site: West Blvd. Newfield, NJ		
Description of Work: 1st qtr. 1999 surveillance		

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS

0740 On site, preparing instruments for today's use.
0815 Conducted surveys in areas of storage yard to be reforested to determine general exposure rates/background values. This was done to see if mislocated slag could be easily detected during γ walkover surveys, even with interference (high bkgd.) from CANAL pile. Slag was easily located
0850 Conducted survey on soil areas between the Flexkleen and AAF baghouses. This was performed to determine if the area surrounding the baghouses had radioactive slag present, determine general area exposure rates prior to AAF baghouse decommissioning.
0900 Conducted survey at CANAL-like storage location north of Bldg. D111. Posted area as "Radioactive Materials" area.
0915 Conducted release survey of baghouse in 'B' Warehouse.
1000 Held debrief of site activities w/RSO. Discussed checking of posting results, materials needing removal from D202 basement & D117 Cave, results of quarterly surveys, TLD exchange, results of surveys in storage yard & baghouses, drum in 'G' warehouse, instrument calibration.
1045 Left site

No Further Entries for

Changes from Plans and Specifications, and Other Special Orders and Important Decisions: None	
Weather Conditions: Partly, cloudy, cool	Important Telephone Calls and Interactions: None
Personnel on Site: Duff, D. Smith	
Name (print): R. Alan Duff	Signature: RA Duff

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
FIELD ACTIVITY DAILY LOG

Facility: SMC Newfield		
Date: 5/17/99	Time: 0700	Job/Task Number: 94005.20
Client Name: Shieldalloy Metallurgical Corp.		
Address of Work Site: West Blvd., Newfield, NJ.		
Description of Work: Setup for baghouse disassembly.		

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS

0700 On Site, Merkel & Duff, Met w/ Rob Bennett of summit
0715 Signed in w/guard @ guardhouse.
0730 Held initial tailgate meeting, discussed work plan & activities to be performed & precautions to be taken.
0830 Completed training on project, making preparations to commence work, performing instrument setups.
0845 Retrieved Pentek VacPac System & unloaded, vacuum hose not shipped with system. Called Pentek's Chris Futrick, hose will be here by common carrier before noon today.
1045 Issued BZA samplers to workers.
10:55 Workers Cutting & Dropping Bags into Summit Dump Truck, moving them to storage yard to unload & store.
1200-1230 Lunch, 1300 - Recommenced work @ baghouse
1330 Commenced walkover & survey at eastern end of storage yard, area has had surface soil removed ~1'-3' depth. Hose (vacuum) arrived.
1530 Secured surveying in storage yard, secured work at baghouse.
1600 Performing paperwork in inst. office (Duff & Merkel), preparing air samplers for use tomorrow.
1630 Left Site, ~1/4 of bags complete.

No Further Entries

Changes from Plans and Specifications, and Other Special Orders and Important Decisions:
Significantly more materials in bags than expected, silo ~1/3 full.

Weather Conditions: Partly cloudy, mild, wind calm	Important Telephone Calls and Interactions: None
Personnel on Site: Duff, Merkel, Bennett, White, Taylor, Schnorbus, Butler, D. Smith	
Name (print): R. A. Duff	Signature:

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
FIELD ACTIVITY DAILY LOG

Facility: SMC Newfield		
Date: 5/18/99	Time: 0700	Job/Task Number: 94005.20
Client Name: Shieldalloy Metallurgical Corp.		
Address of Work Site: West Blvd. Newfield, NJ		
Description of Work: Setup For baghouse disassembly		

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS

0700 On site, preparing instruments for days use
0730 At baghouse, issued BZA pumps to personnel, commenced baghouse bag removal into dump truck. Duff @ storage yard performing walkover survey.
0815 Encountered a problem w/ BZA filter papers clogging up & stopping pumps.
1200-1245 Lunch
1300 Recommenced storage yard survey & baghouse bag removal
1530 Secured workers. Bag removal ~75% complete, storage yard survey ~1/3 complete. Duff + Merkel @ lab, preparing instruments for use, cleaning BZA pumps & filter holders, doing paperwork.
1600 Duff / Merkel left site

No Further Entries

Changes from Plans and Specifications, and Other Special Orders and Important Decisions:

None

Weather Conditions: Cloudy, light drizzle, wind From NE ~5 mph	Important Telephone Calls and Interactions: None
Personnel on Site: Duff, Merkel, Bennett, White, Taylor, Schnorbus, Butler.	
Name (print): R. Alan Duff	Signature:

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
FIELD ACTIVITY DAILY LOG

Facility: SMC NewField		
Date: 5/19/99	Time: 0700	Job/Task Number: 94005.20
Client Name: Shieldalloy Metallurgical Corp.		
Address of Work Site: West Blvd., NewField, N.J.		
Description of Work Baghouse bag removal, survey of storage yard		

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS

0630 Merkel on site, preparing instruments for use.
0645 Duff on site, preparing instruments for use.
0700 Merkel at baghouse w/crew, commenced removing baghouse bags.
0715 Duff @ storage yard, commenced walkover & survey.
0900 Secured survey of storage yard (rain), Duff @ lab doing paperwork. Spoke w/D. Smith. Since slag being found in Stor. yard right up to perimeter Fence, wants me to perform a walkover & survey outside of Fence.
1100 Recommenced storage yard survey.
1200-1230 Lunch
1300 Continued work on baghouse & storage yard survey.
1445 Secured work for the day, bag removal complete.
1530 Duff & Merkel left site.

No Further Entries

Changes from Plans and Specifications, and Other Special Orders and Important Decisions: None.	
Weather Conditions: Rain, warm, wind calm.	Important Telephone Calls and Interactions: None
Personnel on Site: Duff, Merkel, D. Smith, R. Bennett, White, Taylor, Schnorbus, Butler	
Name (print): R. Alan Duff	Signature:

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
FIELD ACTIVITY DAILY LOG

Facility: SMC New Field		
Date: 5/20/99	Time: 0700	Job/Task Number: 94005.20
Client Name: Shieldalloy Metallurgical Corp.		
Address of Work Site: West Blvd., New Field, NJ		
Description of Work: Baghouse decontamination, storage yard survey		

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS

0630 Merkel on site, preparing instruments for use.
0700 Duff on site, crew commenced sweeping upper levels of baghouse to remove gross amts. of residual dust.
0730 Duff @ storage yard, ~~commenced~~ continued walkover & survey. Spot frisks of upper levels of baghouse show all areas should meet release criteria.
0900 Cutting vent duct between baghouse & Fans w/ oxy-acetylene torch. Pieces ~~to be~~ removed have shown 1000-3000 dpm/100cm² ~~total~~ fixed.
1200-1230 Lunch
1300 Recommenced work.
1400 Duff completed walkover & survey of excavated areas, commenced walkover outside fence. Flags placed in areas of elevated measurements
~~1530~~ 1545 Completed work at the baghouse for the day.
1545 Completed walkover around fence perimeter. Some elevated locations were located & marked on survey maps & w/Flags.
1630 Duff/Merkel left site for the day.

No Further Entries

Changes from Plans and Specifications, and Other Special Orders and Important Decisions: None	
Weather Conditions: Clear, mild, wind 5 mph From SE	Important Telephone Calls and Interactions: N/A
Personnel on Site: Duff, Merkel, D. Smith, Schnorbus, White, Butler, Taylor	
Name (print): R. Alan Duff	Signature:

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
FIELD ACTIVITY DAILY LOG

Facility: SMC Newfield		
Date: 9/9/99	Time: 0720	Job/Task Number: 94005.05
Client Name: Shieldalloy Metallurgical Corp.		
Address of Work Site: 12 West Blvd., Newfield, NJ		
Description of Work 1999 Q3 Surviellance		

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS

0725 On site, preparing instruments for today's use.
0745 Performing TLD exchange on Finger ring TLDs & Perimeter Fence TLDs
0900 Completed TLD exchange W/exception of J. Valenti TLD, checking posted areas for proper warning signs.
1050 Surveying areas of soil that were remediated in Storage yard (far east end of site). Performing verification surveys that remediation was effective. Several areas still need further excavation
1130 NRC inspector (Marie Miller) on site to observe activities, currently observing the conduct of the storage yard survey.
1200 Preparing to conduct contamination surveys of AAF baghouse concrete pad
1400 Had intended to perform a release survey For unrestricted use on the concrete pad @ the AAF baghouse, but several readings exceed the release criteria. Will be conducting α & β^- characterization of the pad instead of a release survey.
1500 Performing α & β^- 1 min. contamination counts at several locations at AAF Concrete pad.
1800 Completed on site work, left site for Fed Ex dropoff
1830 Fed Ex would not take Floor monitor cart, returned it to SMC for future shipment. Left site.
No Further Entries

Changes from Plans and Specifications and Other Special Orders and Important Decisions:
Storage yard not entirely remediated, cannot release AAF concrete pad due to contamination levels.

Weather Conditions: Warm, humid	Important Telephone Calls and Interactions: Conference call w/NRC, B. Kelly, D. Smith, A. Duff on storage yard Surveys & Samples
Personnel on Site: Duff, D. Smith, SMC workforce, Maria Miller-NRC inspector	
Name (print): R. Alan Duff	Signature:

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
FIELD ACTIVITY DAILY LOG

Facility: SHIELDALLOY METALLURGICAL CORP.	
Date: 9/30/99	Job/Task Number: 94005.22
Client Name: SHIELDALLOY	
Address of Work Site: 12 WEST BLVD, NEWFIELD, NJ	
Description of Work RADIOLOGICAL SURVEY FORM	

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS

Arrived on site at (insert date and time): 9/30/99 ~ 7:30 AM

- MET CAROL BERGER ON SITE @ ~7:30AM
- RETRIEVED MODEL 2241 METER & MODEL 44-10 DETECTOR
- TOOK BACKGROUND READINGS & CHECK SOURCE READINGS
- FILLED OUT INSTRUMENT DAILY CHECK FORM
- BEGAN TAKING READINGS ALONG THE SOUTH & EAST FENCE LINE IN STORAGE YARD
- SUMMIT EXCAVATED AREAS WHERE ELEVATED READINGS WERE OBSERVED. SOIL & ROCK WAS TRANSPORTED TO SLAG STOCKPILE
- TOOK READINGS AROUND AREAS IN STORAGE YARD THAT HAD PREVIOUSLY BEEN MARKED WITH FLAGS. ALL AREAS WITH ELEVATED READINGS WERE EXCAVATED & ROCK & SOIL TRANSPORTED TO SLAG STOCKPILE

Departed site at (insert date and time): 9/30/99 ~ 4:00PM

Changes from Plans and Specifications, and Other Special Orders and Important Decisions:

Weather Conditions: WINDY, SUNNY, 70°-75°	Important Telephone Calls and Interactions:
Personnel on Site: SUMMIT CAROL BERGER - IEM	
Name (print): CRAIG L BRUNE	Signature:

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
FIELD ACTIVITY DAILY LOG

Facility: SHIELD ALLOY METALLURGICAL CORP	
Date: 10/1/99	Job/Task Number: 94005.22
Client Name: SHIELDALLOY	
Address of Work Site: 12 WEST BLVD, NEWFIELD, NJ.	
Description of Work RADIOLOGICAL SURVEY, SURFACE SOIL SAMPLING	

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS

Arrived on site at (insert date and time): 10/1/99 ~ 0700

- RETRIEVED MODEL 2241 MOTEK & MODEL 44-10 DETECTOR
- TOOK BACKGROUND READINGS & CHECK SOURCE READINGS.
- FILLED OUT DAILY INSTRUMENT CHECK FORM
- BEGAN TAKING 15 SURFACE SOIL SAMPLES FROM STORAGE YARD. DIVIDED STORAGE YARD INTO 15 DIFFERENT SECTIONS & COLLECTED 1 SURFACE SOIL SAMPLE FROM EACH SECTION. LABELED JARS, FILLED OUT C.O.C. & PACKED SAMPLES IN COOLER FOR FED EX DELIVERY TO T.V.A. (MONDAY A.M. DELIVERY)
- BEGAN SURVEYING AREA BEHIND SOUTH & EAST & WEST FENCE LINE. LEFT FLAGS AT AREAS WITH ELEVATED READINGS
- SPOKE W/ ALAN DUFF & DAVE SMITH (SHIELD ALLOY) BEFORE DEPARTURE FROM SITE.
- SUMMIT TO REMOVE TWO LARGE "ROCKS" NOTED ON SURVEY MAP.

