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DAVID R. SMITH
DIRECTOR OF ENVIRONMETAL SERVICES

March 14, 1991

Ms. Donna Gaffigan
State of New Jersey
Department of Environmental Protection
Division of Hazardous Waste Management
Bureau of Federal Case Management
401 East State Street
CN-028
Trenton, NJ 08625

RE: Radiological Characterization of the Shieldalloy Metallurgical Corporation Newfield Facility

Dear Ms. Gaffigan:

Please find enclosed three copies of the subject work plan which has been revised. The revision of the Work Plan was based on (1) the pre-survey investigation performed in September 1990, (2) the review and comments from New Jersey Department of Environmental Protection (NJDEP), U.S. Environmental Protection Agency (EPA), and U.S. Nuclear Regulatory Commission (NRC), and (3) the Newfield Plant Radiological Pre-Survey of February 1991.

ENSR is scheduled to initiate the field investigation beginning the week of March 18, 1991. The field investigation portion is estimated to take approximately four weeks to complete. The radiochemistry analytical portion is scheduled to be completed by the end of May. Therefore, the data should be available for inclusion into the Draft Report of the Remedial Investigation/Feasibility Study, as appropriate.

If there are any questions concerning the subject matter, please do not hesitate to contact Mr. James Valenti, Mr. Michael Morgenstern, and myself.

Sincerely,

David R. Smith
Director of Environmental Services

DRS:lms
Enclosures
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SHIELDALLOY METALLURGICAL CORPORATION

NEWFIELD, NJ

ENSR

WORK PLAN FOR THE RADIOLOGICAL CHARACTERIZATION OF THE SHIELDALLOY METALLURGICAL CORPORATION NEWFIELD FACILITY

ENSR Consulting and Engineering

March 1991

Document Number 5990-006-170

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1.0 INTRODUCTION

1.1 Site Historical Review

A radiological survey of the Shieldalloy Metallurgical Corporation (SMC), Newfield, New Jersey site was conducted in October and December of 1988. This survey, "Radiological Survey of the Shieldalloy Corporation, Newfield, New Jersey", was conducted by Oak Ridge Associated Universities (ORAU) on behalf of the United States Nuclear Regulatory Commission, Region I, (NRC), and the New Jersey Department of Environmental Protection (NJDEP).

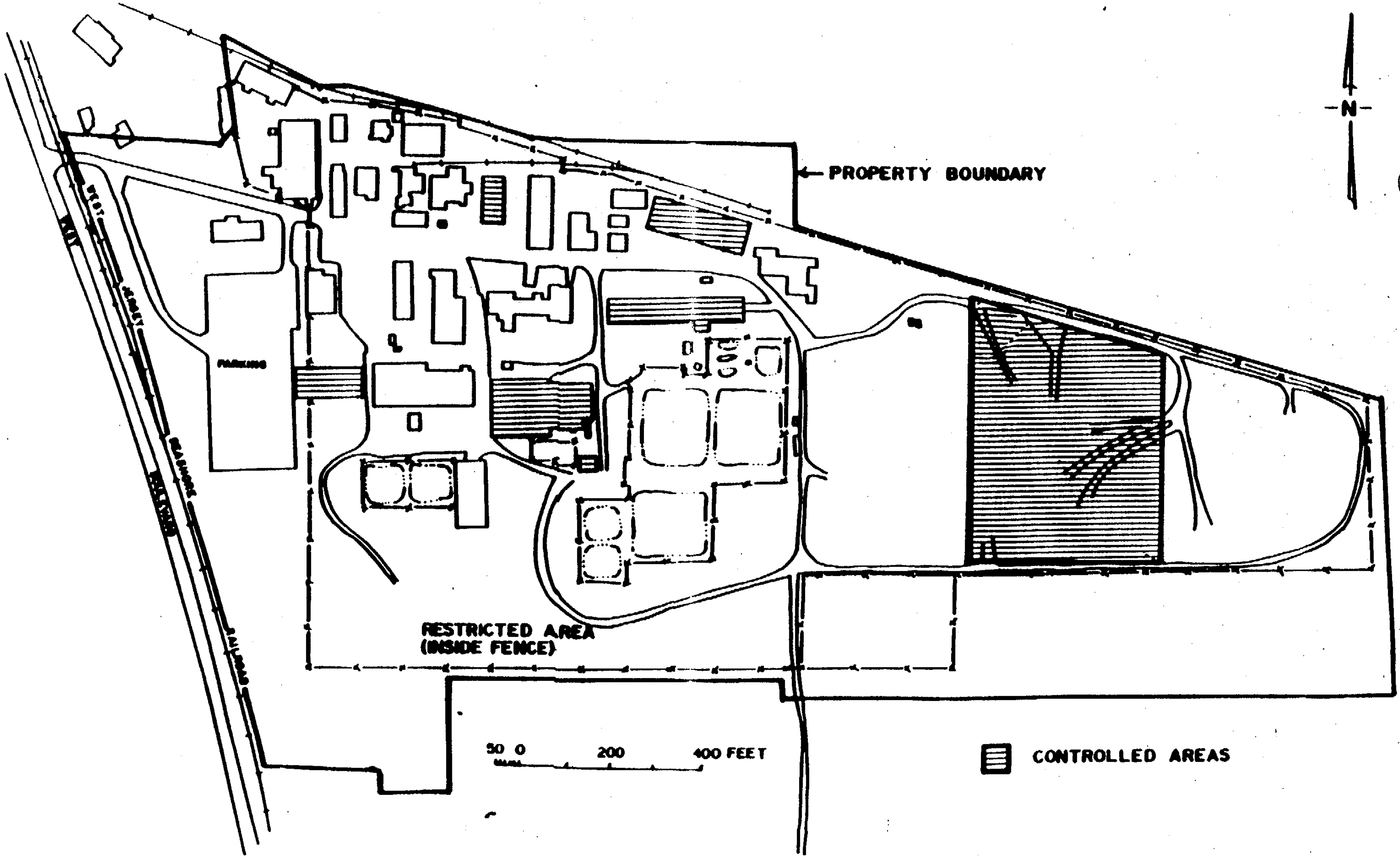
This survey provided information for a preliminary assessment of the radiological impact of the site. Data were provided with respect to area exposure rates, potential areas of contamination, and isotopic composition of the soils, sediment, surface water and ground water. A figure representative of the site is provided as Figure 1-1. This survey partially characterized the radiological conditions that existed at the facility, but did not provide sufficient data to perform a risk assessment required to define the potential remediation approaches necessary to reduce the radiological risk to acceptable levels.

On May 2, 1990 representatives of the State of New Jersey (NJDEP), the Environmental Protection Agency (EPA), Region II, and the NRC completed a cursory inspection of the facility and adjacent areas. This inspection confirmed some of the original findings of the ORAU report. Since the completion of this site visit by representatives of these agencies, SMC has received comments from NJ DEP requiring the performance of a radiological characterization of the site. Comments specific to the radiological component of the work have been accommodated.

As a result of the ORAU effort and the inquiries received from the state and federal agencies, SMC has agreed to complete a radiological characterization of the facility and adjacent properties. This characterization will be conducted under the authority of the existing facility license SMB-743. The facility will continue to operate using source material as part of their manufacturing operation. Therefore, this survey will not include operational areas within the licensed site since these are subject to ongoing variation during the continuing operation of the facility, and since the monitoring of the operation is regulated under the existing conditions of the license. However, areas within the licensed area which may be potential sources of surficial contamination outside the controlled area will be included in order that any remediation plan to decontaminate areas outside the licensed site may properly consider the possibility of future recontamination.

FIGURE 1-1

SITE PLAN FOR THE SHIELDALLOY METALLURGICAL CORPORATION NEWFIELD, NJ FACILITY



A Work Plan was developed to perform a site-wide survey and radiological characterization of the site. The Work Plan was submitted to the NJ DEP in June 1990. Comments from NJ DEP on the June 1990 Work Plan are presented in Appendix C.

The presence of large material stockpiles in the SMSY containing source material results in a direct gamma radiation exposure contribution extending to localized areas both on and off-site. This contribution is significant in that it limits the use of direct-reading portable equipment for on-site determination of contamination by source material in significant areas within or near the facility. Contamination in such areas can only be determined by the collection of samples for analysis in an off-site laboratory.

ENSR undertook preliminary surveys using gamma measurement devices to determine the extent of this problem. The work performed has been utilized to tailor the proposed characterization methodology, from that originally proposed in June 1990. The results and summary of this effort are presented in Appendices A and B. The characterization work has been designed with specific recognition of the extent of the problem. The planned program will produce data whereby the magnitude and extent of the whole body exposure at the perimeter of the licensed site, and the extent and magnitude of any significant surficial contamination of soils and sediments with source materials in adjacent contiguous areas to the licensed site are determined and recorded.

1.2 Objective

The objective of this characterization Work Plan is to provide sufficient detail with respect to the procedures and methods by which the characterization will be achieved, to determine the feasibility of decontaminating uncontrolled areas to conform to site and Federal regulations and guidelines. The work program will be performed under the existing NRC License. Data collected during this stage of the investigation will be incorporated into the Remedial Investigation (RI) effort, as appropriate to the RI.

The program will focus on the determination of the potential sources of radiological concern. The four specific objectives are:

- To determine the exposure rate at the perimeter of the licensed site;
- To determine the extent and location of mislocated slags in the immediate vicinity of the licensed site;

- To determine the extent and location of source material contaminated soils and sediments in the immediate contiguous area of the site; and
- To determine the extent of source material contamination, if any, of surface water and sediments in Hudson's Branch.

1.3 Scope of Work Plan

The scope of the work associated with the planned radiological characterization is presented in this plan. Section 2.0 outlines the technical components of the planned work, including the exposure rate survey and specific activity measurements of soils and other environmental media. Section 3.0 derives the criterion for identification of areas with elevated levels of radionuclides and Section 4.0 outlines the aspects of QA/QC that will be addressed in this Work Plan.

A summary of the components of the characterization work tasks are as follows:

- Complete the exposure rate survey by obtaining pressurized ion chamber (PIC) readings at 20 meter intervals at the licensed boundary. Determine attenuation of shine with distance and define the background isopleth from shine.

- Define the extent and location of mislocated slags with a walkover survey of specific areas of the facility and the adjacent property using gamma scintillation survey equipment in those areas not affected by source material stockpile shine. Conduct a grid point survey using gamma scintillation equipment to obtain data at 1 meter and contact.