Departed site at (insert date and time): 10/1/99 ~ 1:00pm

Changes from Plans and Specifications, and Other Special Orders and Important Decisions:

Weather Conditions: SUNNY 75°-80°	Important Telephone Calls and Interactions:
Personnel on Site: SUMMIT - A.M.	
Name (print): CRAIG L BRUNE	Signature:

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
FIELD ACTIVITY DAILY LOG

Facility: SMC Newfield		
Date: 12/13/99	Time: 1145	Job/Task Number: 94005.05
Client Name: Shieldalloy Metallurgical Corp.		
Address of Work Site: West Blvd., Newfield, NJ		
Description of Work: Quarterly Surveillance, 4th Qtr: 1999		

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS

0545 - At airport, traveling to site.
1130 - Arrived in Newfield, 1130-1145 Lunch.
1145 - At SMC, signed in at Front desk, retrieved lab office key from security
1200 - Conducted source & instrument inventory, no abnormalities.
1215 - Exchanged finger ring TLDs.
1330 - Met w/ Dave Smith, he wanted storage yard survey performed prior to expected rain.
1340 - Performing storage yard survey (SE corner of property) & TLD exchange. Completed survey at 1415. Cleaned up 1 location found, 1 remains
1500 - Completed TLD exchange w/exception of J. Valenti: TLD, gave him TLD to exchange tonight. In lab office performing paperwork, packaging instruments for shipment to calibration.
1615 - Spoke w/ D. Smith about storage yard & perimeter surveys, tried to call C. Berger, left message.
1645 - Left site.

No Further Entries

RAD

Changes from Plans and Specifications, and Other Special Orders and Important Decisions:
No changes. Need to speak w/ C. Berger to see if recent NRC Federal Register notices on soil activity limits will impact storage yard & perimeter surveys.

Weather Conditions: Cloudy, periodic rain, cool, wind 5-10 mph From NW	Important Telephone Calls and Interactions: (Left messages) Call to C. Berger on Storage Yd. surveys
Personnel on Site: Duff, Valenti, Smith, SMC work force	
Name (print): R. Alan Duff	Signature: RAD

Appendix D - Survey and Sample Collection Maps

SHIELDALLOY METALLURGICAL CORPORATION
RADIOLOGICAL SURVEY FORM
RSP-008

Survey Number 031099-01 Date of Survey 3/10/99

Survey Description	Survey Performed by:
Survey of areas of storage yard to be reforested to determine background values & survey of soil areas adjacent to AAF + Flexkleen baghouses. & survey for posting of CANAL-Lite storage area. Survey of dust collector for release.	Signature: [signature]
Drawing Attached: ☒ Yes ☐ No	Print Name: R. Alan DuFF

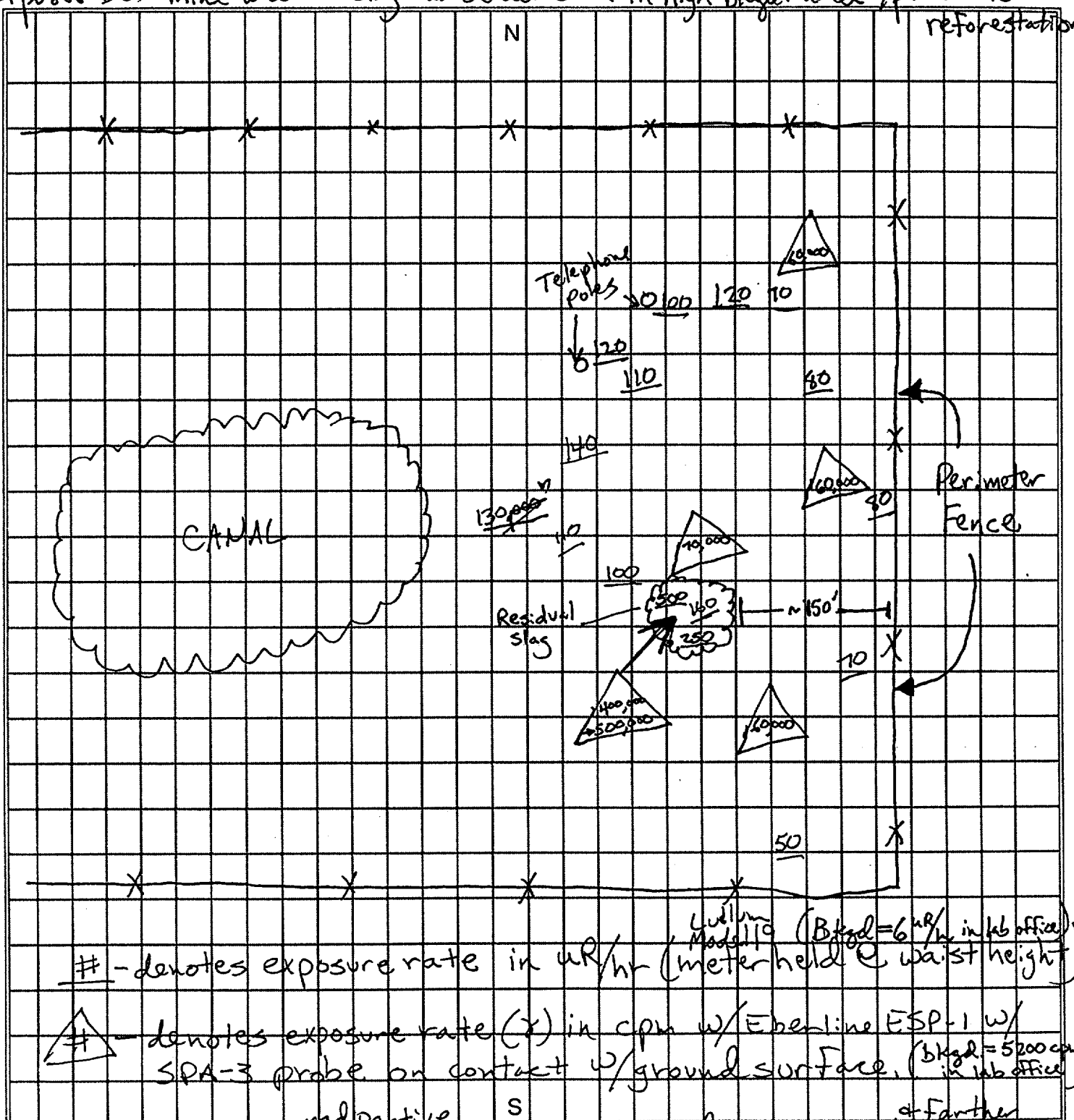
Instrument (1)	Instrument (2)	Instrument (3)
Model: Eberline ESP-1/SPA-3	Model: Ludlum Model 19	Model: Eberline ESP-1/AC-3
Serial No. 03047/408462	Serial No. 144771	Serial No. #3049/407083-39
Calibration Due: 12 JAN 00	Calibration Due: 14 JAN 00	Calibration Due: 7 OCT 99
Efficiency N/A	Efficiency N/A	Efficiency 17.1%
MDA N/A CF N/A BKG	MDA N/A CF N/A BKG 7 uR/hr	MDA 73 CF 9.8 BKG 1 cpm

Survey Point	Contamination Levels					Ambient Radiation Levels	Instrument Used	Comments and Additional Information
	Fixed (F) or Total (T)	Beta/gamma		Alpha		(microR/hour)		
		cpm/area	(dpm/100 cm²)	cpm/area	(dpm/100 cm²)			

SHIELDALLOY METALLURGICAL CORPORATION
RADIOLOGICAL SURVEY MAP
RSP-008

Survey Number 031099-01 Building/Area Storage Yard Date of Survey 3/10/99 0815

Purpose: Determine whether res:dual slag can be detected in high bkgd. area prior to reforestation.



#- denotes exposure rate in uR/hr (meter held @ waist height) (Bkgd = 6 uR/hr in lab office)

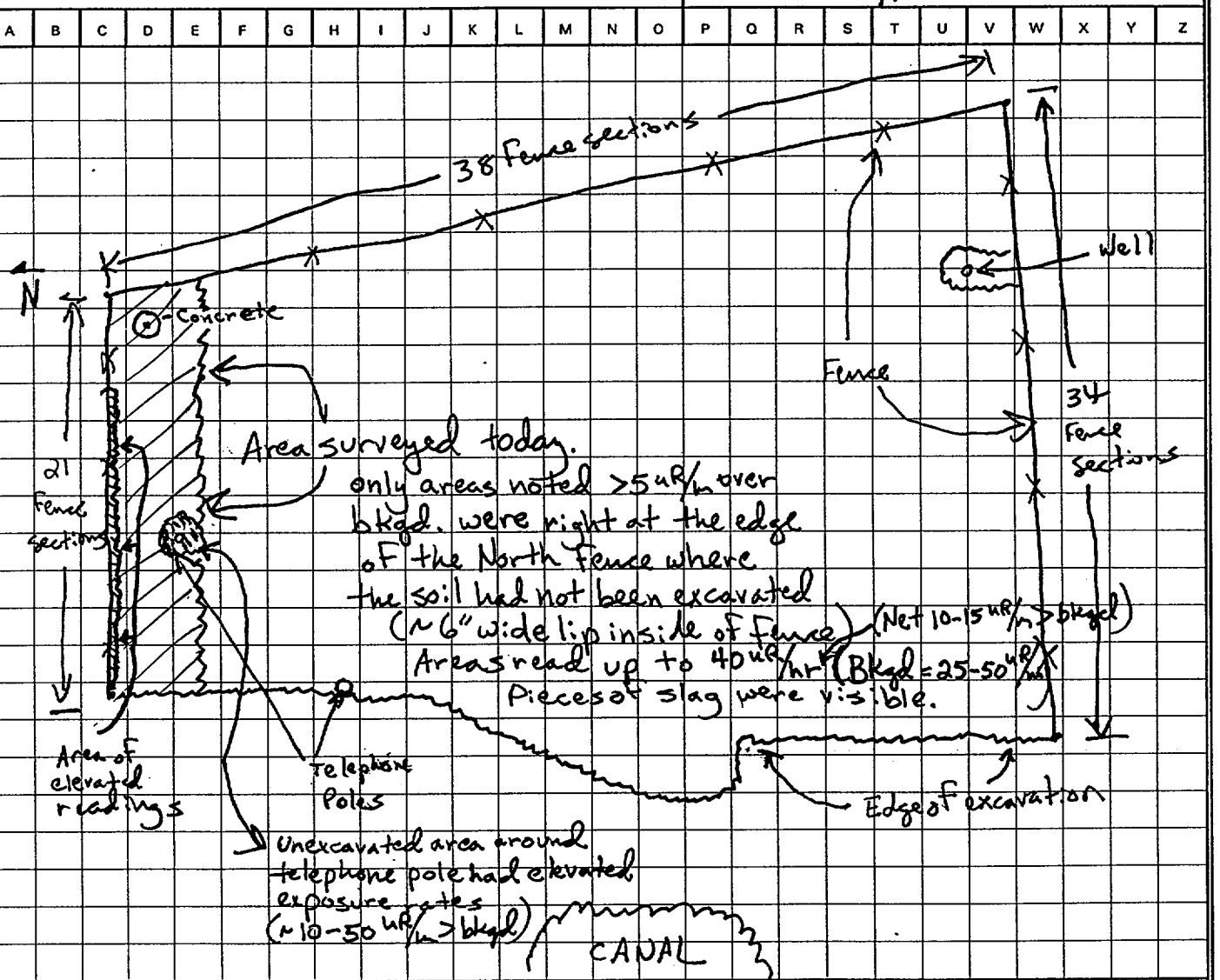
#- denotes exposure rate (γ) in cpm w/ Eberline ESP-1 w/ SPA-3 probe on contact w/ ground surface. (bkgd = 5200 cpm in lab office)

Spots of res:dual slag were easily detected up to 50' from CANAL pile.