- Conduct random soil sampling within the two times background isopleth where stockpile gamma radiation prevents the use of instrument survey techniques to identify surficial soil activity. Perform the walkover and grid point survey utilizing the Eberline SPA-3. Conduct random soil and sediment sampling in targeted areas throughout the site to provide isotopic data that will correlate with activity measurements obtained using the SPA-3.

- Collect water and sediment samples in Hudson's Branch upstream of the site, and in the immediate vicinity of the site. Collect surface runoff samples during a storm event in areas of prior erosion.

Samples of groundwater will not be included in the scope of this radiological characterization of the Newfield facility. SMC has been monitoring wells SC-11S, SC-12S, and SC-13S for over 24 months in accordance with the 1988 Administrative Consent Order (ACO) for Radiological

Constituents. No significant radiological impact has been observed. This monitoring program will continue.

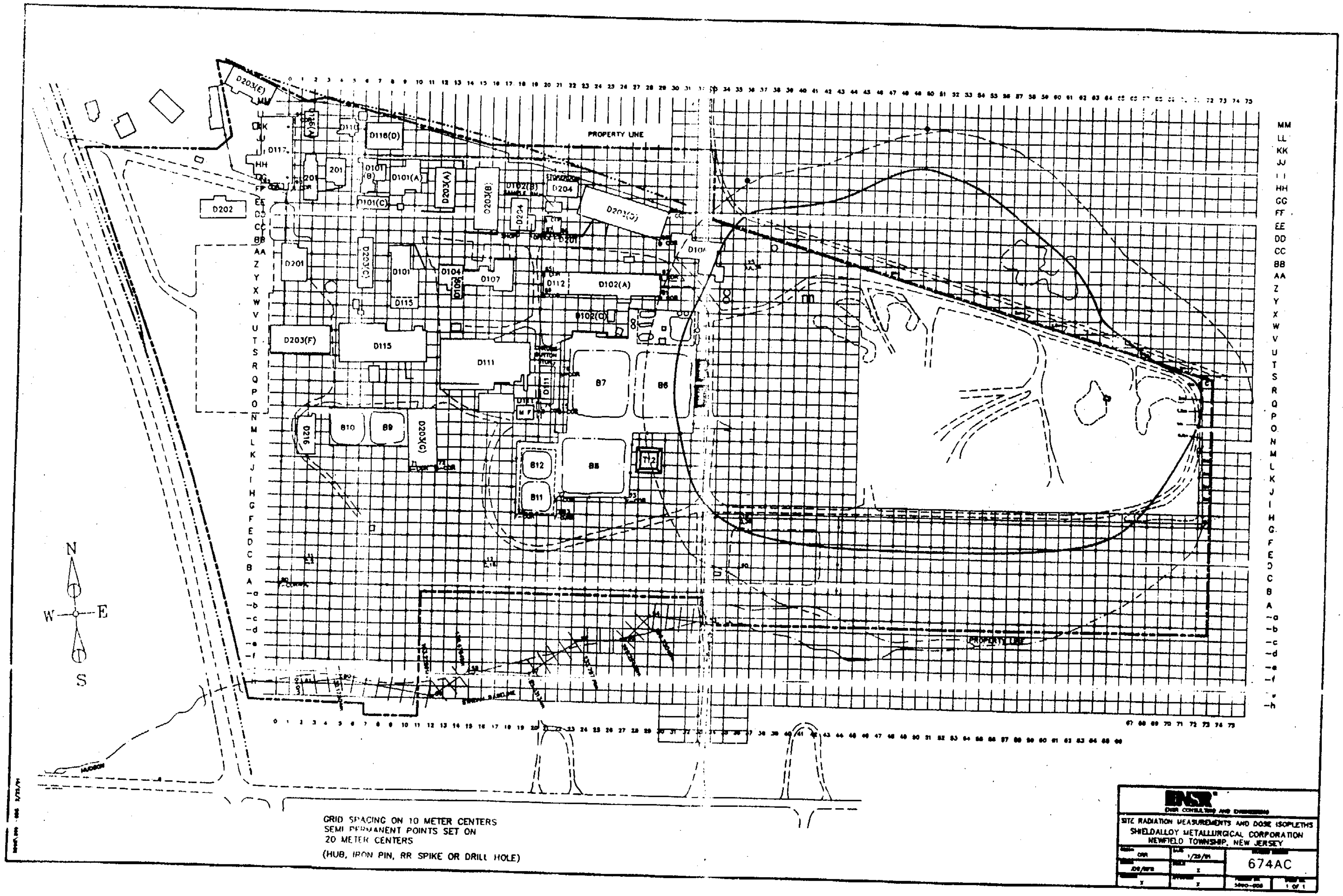
2.0 CHARACTERIZATION ACTIVITIES

2.1 Grid System

A 10 meter grid has been established over a limited part of the site licensed area. The grid has been established where legal access can be obtained to a distance of at least 30 meters outside the existing facility property lines. If it is determined during the characterization that measurements will be necessary beyond the established grid, the grid will be extended in 10 meter increments until the limit of elevated activity is included. The limit of elevated activity is defined to be the point at which the survey equipment reads less than twice the established background level in counts per minute.