INTEGRAGED ENVIRONMENTAL MANAGEMENT, INC.
RADIOLOGICAL SURVEY FORM

Survey Number SMC-051199 Page 1 of 1

Instrument/SN: Ludlum 2241 w/44-10 #PR 535/132520	Calibration Due: 1/14/00	Site Name: SMC NewField	Date: 5/17/99 Time: 1330
Instrument/SN: N/A	Calibration Due: N/A	Location: East End of storage yard	
Instrument/SN: N/A	Calibration Due: N/A	Purpose: Survey (Y walkover) after excavation.	
Survey Performed By (Print): R. Alan Duff		Survey Performed By (Signature): [signature]	
[X] Battery OK [ ] HV OK N/A [X] Source Check OK		Grid Dimensions: N/A x ☐ meters ☐ feet ☐ inches ☐ centimeters	



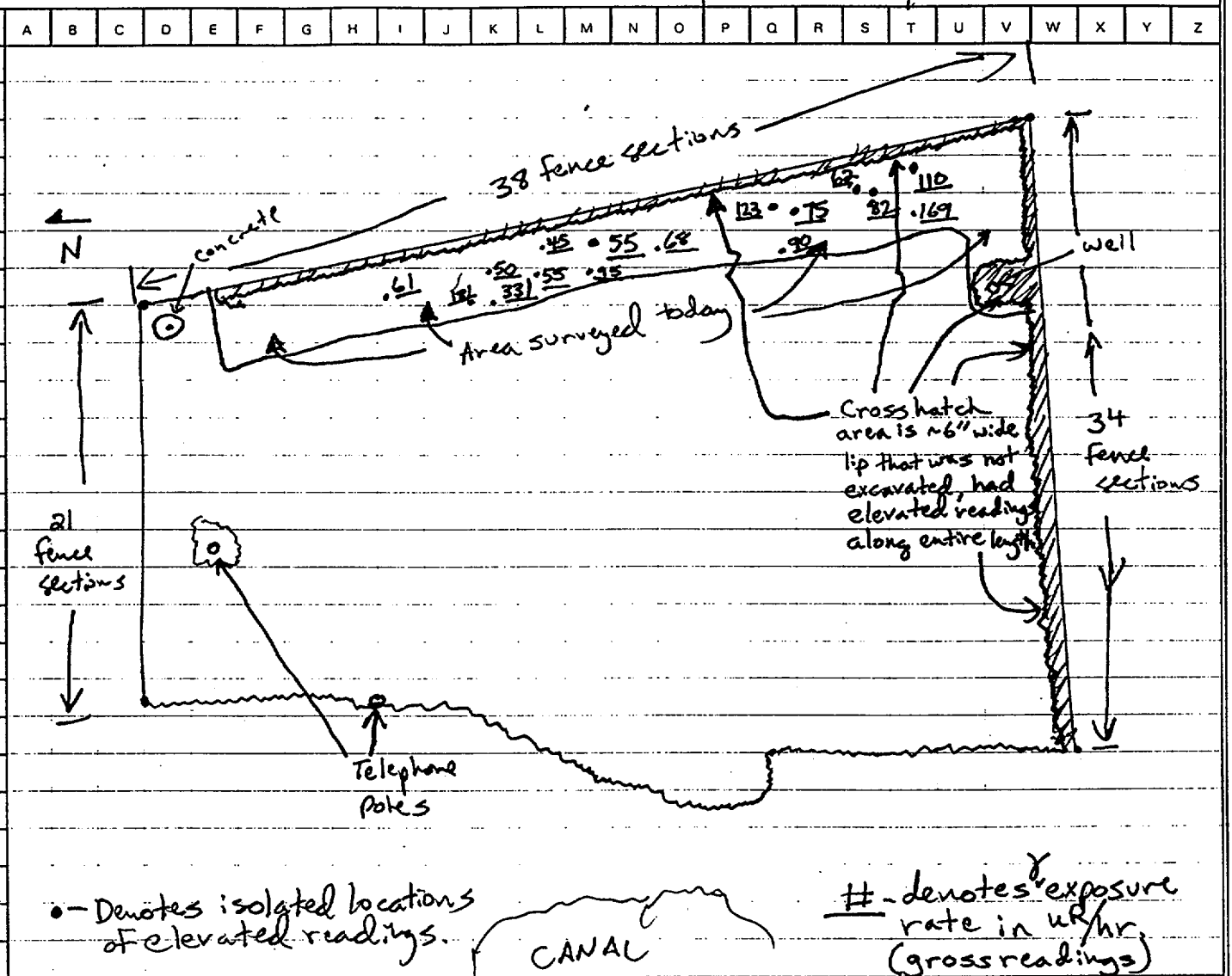
Notes: Each Fence section in ~10'-11' wide. Performed walkover & survey by walking ~3' wide path, swinging probe in a serpentine pattern ~1" above surface of ground. Areas noted with detectable exposure rates above bkgd. (>5 uR/hr) were marked w/Flags to identify them for further remediation. Excavation varied in depth from ~1'-5'. Rate of survey ~ 1'/sec.

INTEGRAGED ENVIRONMENTAL MANAGEMENT, INC.

RADIOLOGICAL SURVEY FORM

Survey Number SMC-051899

Instrument/SN: Ludlum 2241 #114535	Calibration Due: 1/14/00	Site Name: SMC Newfield	Date: 5/19/99 Time: 0900
Instrument/SN w/Ludlum 44-10 probe #132520	Calibration Due: N/A	Location: Storage Yard, east end	
Instrument/SN N/A	Calibration Due: N/A	Purpose: γ walkover after excavation	
Survey Performed By (Print): R. Alan Duff		Survey Performed By (Signature):	
X Battery OK ☐ HV OK N/A X Source Check OK		Grid Dimensions: N/A × ☐ meters ☐ feet ☐ inches ☐ centimeters	



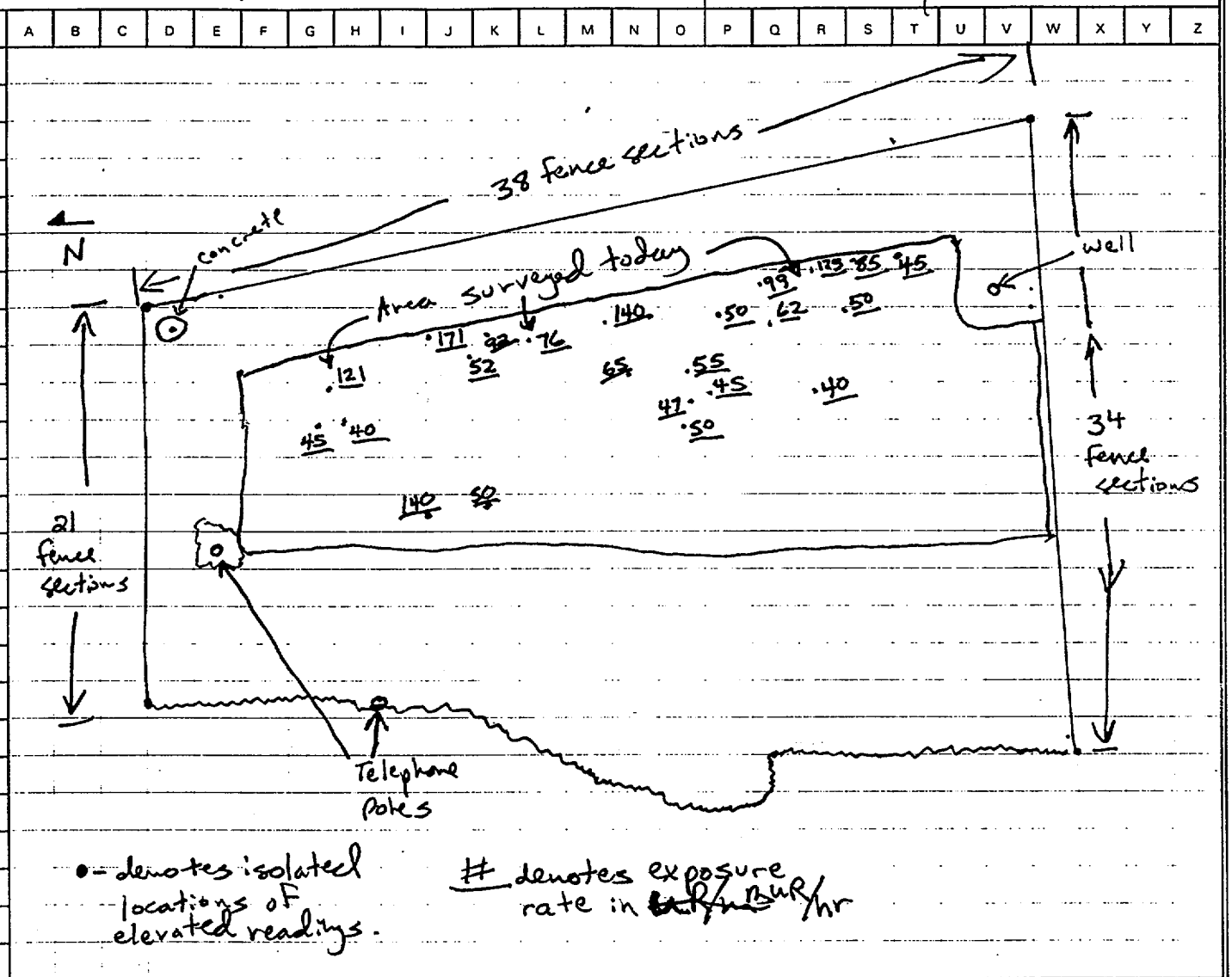
Notes: Bkgd. is 25-30 uR/hr at east edge, increases to 40-50 uR/hr at west ~~edge~~ edge due to close proximity to CANAL
Slag found (readings [gross] up to From 50 uR/hr up to 800 uR/hr) All along Fenceline on east & south sides. Survey consisted of γ walkover survey, ~1'/sec, probe w/in 1" of soil, moving in serpentine pattern.
Elevated points marked w/Flags to identify for future excavation

INTEGRAGED ENVIRONMENTAL MANAGEMENT, INC.

RADIOLOGICAL SURVEY FORM

Survey Number SMC-051999

Instrument/SN: Ludlum 2241 #114535	Calibration Due: 1/14/00	Site Name: SMC New Field	Date: 5/19/99 Time: 0730
Instrument/SN: Ludlum 44-10 Probe #132520	Calibration Due: —	Location: Storage Yard, east end	
Instrument/SN —	Calibration Due: —	Purpose: walkover & walkover after excavation	
Survey Performed By (Print): R. Allan Duff		Survey Performed By (Signature):	
X Battery OK	N/A OK	X Source Check OK	Grid Dimensions: N/A x ☐ meters ☐ feet ☐ inches ☐ centimeters



•= denotes isolated locations of elevated readings.

# denotes exposure rate in ~~uR/hr~~ uR/hr

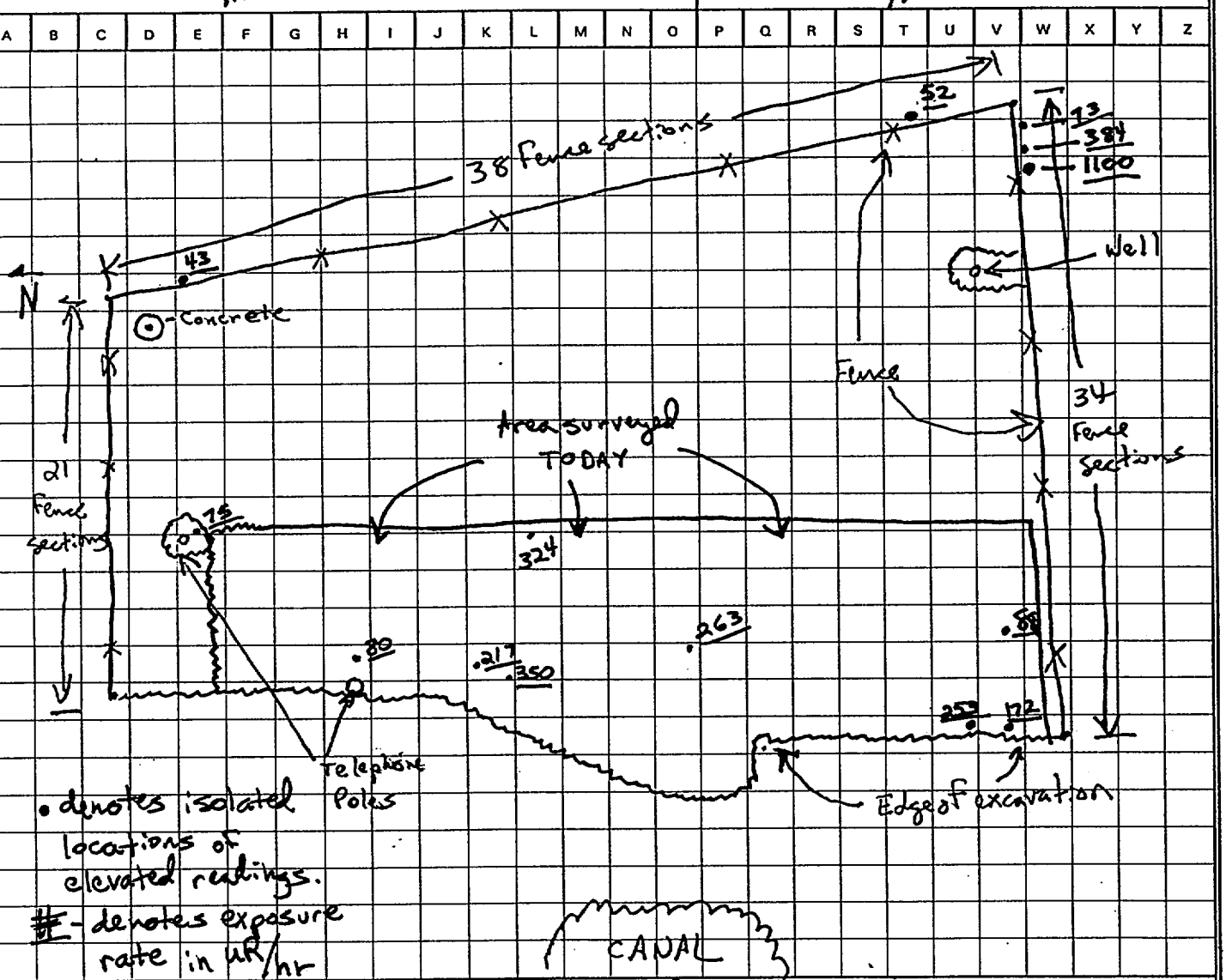
Notes: Bkgd. = 25-30 uR/hr at east edge & ↑ to 40 to 50 uR/hr at west edge. Survey was a jr walkover survey, ~1'/sec, probe w/in 1" of soil surface, moving in a serpentine pattern. Elevated points were ~~noted~~ marked w/flags to identify for further excavation.

INTEGRAGED ENVIRONMENTAL MANAGEMENT, INC.

RADIOLOGICAL SURVEY FORM

Survey Number SMC-052899

Instrument/SN: Ludlum 2241 w/44-10 #PR535/132520	Calibration Due: 1/14/00	Site Name: SMC Newfield	Date: 5/6/99 Time: 0730
Instrument/SN: N/A	Calibration Due: N/A	Location: East End of storage yard	
Instrument/SN: N/A	Calibration Due: N/A	Purpose: Survey (walkover) after excavation.	
Survey Performed By (Print): R. Alan Duff		Survey Performed By (Signature):	
☒ Battery OK ☐ HV OK N/A ☒ Source Check OK		Grid Dimensions: N/A x ☐ meters ☐ feet ☐ inches ☐ centimeters	



Notes: Each Fence section in ~10'-11' wide. Performed walkover & survey by walking ~3' wide path, swinging probe in a serpentine pattern ~1" above surface of ground. Areas noted with detectable exposure rates above bkgd. (>5uR/hr) were marked w/Flags to identify them for further remediation. Excavation varied in depth from ~1'-5'.

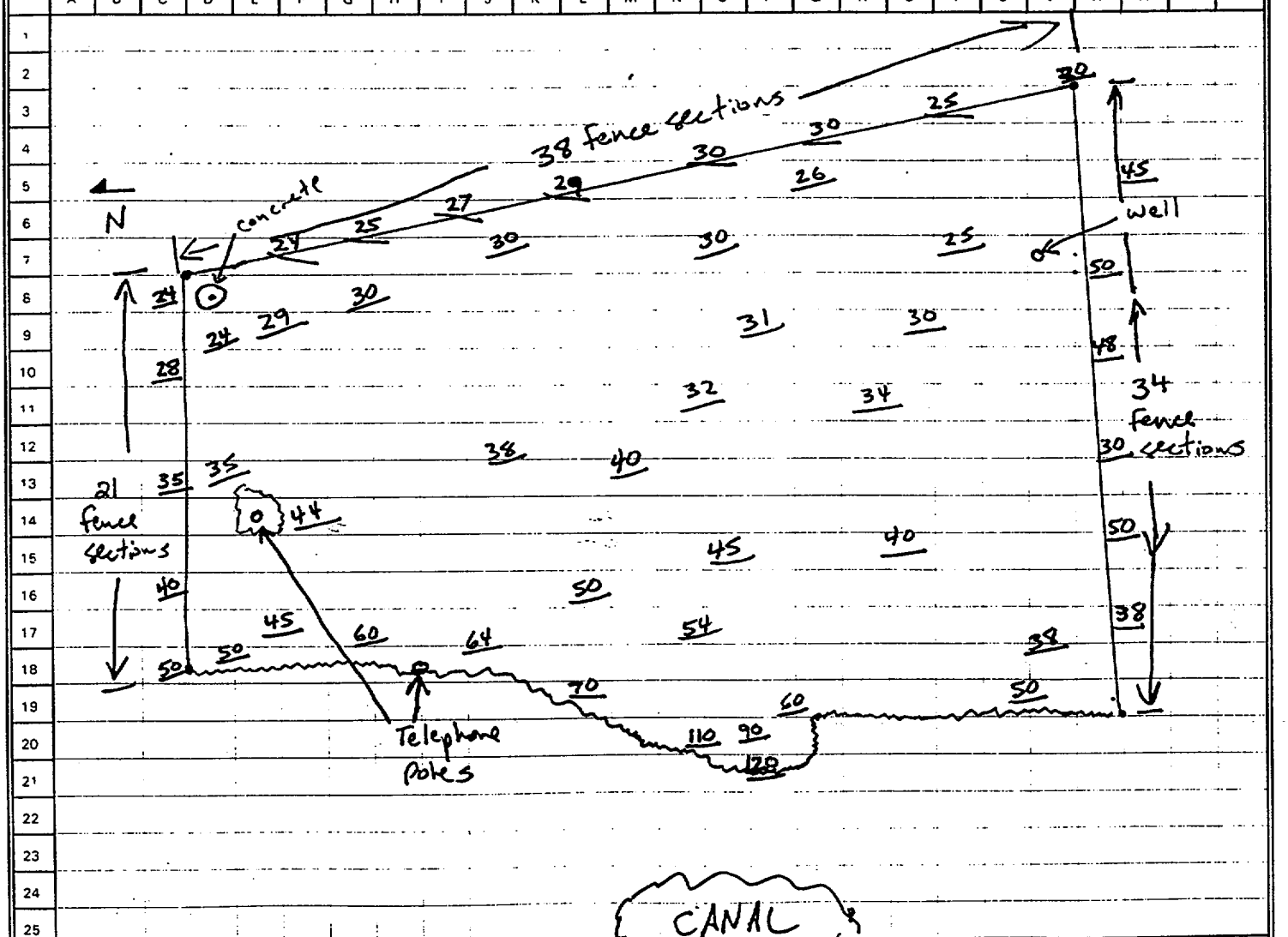
INTEGRAGED ENVIRONMENTAL MANAGEMENT, INC.

RADIOLOGICAL SURVEY FORM

Survey Number SMC-0520-99

Page 2 of 2

Instrument/SN: Ludlum 2241 W/44-10	Calibration Due: 1/14/00	Site Name: SMC Newfield	Date: 5/24/99 Time: 1400
Instrument/SN #114535/132520	Calibration Due: N/A	Location: East End of Storage Yard	
Instrument/SN N/A	Calibration Due: N/A	Purpose: Get approx. values of background in excavation	
Survey Performed By (Print): R. Alan Duff		Survey Performed By (Signature):	
X Battery OK	N/A HV OK	X Source Check OK	Grid Dimensions: N/A ☐ meters ☐ feet x ☐ inches ☐ centimeters



Notes: General BACKGROUND VALUES @ Various Locations (in uR/hr)
Probe held ~1" From ground surface (Avoided areas of elevated exposure rates generated by remaining slag.

SHIELDALLOY METALLURGICAL CORPORATION
RADIOLOGICAL SURVEY FORM
RSP-008

Survey Number SMC-090999 Date of Survey 9/9/99

Survey Description:
Survey of AAF baghouse concrete pad. Survey of storage yard areas that were excavated.

Drawing Attached: X Yes ☐ No

Survey Performed by:
R. Alan DuFF
Signature

R. Alan DuFF
Print Name

Instrument (1)	Instrument (2)	Instrument (3)
Model: Bicron MicroRem	Model: Ludlum Model 2224 U/43-89	Model: ~~Ludlum Model 2221~~ Floor Monitor W/43-37
Serial No. B296W	Serial No. i25607/132117	Serial No. 91953/094974
Calibration Due: 3/19/00	Calibration Due: 1/14/00	Calibration Due: 2/26/00
Efficiency N/A	Efficiency α 19.1 % / β 46	Efficiency 18.29% B⁻ / 13.98% α (From Cal Sheet)
MDA N/A CF N/A BKG 4 ~~uR/hr~~	MDA 56.4 dpm α / dpm B⁻/B CF 5.24 α BKG 3 cpm α B⁻ 453 cpm	MDA CF BKG Not Used