This grid has its origin located at the southwest corner of the facility. The x-axis continues in an easterly direction roughly parallel to the facility fence line. The y-axis extends in a north-south direction along the western boundary of the property. This y-axis extends south so as to intersect Hudson's Branch and provide a point of reference for measurements in this area. Due to the topography and field conditions, a second x-axis was extended along the nominal centerline of the channel of this small tributary. The grid was then extended 20 meters to each side of this established center-line. The axis is labelled with an alpha-numeric system as a means of reference. The linear distance of this axis was determined in the field, but at a minimum it extends from the holding pond westward to the culvert passing underneath West Boulevard. The grid systems relating the grid specific to Hudson's Branch and the grid relating to the balance of the facility will be joined and overlapped on the drawing. Any other potentially contaminated areas identified outside of this grid will be extended to the nearest grid landmark. Figure 2-1 presents the grid, that has been established for this site. Measurements and sample locations obtained west of the culvert underlying West Boulevard to Weymouth Road and along the south haul road will be designated on an extended grid. These grid locations will be established in the field.

The grid will be established on 10 meter centers, as it is consistent with established radiological survey methodology and release criteria. It may therefore differ from other reference systems currently established for the facility. The grid will be overlayed against existing facility layout drawings to provide a reference to existing structures and equipment. The intersections of the grid established in the field will be established as grid coordinates. This grid will be used to reference all measurements obtained in the field and as an aid in determining the extent of the area to be considered for future decontamination.


PROPERTY LINE
D203(E)
D117
D118(D)
201
D101(A)
D203(A)
D203(B)
D204
D203(D)
D202
D201
D203(C)
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D115
D104
D107
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D102(A)
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Figure 2-1

Shieldalloy will utilize the services of a licensed professional surveyor to establish the grid for the radiological characterization of the Newfield facility. The surveyor of record is James Stewart, Inc., of Philadelphia, Pennsylvania. The grid system has been established, transferred to a Computer Aided Drawing (CAD) system, and issued for use on-site.

2.2 Background Measurements

Background measurements will be obtained to determine:

1. natural background concentrations in uncontaminated soils and sediments of uranium, thorium, and radium for comparative purposes;
2. gamma exposure rates at 10 cm and 1 m above the surface in uncontaminated areas; and
3. a correlation between exposure rate measurements and measured specific activity in the top six inches of soil with sufficient measurements taken with the PIC at the same location as the SPA-3 to ensure adequate data for correlation determination.

Prior to initiating the exposure rate survey for the balance of the facility and its adjacent property, it will be necessary to establish the area-specific background exposure rate and soil activity. Six locations will be selected in the immediate Newfield/Vineland area to establish these background values. At each of the selected locations an instrument cross calibration and soil sampling will occur.

Background sediment and surface water samples will also be obtained to provide a point of reference for any differences in activity. Two, three sample sediment transects and one, three sample surface water transect will be established along Hudson's Branch. The collected soil and sediment samples will be analyzed for U-238, Th-232, Ra-226, Ra-228, and Ac-228. The water samples will be analyzed for gross alpha and gross beta activity and if the activity is above action levels, further analysis will be conducted for the uranium and thorium isotopes. The surface water samples will be filtered to determine both the soluble and insoluble fractions.

The soil sampling will involve obtaining a single sample at each location composited over the top six inches of soil. The sample will be identified by location and sent for isotopic analysis using alpha spectrometry for Uranium-238; gamma spectrometry for Thorium-232, Radium-226 and Actinium-228; and beta-gamma coincidence counting for Radium-228.. Refer to Section 4.0 for the referenced analytical procedures. Upon receipt of the sample results from each of these areas a mean site value for those isotopes will be established.

To correctly establish a correlation between the background soil activity and a measurement of exposure, it will be necessary to determine the exposure rate in microroentgen per hour (uR/hr) using a calibrated Pressurized Ion Chamber (PIC). This instrument shall have been calibrated within the previous six months against a National Bureau of Standards (NBS) traceable source (Co-60) of similar energies. In addition, it will be required that the portable gamma scintillation field instrumentation be cross calibrated against this ion chamber to establish a counts per minute per microreontgen per hour (cpm/uR/hr) value for determining the presence of potential contamination during the exposure rate survey of the facility in areas below two times background.

Details of the instrumentation are as follows. The instrumentation utilized to establish the exposure rate correlation will be the PIC in conjunction with two inch by two inch Sodium Iodide gamma scintillation probes with compatible ratemeter/scalers. The PIC is a direct reading environmental exposure rate instrument that will provide continuous measurement of exposure rate, with the capability to provide total exposure integrated over a definite time of measurement. Measurements obtained for this project will be done using the integrated mode.

The gamma scintillators are low energy gamma detection instruments utilizing two-inch by two-inch sodium-iodide, thallium [NaI(Tl)] detectors in conjunction with a photomultiplier tube providing impulses directly to the ratemeter/scaler. The gamma scintillator will have been calibrated in the last six months against a NBS traceable source (Cs-137). These instruments are being utilized for the site survey because of their practical convenience and portable nature.

Potential measurement errors made in the field arise from variation in the energy spectrum of radionuclides within the ground. This uncertainty arises not only from possible variation in the isotopic composition but also from variation in degradation of their initial spectrum according to the distribution of radioactivity with depth from surface.

In order to compensate for energy variance, the pressurized ion chamber will be utilized to determine the absolute exposure rate at the off site background locations. This instrument has a near constant response over the range of energies which are significant in this application. Therefore, any non-linearity in response of the SPA-3 will be overcome by cross calibration utilizing the more linear PIC as the absolute reference.

At each background location, five one-minute measurements will be obtained using the PIC, positioned one meter above the ground, and the values in uR/hr recorded. At these locations gamma scintillator measurements in cpm for each of the scintillators to be used in the field shall be obtained. The gamma scintillator's shall be positioned on each of the four sides of the PIC. The four measurements per location will then be averaged giving a calibration of cpm and dose rate. An averaged value will be obtained per instrument due to the marginal inherent differences between individual probes.

A graph will be developed using the cpm values as the abscissa against the ordinate values in uR/hr. Each averaged cpm value per location per instrument will then be plotted to develop an instrument specific correlation between the two sets of instruments. The data points will be plotted for each probe then a line of best fit established for the data points.

The correlation between counts per minute and microroentgens per hour may not be linear over the entire range of values. As a result, the "line of best fit" will be used. The relationship may flatten out at the higher energy end of the exposure rate. Separate correlations will be developed for specific subsets of the site areas. These subsets may include areas of the site where shine from the SMSY are evident (two times background areas), areas where there is elevated activity (measurements between background and two times background), and areas that are potentially non-contaminated (background).

After regression analysis is performed, a correlation coefficient will be determined. The correlation coefficient will estimate the degree of closeness of the linear relationships between instrument readings for both instruments.

The equation for a linear analysis to demonstrate a correlation between the PIC and the SPA-3 is expected to be:

$$y = mx + b$$

where:
y = value in uR/hr
x = value in cpm obtained using the gamma scintillator
m = slope of the line (a constant)
b = y intercept (a constant)

By this means a correlation can be developed for each of the gamma scintillator probes that will be utilized for the characterization measurements. Insertion of the recorded value in cpm, obtained in the field, into the above equation or reading directly from the graph will allow for a direct conversion into uR/hr. Based on field survey results that demonstrated the interference of shine on the SPA-3 measurements (see Appendices A and B), this cross calibration will not be used in areas where the exposure rate from shine is twice natural background. Where the SPA-3 is used (i.e., in areas where the shine is less than twice background), the correlation developed in this section will be established by confirmatory soil samples.

2.3 Exposure Rate Survey

The exposure rate survey of the facility and its adjacent property will be performed as follows:

1. This exposure rate survey will accurately determine and record the exposure rates around the perimeter of the restricted area. The exposure rates at the facility fenceline will be recorded and included in the study report. Measurements shall be taken at 20 meter intervals.

2. The exposure rate survey will facilitate determination of the extent of potential contamination and will define those areas for possible subsequent decontamination. This will be done by establishing the fixed point gamma survey to serve as a guide to the location of elevated levels of activity at the facility in conjunction with the walkover results.

The first technique that will be employed will be that of a "walkover" gamma survey to complete the survey of grid blocks in the southwest and southeast areas of the site. Gamma surveys will not be conducted in areas with two times the background dose rate or in areas previously surveyed (see Appendix B). This survey will be accomplished by walking in a series of parallel paths over a gridded area while slowly swinging the gamma scintillator approximately 10 cm above the ground surface. This method is continued until the entire grid block has been traversed. The data are then recorded on an individual data sheet for each area of the facility, by grid block. The range of exposure rates for each grid block is recorded and any anomalous measurement is located relative to the grid. An anomalous measurement is defined as a measurement that is more than twice the established background level in cpm. This procedure is repeated until all the grid blocks within each area have been covered. It is planned to extend the grids and subsequent surveys in various areas, as necessary, to determine levels of contamination in excess of those defined by NRC for unrestricted use.

At the completion of the walkover survey, measurements will be taken at each of the grid intersection points at contact and one meter in height to provide a data base of measurements at fixed points on the grid for future reference. These readings will be obtained using the gamma scintillator probes. When a measurement is taken at a location where two (or more) grid blocks intersect, that measurement will be used as a data point for all of the intersecting grids. This fixed point survey will obtain measurements only in those areas previously identified as less than or equal to twice the background limit, outside the area influenced by gamma radiation from the source material stockpiles.

In addition, soil and sediment samples will be collected in areas of the plant where gamma dose rates are less than twice background. This sampling is designed to demonstrate the efficacy of using the SPA-3 instrument to locate areas of contamination, as well as demonstrate that areas containing soils with isotopic activity less than 5 pCi/gm Ra-228 have been correctly identified.[1] These soil samples will be isotopically analyzed to accurately determine the possible contamination present. Soil samples will be obtained over the initial depth of six inches. These discrete samples will be obtained individually in single increments at each of the identified locations. The probable locations for these sampling events will be determined by sequentially numbering each of the grid blocks within the approximate grid point boundaries previously described. A random number table (e.g., Appendix A1 in Statistical Methods, Snedecor and Cochran, sixth edition) will then be used to select the appropriate sample locations on the grid map.