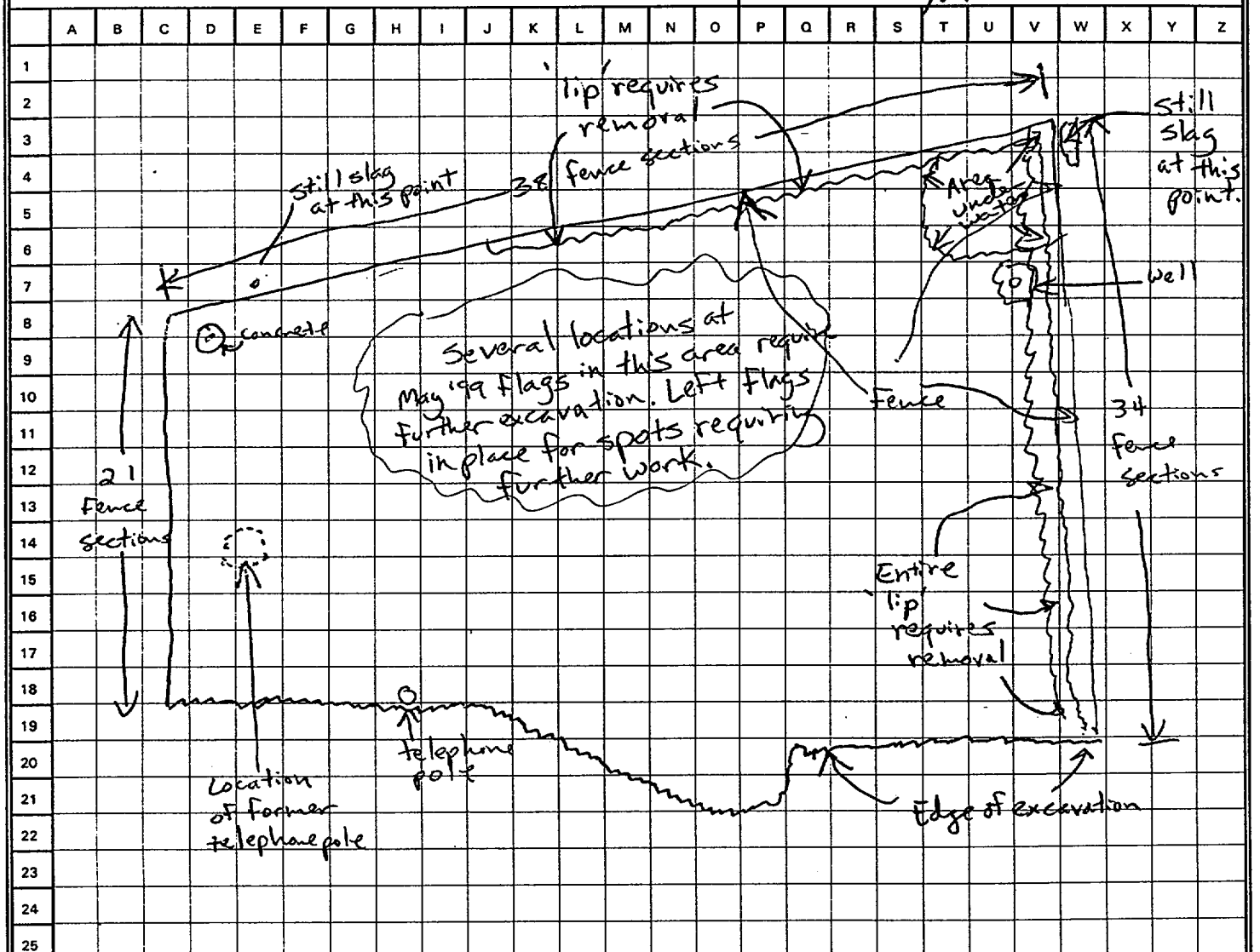
Survey Point	Contamination Levels				Ambient Radiation Levels	Instrument Used	Comments and Additional Information
	Fixed (F) or Total (T)	Beta/gamma		Alpha			
		cpm/area	(dpm/100 cm²)	cpm/area	(dpm/100 cm²)	(microR/hour)		

See Individual Maps
BRD

INTEGRAGED ENVIRONMENTAL MANAGEMENT, INC.
RADIOLOGICAL SURVEY FORM

Survey Number SMC-090999 Page 1 of 1

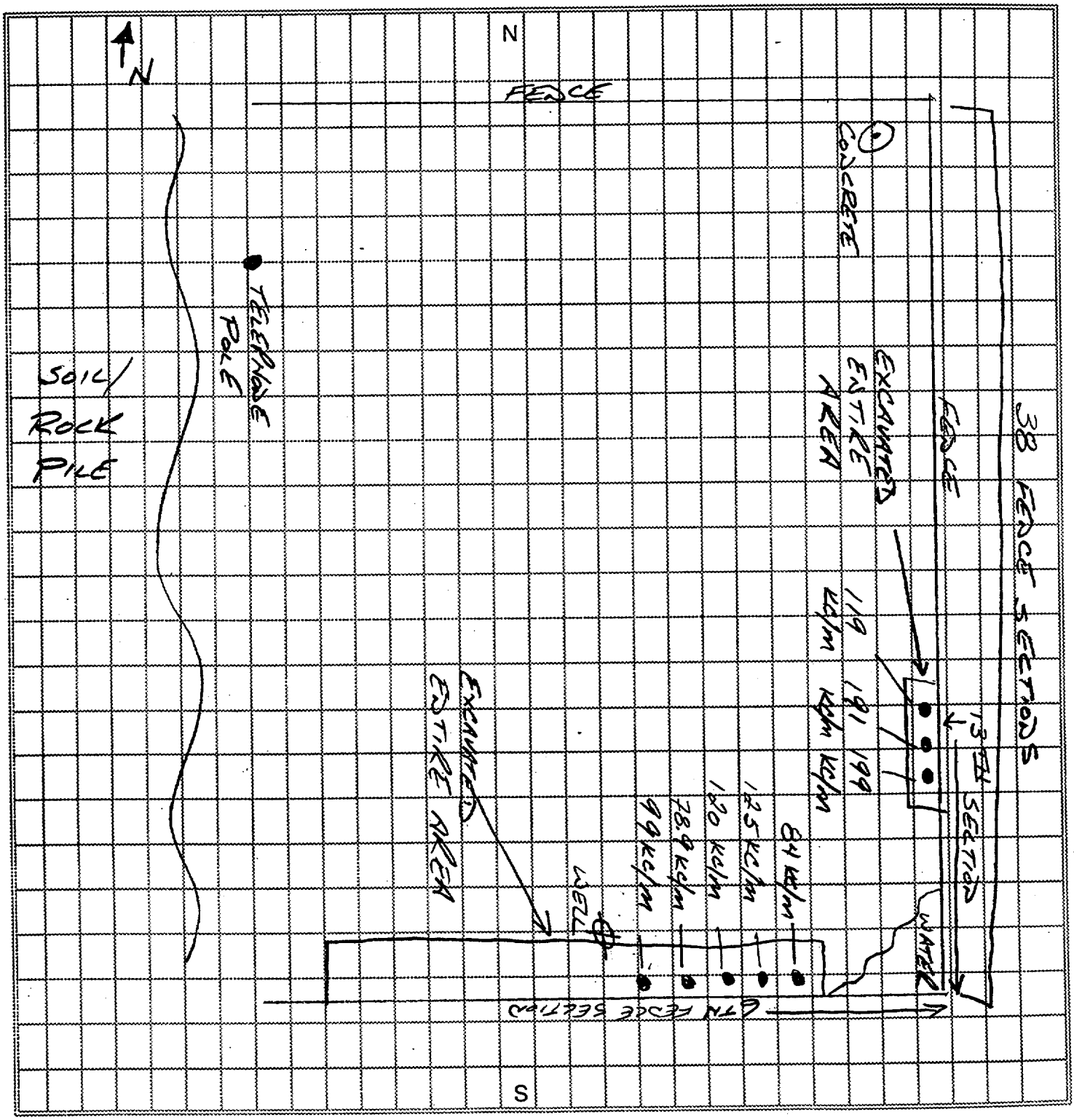
Instrument/SN: Bicron MicroRem #2910	Calibration Due: 3/19/00	Site Name: SMC Newfield	Date: 9/9/99 Time: 1000
Instrument/SN	Calibration Due:	Location: East end of Storage Yard	
Instrument/SN Eberline ESP-1 #03047 / SPA-3 probe	Calibration Due: 1/12/00	Purpose: Verify slag removal after soil excavation	
Survey Performed By (Print): R. Alan Duff		Survey Performed By (Signature):	
☒ Battery OK ☒ HV OK ☒ Source Check OK		Grid Dimensions: N/A x ☐ meters ☐ feet ☐ inches ☐ centimeters	



Notes: Conducted γ scans of areas that were marked during surveys conducted during May 1999 surveillance. Several areas ~~st~~ were supposed to have been remediated since May '99 survey. During this survey, found numerous areas that were flagged during May survey that required further excavation. Left flags in place on spots still requiring excavation. Large areas, primarily at east & south edges of fence line, require 6"-12" lip removed.

SHIELDALLOY METALLURGICAL CORPORATION
RADIOLOGICAL SURVEY MAP
RSP-008

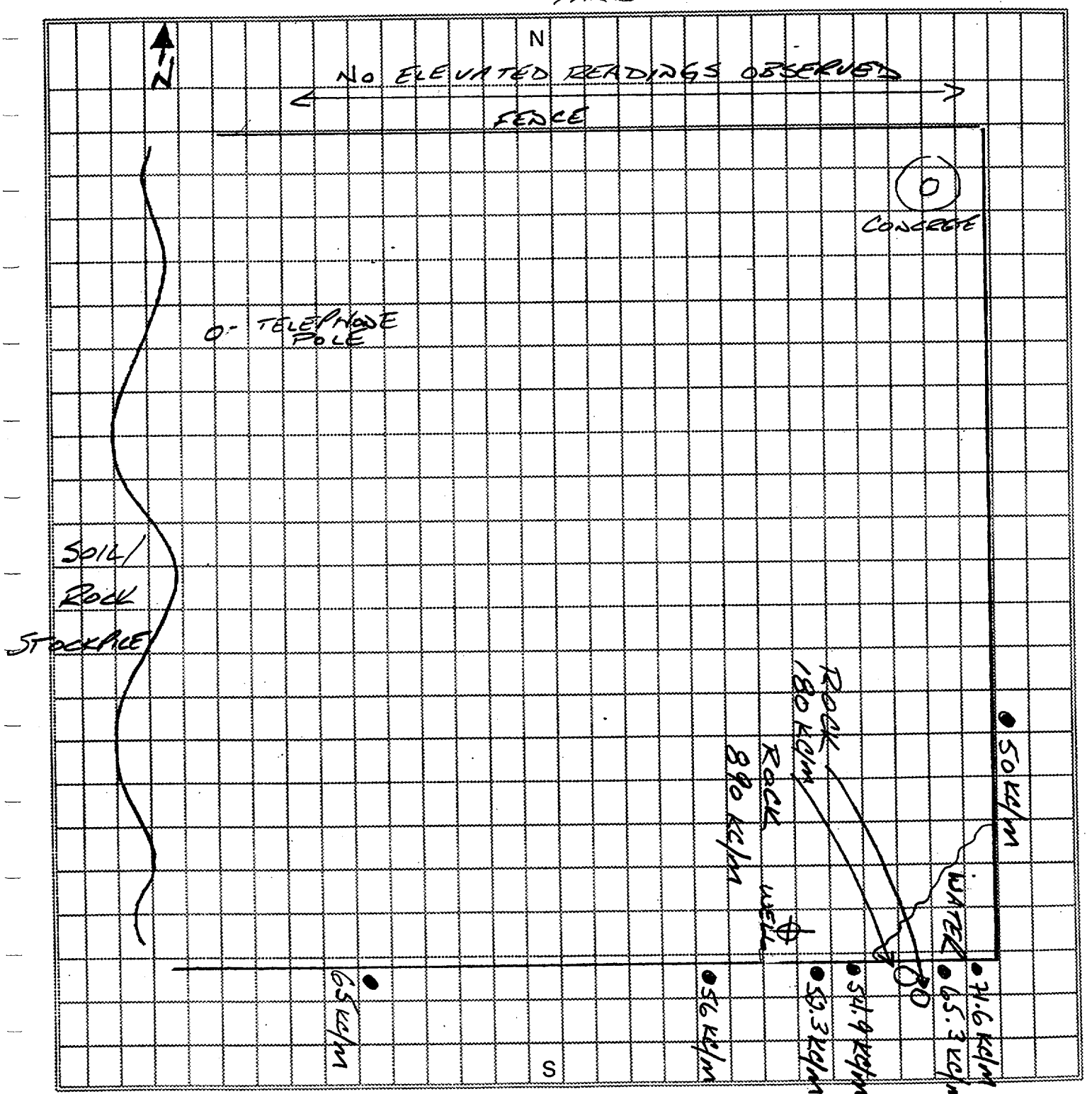
Survey Number 001 Building/Area STORAGE YARD Date of Survey 9/30/99



* FOLLOWING EXCAVATION, READING WERE TAKEN READING FROM 21.5 KC/M TO 42 KC/M

SHIELDALLOY METALLURGICAL CORPORATION
RADIOLOGICAL SURVEY MAP
RSP-008

Survey Number 002 Building/Area BEHIND FENCE - STORAGE YARD Date of Survey 10/01/99



* ALL AREAS WITH ELEVATED READINGS MARKED WITH ORANGE FLAGS

* READINGS RANGED FROM 25 KC/M TO 71.6 KC/M WITH THE EXCEPTION OF "ROCKS" FOUND ON SURFACE

SHIELDALLOY METALLURGICAL CORPORATION
RADIOLOGICAL SURVEY FORM
RSP-008

Survey Number SMC-121399-01 Date of Survey 12/13/99

Survey Description: Survey of excavated areas of storage yard previously under water or had pieces of slag identified from prior surveys Drawing Attached: ☒ Yes ☐ No	Survey Performed by: R. Alan Duff Signature R. Alan Duff, RRPT Print Name