These soil samples will be obtained using a hollow stem hand auger coring device, resulting in a single core per sample location. Initially, only the top six inches of the core will be sampled and sent for analysis. If the results of this analysis exceed current soil release criteria (see Section 3.0), then additional six-inch core segments will be sampled and analyzed until the limit of activity is reached.

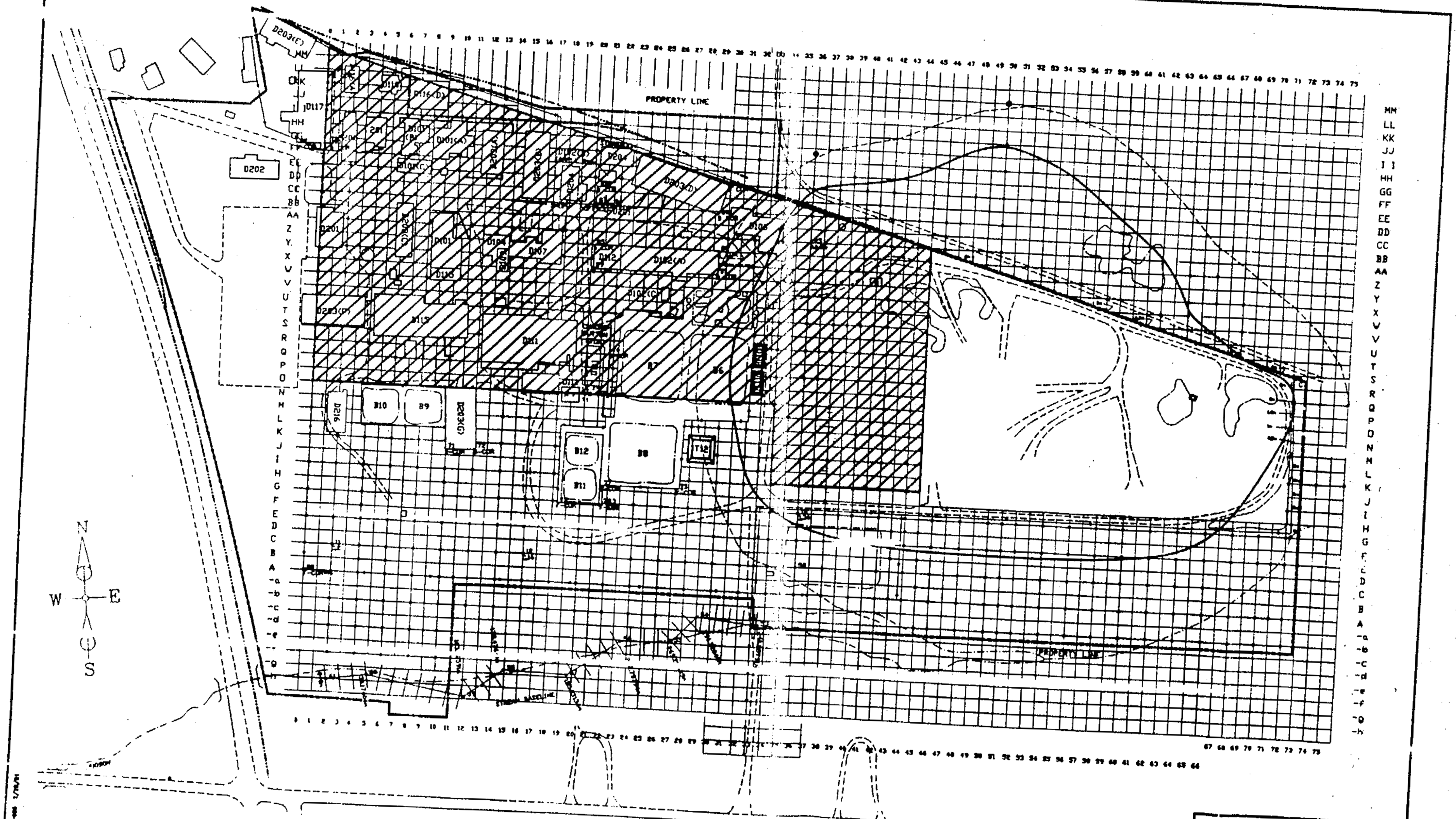
A report will be prepared that documents the results of the survey/characterization, including a description of all work performed and methods used, all measurements and data obtained, delineation on grid maps of the extent and approximate depth of soil contamination and recmmended options for control/mitigation.

It should be noted that the facility building interiors and surrounding roadways will not be a part of this characterization effort due to the ongoing process and manufacturing operations. These buildings will simply be referenced on the site map (see Figure 2-2).

2.4 Environmental Media Sampling and Analysis

For each of specific sampling areas identified in Section 2.3, it will be necessary to sample for isotopic activity to plan decontamination and identify non-contaminated zones. Media that will be analyzed during the characterization activity will include soils, sediments, surface runoff water and surface water. The isotopic analysis that will be conducted will be for the radionuclides

[1] E. Y. Shum and S. M. Neuder, " Decommissioning of Nuclear Facilities Involving Operations with Uranium and Thorium," USNRC, From the 28th Hartford Synposium on Health and the Environment, 1990.