Instrument (1)	Instrument (2)	Instrument (3)
Model: Victoreen 490/489-55	Model:	Model:
Serial No. 5279/860128-3	Serial No. N/A	Serial No.
Calibration Due: 9/19/00	Calibration Due:	Calibration Due: N/A
Efficiency N/A	Efficiency	Efficiency
MDA N/A CF N/A BKG 3000 cpm in lab office 12,000 cpm in Field - 15,000	MDA CF BKG	MDA CF BKG

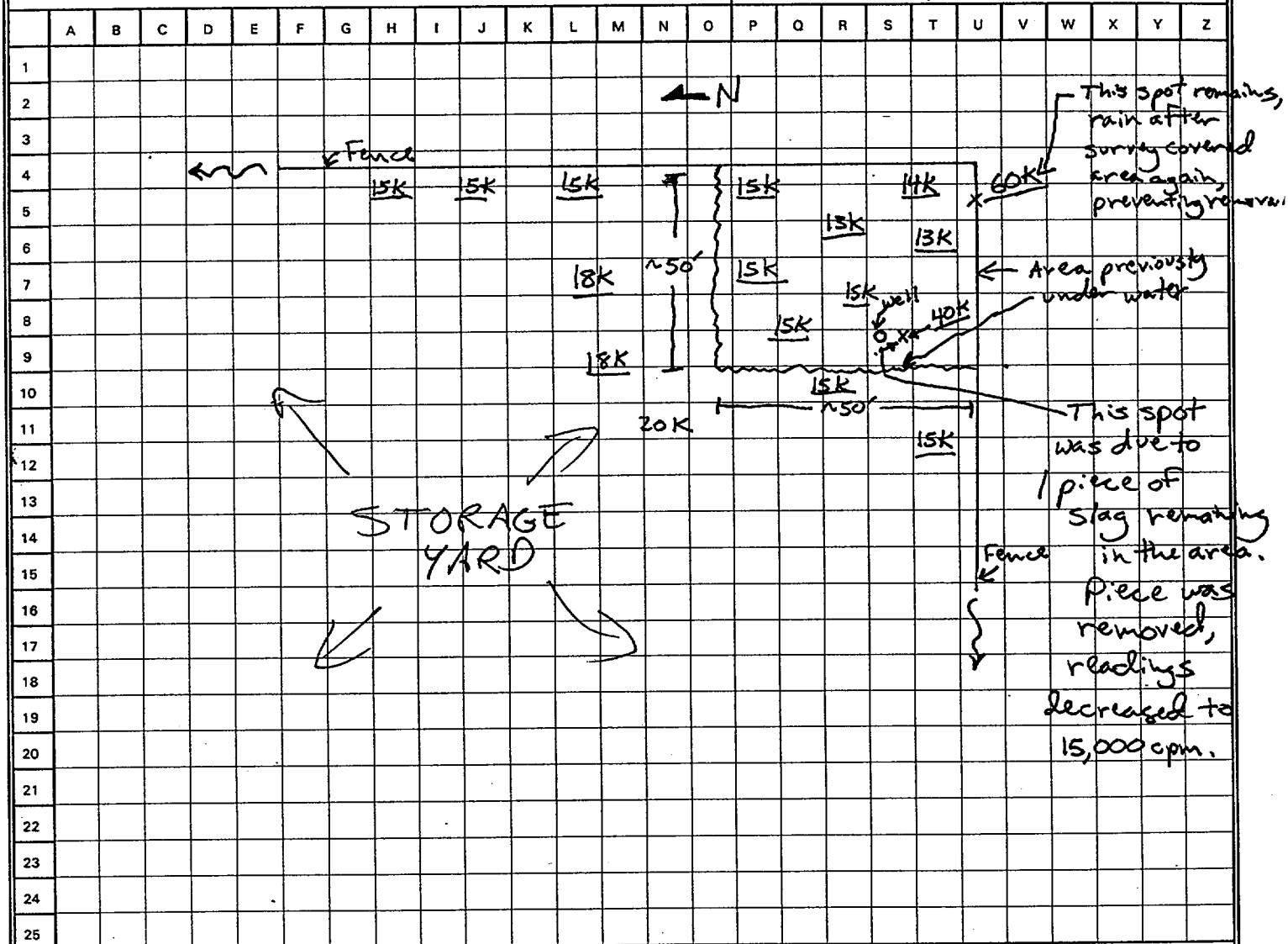
Survey Point	Contamination Levels				Ambient Radiation Levels	Instrument Used	Comments and Additional Information
	Fixed (F) or Total (T)	Beta/gamma		Alpha		(microR/hour)		
		cpm/area	(dpm/100 cm²)	cpm/area	(dpm/100 cm²)			
				SEE ATTACHED MAP				

INTEGRAGED ENVIRONMENTAL MANAGEMENT, INC.

RADIOLOGICAL SURVEY FORM

Survey Number SMC-121399-01

Instrument/SN: Victoreen 490/5279	Calibration Due: 9/19/00	Site Name: SMC NewField	Date: 12/14/99 Time: 1390
Instrument/SN —	Calibration Due: —	Location: Storage Yard - SE corner	
Instrument/SN —	Calibration Due: —	Purpose: Survey for any excavated areas previously under water.	
Survey Performed By (Print): R. Alan Duff, RRPT		Survey Performed By (Signature):	
X Battery OK	X HV OK	X Source Check OK	Grid Dimensions: N/A x ____ ☐ meters ☐ feet ☐ inches ☐ centimeters

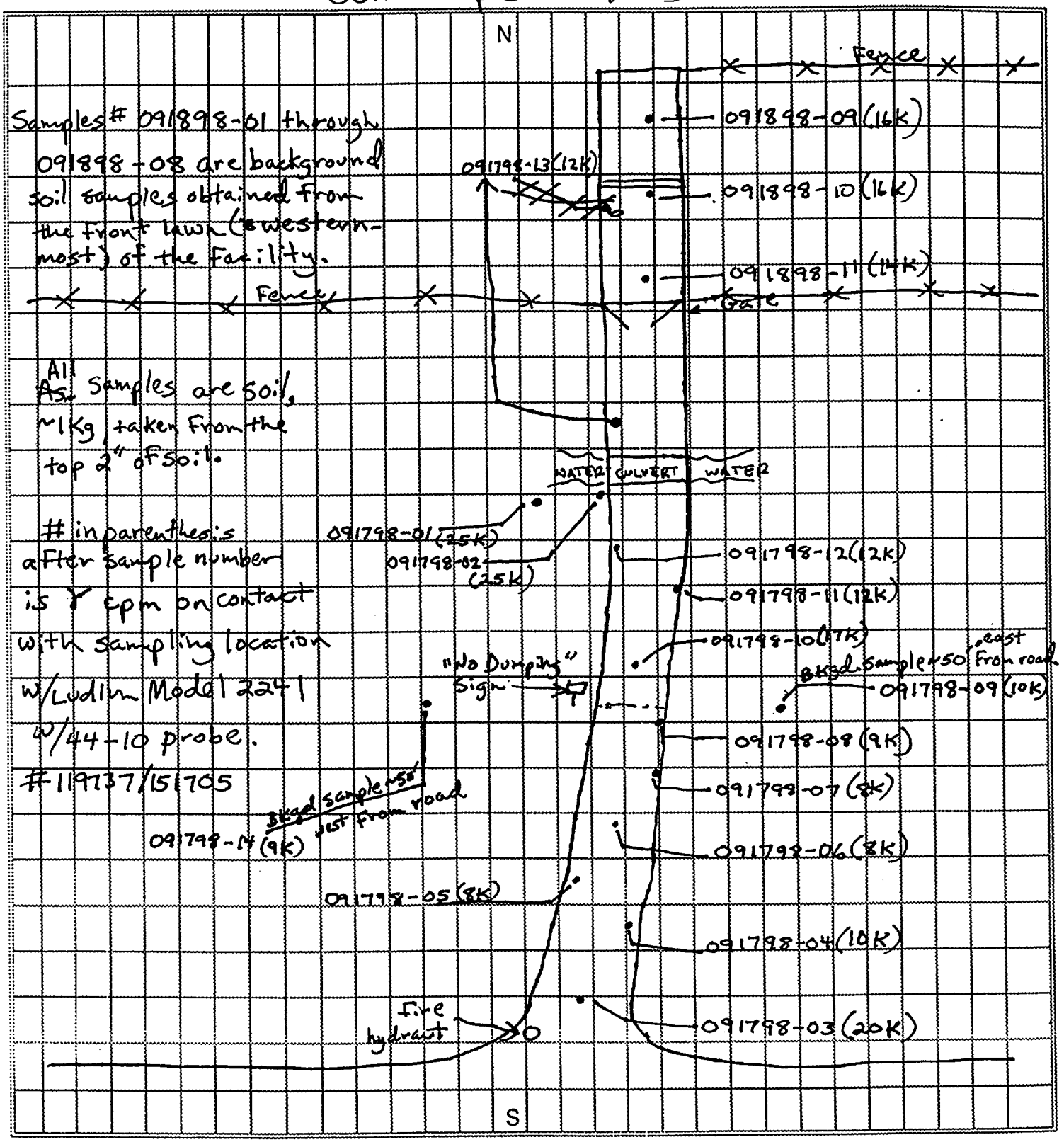


Notes: Bkgd. in this area = ~ 15,000 cpm.
#- denotes gross cpm with γ probe held w/in 1" of soil surface,
Conducted γ scan of area previously covered by water during prior surveys. Performed γ walkover of area, moved probe over surface of area in a serpentine pattern w/probe ~ 1" from soil surface. Remaining area marked w/orange Flags to identify ~~them~~ it for excavation.