GRID SPACING ON 10 METER CENTERS
SEMI PERMANENT POINTS SET ON
20 METER CENTERS
(HUB, IRON PIN, RR SPIKE OR DRILL HOLE)

SITE RADIATION MEASUREMENTS AND DOSE ISOPLETHS
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Thorium-232, Radium-226, Uranium-238, Radium-228, Actinium-228, and for the gross alpha and gross beta activity parameters for water.

Initial analysis of water samples will be for dissolved and suspended gross alpha and gross beta activity. Isotopic analysis of water samples will be performed if the gross alpha activity exceeds the screening value of 15 pCi/liter or the gross beta activity exceeds 50 pCi/liter.
Water sampling of Hudson's Branch will occur at locations between the outfall from the holding pond, to a point immediately south of the culvert passing underneath Weymouth Road. The samples obtained will be grab samples of one liter volume. These samples will be iced and preserved and sent for analysis. Nine surface water samples including three samples taken upstream plus one QC sample and one field blank will be obtained. This procedure is consistent with the EPA established analytical procedure for the drinking water parameter "Determination of Gross Alpha and Gross Beta Activity, SW-846, Method 9310." The analysis will be conducted by an independent laboratory selected for protocols/procedures acceptable to the NRC. The filtrate and filter will be analyzed for dissolved and suspended gross alpha and gross beta activity, respectively.

Surface runoff samples will be collected during a storm event which will be roughly quantified as a continuous period of precipitation exceeding two hours in duration. Prior to this event, areas of prior erosion and runoff at the site perimeter will have been identified and marked as potential sampling locations. Four surface runoff samples plus one QC sample and one field blank will be obtained during the storm event. A one liter sample will be obtained and preserved for subsequent filtration. The filtrate and filter will be analyzed for dissolved and suspended gross alpha and gross beta activity, respectively.

Due to the presence of the material stockpiles that contain elevated levels of activity, it will be necessary to utilize soil sampling in certain areas. A map is presented in Appendix B that identifies the areas where soil sampling, not conventional surveying, will be used. The area north of the SMSY included in the greater than twice background isopleth (i.e., approximate grid point boundaries DD35, II50,S70); as well as the area immediately south of the SMSY will be sampled (i.e., approximate grid boundaries G34, D50, G66). The shaded area immediately west of the SMSY has historically been used for a variety of source material purposes and falls under Shieldalloy's current NRC license responsibilities and, as such, will not be surveyed. The walkover technique will not be employed and instead will be supplemented by soil sampling.

In some cases where a high percentage of slag is present in the soil samples it may be necessary for SMC to conduct initial sample preparation to allow for further analysis. This is due to the material characteristics of the slag, as its extreme hardness creates difficulty for the analytical lab if it is not reduced to a particle size sufficient for its analysis.

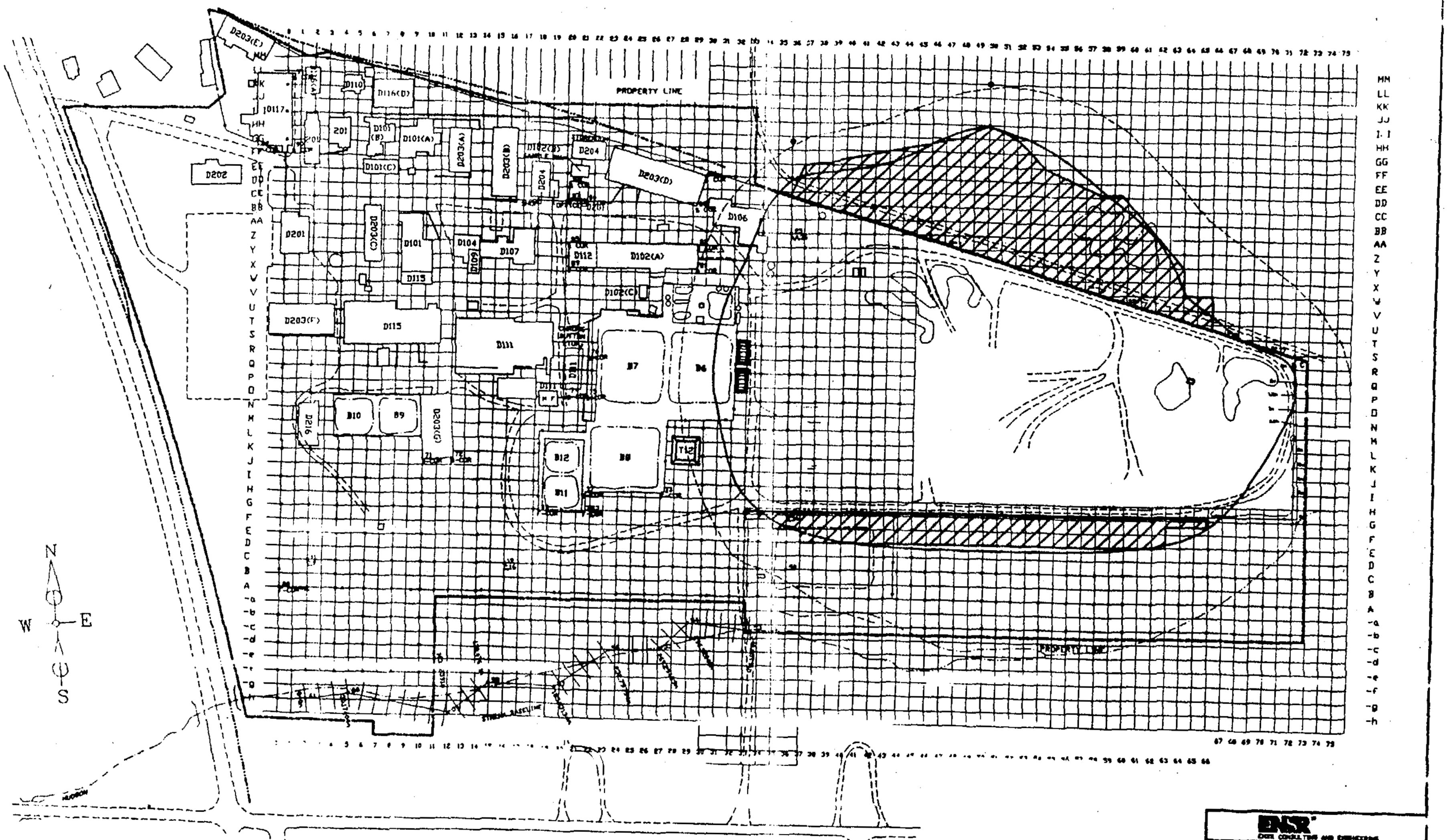
Soil samples will be discrete as described from each of the sampling locations. The initial work scope description outlined obtaining correlation soil samples in a site area where the shine from the SMSY is less than twice background. An estimated 30 soil samples will be obtained from site areas with gamma readings below two times background, including the southwest corner of the plant property and the area below the south fenceline. Three duplicate samples will be collected in these areas.