SHIELDALLOY METALLURGICAL CORPORATION
RADIOLOGICAL SURVEY MAP
RSP-008

Survey Number 091598-01 Building/Area Haul Road Date of Survey 9/17/98 - 9/18/98

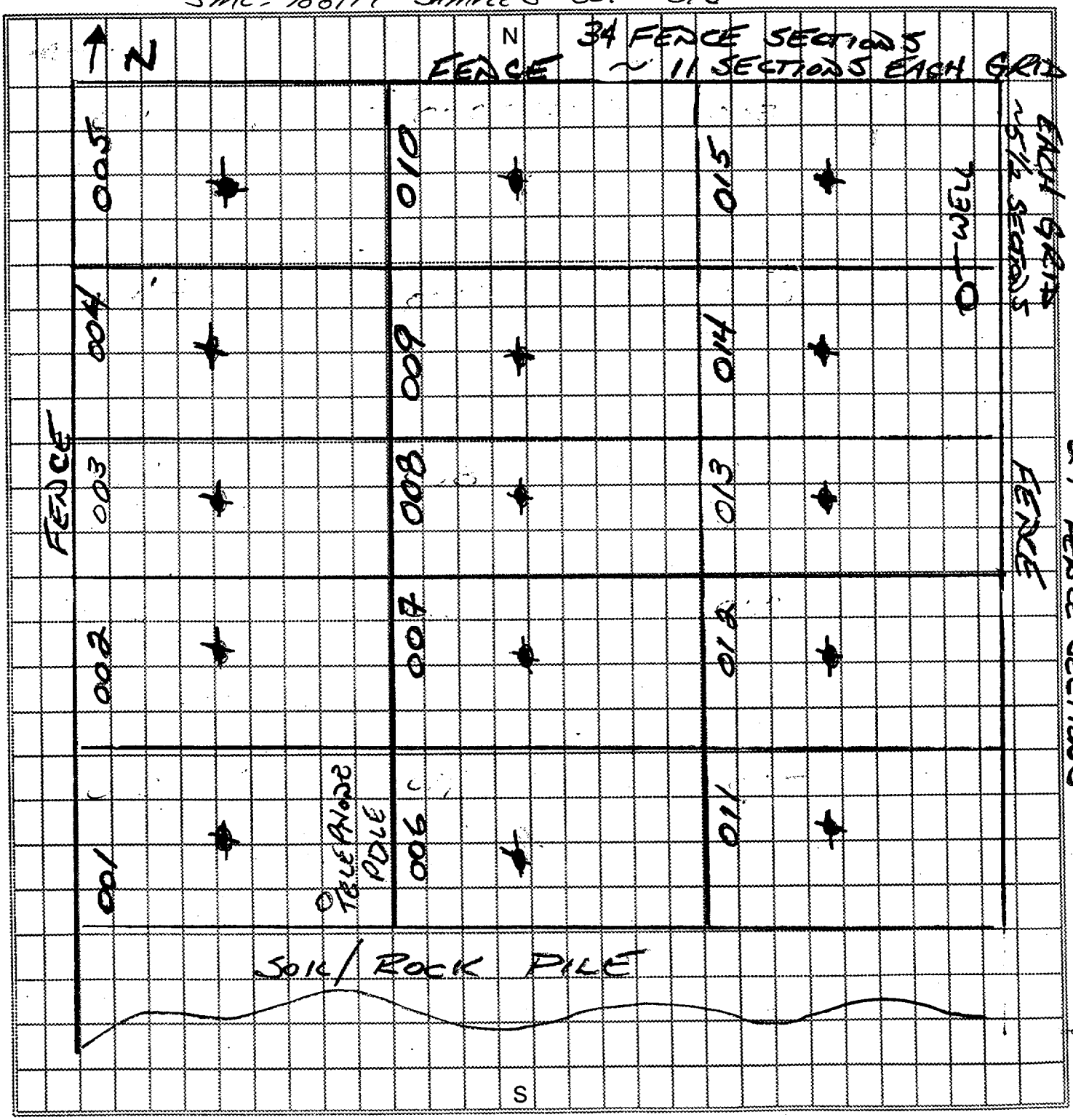
Soil Sample Locations



SHIELDALLOY METALLURGICAL CORPORATION
RADIOLOGICAL SURVEY MAP
RSP-008

SAMPLING
~~Survey~~ Number 001 Building/Area STORAGE YARD SAMPLING Date of ~~Survey~~ 10/01/99

SMC-100199 SAMPLES 001-015



Appendix E - Analytical Results for Soil Samples Collected

Results of Characterization Samples
(pCi/g)

Storage Yard - Newfield

Sample #	Ac-228	Ra-224	Pb-212	Bi-212	Tl-208(adj)		Ra-226	Pb-214	Bi-214
906000-5	0.7548	0.8606	0.7962	0.7413	0.6841667		0.5868	0.6062	0.5868
906001-3	0.5769	0.6651	0.5972	0.6452	0.4880556		0.4012	0.4223	0.4012
906002-1	0.3199		0.29	0.2488	0.2425		0.2249	0.2458	0.2249
906003-9	0.953		0.87	1.0411	0.9186111		0.3956	0.4116	0.3956
906004-7	0.373		0.3724	0.3304	0.3255556		0.324	0.3695	0.324
906005-4	0.3297		0.3328	0.4143	0.2775		0.2293	0.2649	0.2293
906006-2	0.4415	0.4559	0.4327	0.5179	0.3302778		0.3897	0.4337	0.3897
906007-0	0.596		0.5917	0.69	0.5008333		0.4063	0.474	0.4063
906008-8	0.4274	0.3686	0.4014	0.4165	0.3522222		0.3244	0.3325	0.3244
906009-6	0.5802		0.5337	0.6327	0.4358333		0.5101	0.5799	0.5101
906010-4	0.5597		0.5313	0.6024	0.4727778		0.4663	0.5457	0.4663
906011-2	0.4831		0.445	0.5666	0.4463889		0.4202	0.3952	0.4202
906012-0	0.9003	0.938	0.9196	0.871	0.7616667		0.6521	0.7337	0.6521
906013-8	0.8324	0.8384	0.8114	0.9491	0.6725		0.5829	0.6352	0.5829
906014-6	0.8034		0.7903	0.9426	0.7005556		0.5236	0.6075	0.5236
Mean =	0.59542	0.687767	0.581047	0.64066	0.5072963		0.42916	0.470513	0.42916

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

SHIELDALLOY METALLURGICAL CORPORATION
P.O. BOX 768, 12 WEST BOULEVARD
NEWFIELD, N.J. 08344 (609)692-4200

Project No. IEM 94005.17 ~~05~~ M	Purchase Order IEM
Sampler: (Print Name) Alan Duff	Chain of Custody Tape No. N/A

Sample No./ Identification	Collection Date	Collection Time	Preserv.	Lab Sample Number	Sample Matrix (Liquid, Sludge, etc.)	ANALYSES: Gamma Spectroscopy						Number of Containers/ REMARKS
091798-001	9/17/98	1300	None		Soil	✓						Area w of haul Rd.
091798-002		1305				✓						↓
091798-003		1400				✓						Haul Road Soil
091798-004		1410				✓						
091798-005		1420				✓						
091798-006		1440				✓						
091798-007		1445				✓						
091798-008		1450				✓						
091798-009		1455				✓						
091798-010	↓	1500	↓		↓	✓						↓

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
1. [signature] 9/17	9/18/98				
2.					
3.					
4.					
5.					

Sample Disposal Method: Return to Shieldalloy	Disposed of by: (Signature) / Date / Time
SAMPLE COLLECTOR/WITNESS (Signature) [signature]	ANALYTICAL LABOARATORY AND CONTACT: Outreach - Ron Eidson

Draft report to Carol Burg ~~w~~ in 20 days
SEE ATTACHED LETTER

091676

ANALYTICAL REQUEST AND CHAIN OF CUSTODY RECORD

SHIELDALLOY METALLURGICAL CORPORATION

P.O. BOX 768, 12 WEST BOULEVARD
NEWFIELD, N.J. 08344 (609)692-4200

Project No. IEM 94005.17

Purchase Order IEM

Sampler: (Print Name) R. Alan DuFF

Chain of Custody Tape No. N/A

Sample No./ Identification	Collection Date	Collection Time	Preserv.	Lab Sample Number	Sample Matrix (Liquid, Sludge, etc.)	ANALYSES: Gamma Spectroscopy	Total Uranium	Thorium Isotopic				Number of Containers/ REMARKS
091798-011	9/17/98	1510	None		Soil	✓						Haul Rd Soil
091798-012	9/17/98	1515				✓						
091798-013	9/17/98	~~1530~~ 1525				✓						
091798-014	9/17/98	1530				✓						
091798-015	9/17/98	0900				✓	✓	✓				Landfill Soil
091898-01	9/18/98	1115				✓						Front Lawn
091898-02	9/18/98	1120				✓						
091898-03	9/18/98	1125				✓						
091898-04	9/18/98	1130				✓						
091898-05	9/18/98	1135				✓						

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
1.					
2.					
3.					
4.					
5.					

Sample Disposal Method: Return to Shieldalloy

Disposed of by: (Signature) | Date | Time

SAMPLE COLLECTOR/WITNESS (Signature)

ANALYTICAL LABORATORY AND CONTACT: Conteidson - Outreach

001677

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

SHIELDALLOY METALLURGICAL CORPORATION

P.O. BOX 768, 12 WEST BOULEVARD
NEWFIELD, N.J. 08344 (609)692-4200

Project No.	Purchase Order
94005.17	IEM
Sampler: (Print Name) R. Alan DUFF	**Chain of Custody Tape No.** N/A

Sample No./ Identification	Collection Date	Collection Time	Preserv.	Lab Sample Number	Sample Matrix (Liquid, Sludge, etc.)	ANALYSES: Gamma Spec.						Number of Containers/ REMARKS
091898-06	9/18/98	1140	None		Soil	✓						Front Lawn Sa.
091898-07	9/18/98	1145	↓		↓	✓						↓
091898-08	9/18/98	1150				✓						
091898-09	9/18/98	1315				✓						Haul Rd.-Ins. & F.
091898-10	9/18/98	1324				✓						↓
091898-11	9/18/98	1337	↓		↓	✓						

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
1. [signature]	9/18/98	1430			
2.					
3.					
4.					
5.					

Sample Disposal Method	Disposed of by: (Signature)	Date	Time
Return to Shieldalloy			

SAMPLE COLLECTOR/WITNESS (Signature)	ANALYTICAL LABOARATORY AND CONTACT
[signature]	Outreach - Ron Fidson

001678

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

SHIELDALLOY METALLURGICAL CORPORATION
P.O. BOX 768, 12 WEST BOULEVARD
NEWFIELD, NJ 08344 • (609) 692-4200

Project No: 94005.22

Chain of Custody Tape No: N/A

Sampler: *(Print Name)* CRAIG BRUNE

Purchase Order:

Sample No./ Identification	Collection Date	Collection Time	Preserv.	Lab Sample Number	Sample Matrix	ANALYSES	pH*	Number of Containers/ REMARKS
SMC-100199-001	10/1/99	0830	NONE	906000-5	SOIL	ANALYTICAL METHOD		1
SMC-100199-002		0840		906001-3		REFERENCE "LETTER		1
SMC-100199-003		0850		906002-1		FROM CAROL BERGER (IEM)		1
SMC-100199-004		0900		906003-9		TO W. RAINES (TVA) DATED		1
SMC-100199-005		0910		906004-7		SEPT. 7, 1999"		1
SMC-100199-006		0920		906005-4				1
SMC-100199-007		0930		906006-2				1
SMC-100199-008		0940		906007-0				1
SMC-100199-009		0950		906008-8				1
SMC-100199-010		1000		906009-6				1
SMC-100199-011		1010		906010-4				1
SMC-100199-012		1020		906011-2				1
SMC-100199-013		1030		906012-0				1
SMC-100199-014		1040		906013-8				1
SMC-100199-015		1050		906014-6				1

Relinquished By: *(Signature)*	Date	Time	Received By: *(Signature)*	Date	Time
1. C. J. Brune	10/1/99	1230pm	1. Charles E Frederick	10/4/99	1052
2.			2.		
3.			3.		
Sample Disposal Method:			Disposed By: *(Signature)*		
SAMPLE COLLECTOR/WITNESS: *(Signature)* C. J. Brune			ANALYTICAL LABORATORY AND CONTACT: William L Raines, TVA Western Area Rad Lab		

003701

* If required pH should be taken within 15 minutes of sample collection time. Record result in the corresponding row.

L=Liquid S=Sludge S=Solid O=Other (Specify)

October 29, 1999

Carol D. Berger, C. H. P.
Integrated Environmental Management, Inc.
1680 East Gude Drive, Suite 305
Rockville, Maryland 20850

Dear Ms. Berger:

Enclosed are two copies of the final results from the 15 soil samples received on October 4, 1999, from your Shieldalloy Metallurgical Corporation project. Per your request, the samples were analyzed by gamma spectroscopy to quantify the gamma-emitting radionuclides present from the thorium and uranium decay series. Results are reported for these radionuclides in units of picocuries per gram. As expected for gamma analysis of soil samples, normal levels of other natural background radionuclides such as Be-7 and K-40 were measured in the samples. Also enclosed is a copy of your chain of custody record.

Our invoicing for these analyses may be delayed for a couple of weeks pending the finalizing of the contract. We are holding the samples pending instructions. We would prefer to return the samples to you in your shipping container. We will pay for the cost of return shipment of the samples and the container.

Thank you for this opportunity to assist your company with these radioanalytical services. If you have any questions concerning this data please call me at (256) 386-2536.

Bill Raines

William L. Raines
Manager
TVA Western Area Radiological Laboratory

(berger.doc)

SAMPLE # 906000-5

SOIL picoCuries/gram
COLLECTION AT 10/01/99 08:30
GAMMA VOLUME 600.000 g

ANALYSIS	ACTIVITY	ERROR (1S)	LLD
208TL	.2463	.0199	.0130
212BI	.7413	.0953	.1648
212PB	.7962	.0388	.0223
214BI	.5868	.0338	.0243
214PB	.6062	.0347	.0277
224RA	.8606	.1062	.2219
226RA	.5868	.0338	.0243
228AC	.7548	.0614	.0477

SHIELDALLOY METALURGICAL CORP. SOIL ID#SMC_100199_001

SAMPLE # 906001-3

SOIL picoCuries/gram
COLLECTION AT 10/01/99 08:40
GAMMA VOLUME 600.000 g

ANALYSIS	ACTIVITY	ERROR (1S)	LLD
208TL	.1757	.0147	.0119
212BI	.6452	.0739	.1513
212PB	.5972	.0336	.0193
214BI	.4012	.0268	.0247
214PB	.4223	.0309	.0253
224RA	.6651	.1025	.1905
226RA	.4012	.0268	.0247
228AC	.5769	.0532	.0469

SHIELDALLOY METALLURGICAL CORP. SOIL ID#SMC_100199_002

SAMPLE # 906002-1

SOIL picoCuries/gram
COLLECTION AT 10/01/99 08:50
GAMMA VOLUME 600.000 g

ANALYSIS	ACTIVITY	ERROR (1S)	LLD
208TL	.0873	.0080	.0113
212BI	.2488	.0400	.1137
212PB	.2900	.0252	.0214
214BI	.2249	.0195	.0217
214PB	.2458	.0196	.0246
226RA	.2249	.0195	.0217
228AC	.3199	.0373	.0375

SHIELDALLOY METALLURGICAL CORP. SOIL ID#SMC_100199_003

SAMPLE # 906003-9

SOIL picoCuries/gram
COLLECTION AT 10/01/99 09:00
GAMMA VOLUME 600.000 g

ANALYSIS	ACTIVITY	ERROR (1S)	LLD
208TL	.3307	.0269	.0172
212BI	1.0411	.1419	.2267
212PB	.8700	.0806	.0438
214BI	.3956	.0328	.0355
214PB	.4116	.0297	.0407
226RA	.3956	.0328	.0355
228AC	.9530	.0979	.0613

SHIELDALLOY METALLURGICAL CORP. SOIL ID#SMC_100199_004

SAMPLE # 906004-7

SOIL picoCuries/gram
COLLECTION AT 10/01/99 09:10
GAMMA VOLUME 600.000 g

ANALYSIS	ACTIVITY	ERROR (1S)	LLD
208TL	.1172	.0098	.0103
212BI	.3304	.0551	.1237
212PB	.3724	.0273	.0190
214BI	.3240	.0259	.0235
214PB	.3695	.0226	.0220
226RA	.3240	.0259	.0235
228AC	.3730	.0302	.0337

SHIELDALLOY METALLURGICAL CORP. SOIL ID#SMC_100199_005

SAMPLE # 906005-4

SOIL picoCuries/gram
COLLECTION AT 10/01/99 09:20
GAMMA VOLUME 600.000 g

ANALYSIS	ACTIVITY	ERROR (1S)	LLD
208TL	.0999	.0092	.0098
212BI	.4143	.0583	.1159
212PB	.3328	.0256	.0159
214BI	.2293	.0194	.0206
214PB	.2649	.0220	.0197
226RA	.2293	.0194	.0206
228AC	.3297	.0312	.0368

SHIELDALLOY METALLURGICAL CORP. SOIL ID#SMC_100199_006

SAMPLE # 906006-2

SOIL picoCuries/gram
COLLECTION AT 10/01/99 09:30
GAMMA VOLUME 600.000 g

ANALYSIS	ACTIVITY	ERROR (1S)	LLD
208TL	.1189	.0118	.0115
212BI	.5179	.0649	.1387
212PB	.4327	.0248	.0187
214BI	.3897	.0288	.0216
214PB	.4337	.0212	.0219
224RA	.4559	.0798	.1790
226RA	.3897	.0288	.0216
228AC	.4415	.0324	.0393

SHIELDALLOY METALLURGICAL CORP. SOIL ID#SMC_100199_007

SAMPLE # 906007-0

SOIL picoCuries/gram
COLLECTION AT 10/01/99 09:40
GAMMA VOLUME 600.000 g

ANALYSIS	ACTIVITY	ERROR (1S)	LLD
208TL	.1803	.0117	.0109
212BI	.6900	.0621	.1303
212PB	.5917	.0291	.0199
214BI	.4063	.0271	.0222
214PB	.4740	.0302	.0245
226RA	.4063	.0271	.0222
228AC	.5960	.0392	.0407

SHIELDALLOY METALLURGICAL CORP. SOIL ID#SMC_100199_008

SAMPLE # 906008-8

SOIL picoCuries/gram
COLLECTION AT 10/01/99 09:50
GAMMA VOLUME 600.000 g

ANALYSIS	ACTIVITY	ERROR (1S)	LLD
208TL	.1268	.0111	.0102
212BI	.4165	.0699	.1352
212PB	.4014	.0235	.0182
214BI	.3244	.0193	.0224
214PB	.3325	.0254	.0221
224RA	.3686	.0740	.1757
226RA	.3244	.0193	.0224
228AC	.4274	.0382	.0405

SHIELDALLOY METALLURGICAL CORP. SOIL ID#SMC_100199_009

SAMPLE # 906009-6

SOIL picoCuries/gram
COLLECTION AT 10/01/99 10:00
GAMMA VOLUME 600.000 g

ANALYSIS	ACTIVITY	ERROR (1S)	LLD
208TL	.1569	.0115	.0128
212BI	.6327	.0816	.1438
212PB	.5337	.0449	.0212
214BI	.5101	.0289	.0254
214PB	.5799	.0342	.0252
226RA	.5101	.0289	.0254
228AC	.5802	.0445	.0441

SHIELDALLOY METALLURGICAL CORP. SOIL ID#SMC_100199_010

SAMPLE # 906010-4

SOIL picoCuries/gram
COLLECTION AT 10/01/99 10:10
GAMMA VOLUME 600.000 g

ANALYSIS	ACTIVITY	ERROR (1S)	LLD
208TL	.1702	.0111	.0133
212BI	.6024	.0661	.1548
212PB	.5313	.0396	.0245
214BI	.4663	.0255	.0253
214PB	.5457	.0358	.0262
226RA	.4663	.0255	.0253
228AC	.5597	.0544	.0436

SHIELDALLOY METALLURGICAL CORP. SOIL ID#SMC_100199_011

SAMPLE # 906011-2

SOIL picoCuries/gram
COLLECTION AT 10/01/99 10:20
GAMMA VOLUME 600.000 g

ANALYSIS	ACTIVITY	ERROR (1S)	LLD
208TL	.1607	.0125	.0149
212BI	.5666	.0841	.2105
212PB	.4450	.0260	.0268
214BI	.4202	.0341	.0321
214PB	.3952	.0327	.0341
226RA	.4202	.0341	.0321
228AC	.4831	.0503	.0518

SHIELDALLOY METALLURGICAL CORP. SOIL ID#SMC_100199_012

SAMPLE # 906012-0

SOIL picoCuries/gram
COLLECTION AT 10/01/99 10:30
GAMMA VOLUME 600.000 g

ANALYSIS	ACTIVITY	ERROR (1S)	LLD
208TL	.2742	.0157	.0128
212BI	.8710	.0835	.1797
212PB	.9196	.0490	.0215
214BI	.6521	.0413	.0259
214PB	.7337	.0330	.0261
224RA	.9380	.1538	.2126
226RA	.6521	.0413	.0259
228AC	.9003	.0581	.0482

SHIELDALLOY METALLURGICAL CORP. SOIL ID#SMC_100199_013

SAMPLE # 906013-8

SOIL picoCuries/gram
COLLECTION AT 10/01/99 10:40
GAMMA VOLUME 600.000 g

ANALYSIS	ACTIVITY	ERROR (1S)	LLD
208TL	.2421	.0159	.0131
212BI	.9491	.0922	.1502
212PB	.8114	.0449	.0213
214BI	.5829	.0384	.0257
214PB	.6352	.0364	.0264
224RA	.8384	.2003	.2095
226RA	.5829	.0384	.0257
228AC	.8324	.0507	.0462

SHIELDALLOY METALLURGICAL CORP. SOIL ID#SMC_100199_014

SAMPLE # 906014-6

SOIL picoCuries/gram
COLLECTION AT 10/01/99 10:50
GAMMA VOLUME 600.000 g

ANALYSIS	ACTIVITY	ERROR (1S)	LLD
208TL	.2522	.0152	.0118
212BI	.9426	.1022	.1537
212PB	.7903	.0459	.0230
214BI	.5236	.0364	.0236
214PB	.6075	.0373	.0260
226RA	.5236	.0364	.0236
228AC	.8034	.0583	.0416

SHIELDALLOY METALLURGICAL CORP. SOIL ID#SMC_100199_015

Appendix F - Wilcoxon Rank Sum Tests for Uranium and Thorium Results

Wilcoxon Rank Sum Results

Storage Yard - Newfield

Criterion =	2.5	pCi/g			
			Adjusted		
		Bi-212	Background	Adjusted	
	Type of	Concentration	Concentration	Background	Characteriazation
Sample #	Sample	(pCi/g)	(pCi/g)	Rank	Rank
906002-1	Characterization	0.2488			1
906004-7	Characterization	0.3304			2
906005-4	Characterization	0.4143			3
906008-8	Characterization	0.4165			4
906006-2	Characterization	0.5179			5
906011-2	Characterization	0.5666			6
906010-4	Characterization	0.6024			7
906009-6	Characterization	0.6327			8
906001-3	Characterization	0.6452			9
906007-0	Characterization	0.69			10
906000-5	Characterization	0.7413			11
906012-0	Characterization	0.871			12
906014-6	Characterization	0.9426			13
906013-8	Characterization	0.9491			14
906003-9	Characterization	1.0411			15
980715-16	Background	0.3	2.8	16	
091898-05	Background	0.6	3.1	18	
091898-06	Background	0.6	3.1	18	
091898-08	Background	0.6	3.1	18	
980715-15	Background	0.9	3.4	20.5	
091898-03	Background	0.9	3.4	20.5	
091898-07	Background	1.2	3.7	22	
091898-02	Background	1.4	3.9	23.5	
091898-04	Background	1.4	3.9	23.5	
091898-01	Background	1.8	4.3	25	
			Sum of Ranks =	205	120
			Critical Value =	171	

Wilcoxon Rank Sum Results

Storage Yard - Newfield

Criterion =	2.5	pCi/g			
			Adjusted		
		Pb-214	Background	Adjusted	
	Type of	Concentration	Concentration	Background	Characteriazation
Sample #	Sample	(pCi/g)	(pCi/g)	Rank	Rank
906002-1	Characterization	0.2458			1
906005-4	Characterization	0.2649			2
906008-8	Characterization	0.3325			3
906004-7	Characterization	0.3695			4
906011-2	Characterization	0.3952			5
906003-9	Characterization	0.4116			6
906001-3	Characterization	0.4223			7
906006-2	Characterization	0.4337			8
906007-0	Characterization	0.474			9
906010-4	Characterization	0.5457			10
906009-6	Characterization	0.5799			11
906000-5	Characterization	0.6062			12
906014-6	Characterization	0.6075			13
906013-8	Characterization	0.6352			14
906012-0	Characterization	0.7337			15
980715-16	Background	0.2	2.7	16	
091898-06	Background	0.5	3	18	
091898-07	Background	0.5	3	18	
980715-15	Background	0.5	3	18	
091898-04	Background	0.6	3.1	20.5	
091898-05	Background	0.6	3.1	20.5	
091898-03	Background	0.8	3.3	22	
091898-08	Background	0.9	3.4	23	
091898-02	Background	1	3.5	24	
091898-01	Background	1.7	4.2	25	
			Sum of Ranks =	205	120
			Critical Value =	171	

This report was prepared under the direction of
Shieldalloy Metallurgical Corporation

by

R. Alan Duff, R.R.P.T.
Integrated Environmental Management, Inc.
9040 Executive Park Drive, Suite 205
Knoxville, Tennessee 37923
(423) 531-9140
RADuff@IEM-Inc.com

and

Brian A. Kelly, C.H.P., P.E.
Integrated Environmental Management, Inc.
9040 Executive Park Drive, Suite 205
Knoxville, Tennessee 37923
(423) 531-9140
BAKelly@IEM-Inc.com