Areas with gamma readings exceeding twice background will be used as another area-specific sample location (see Figure 2-3). An estimated 42 soil samples will be obtained. Thirty samples will be obtained north of the SMSY and 12 samples will be obtained south of the SMSY. Four duplicate samples will be obtained in these areas. To develop adequate background data for the site, six soil samples plus one duplicate will be obtained of background soils remote from the site (see Section 2.2). Again, only the top six inches will be initially sampled and analyzed until results indicate activity in excess of prescribed limits.

Sediment and soil sampling will occur in the area associated with Hudson's Branch. Although a walkover survey will be performed of this area, supplemental sampling will be necessary. It is estimated that 30 samples will be obtained of sediments from Hudson's Branch from the pond south of the plant to the west. Samples will be obtained from contaminated and non-contaminated areas as preliminarily identified during the February 1991 survey (see Appendix B). Samples will be obtained outside of the channel to the limit of the elevated activity as well as outside these elevated areas on either side. Three duplicate samples for quality control will also be obtained. To establish background, two-three sample transects of sediments plus one duplicate will be taken to the east of the pond (see Section 2.2). Analysis of sediments will follow the same protocols established for soils.

Air sampling will not be conducted under the characterization. Air sampling has been implemented by SMC in process buildings in conjunction with the requirements established under the facility source material license. SMC is intending to expand the program to ensure compliance with anticipated source material license reissuance. During any augering for the soil sampling, a lapel sample will be obtained for the purposes of determining the potential risk from inhalation of radioactive particles.

All samples will be accompanied by a chain of custody record from the time they are collected until analysis is performed. When transferring the possession of samples the individuals relinquishing and receiving will sign date and note the time on the record. This record documents sample custody transfer from the sampler to the lab sample custodian.



GRID SPACING ON 10 METER CENTERS
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3.0 CRITERION FOR IDENTIFICATION OF CONTAMINATED AREAS

The criterion for identification of areas with elevated levels of radioactive isotopes is 5 pCi/gm of Radium-228 with natural thorium daughters present in equilibrium. This value is derived by the NRC, whereby soils with an isotopic content less than this are suitable for unrestricted use in the environment. This concentration value is obtained from the NRC's Branch Technical Position (46 FR 52061) for Disposal or Onsite Storage of Thorium or Uranium Wastes From Past Operations and the published paper "Decommissioning of Nuclear Facilities Involving Operations with Uranium and Thorium" by E. Y. Shum and S. M. Neuder of the NRC published in the Proceedings of the 28th Hanford Symposium on Health and the Environment. The identification of areas with elevated activity will be determined where possible by direct gamma exposure rate measurement, with confirmation by analysis of soils for isotopic activity.

Measurements of background exposure rate were conducted by ORAU during their site investigation in July 1988. At a total of seven locations in the Newfield, New Jersey area measurements were obtained resulting in a mean value of 7 uR/hr. Additional measurements taken by the ENSR team in September of 1990, and February of 1991 resulted in a mean background value of 6.9 uR/hr (see Appendix B). These values are consistent with established NCRP data for this area of the country.

Both ORAU and ENSR obtained soil samples at approximately the same locations to determine the background activity for the Newfield area. For the three isotopes of interest the mean activity values are:

ORAU Results		ENSR Results	
Th-232 -	0.4 pCi/gm	Th-232 -	0.5 pCi/gm
Ra-226 -	0.5 pCi/gm	Ra-226 -	0.6 pCi/gm
U-238 -	0.6 pCi/gm	U-238 -	1.1 pCi/gm

The average exposure due to natural elements in the Newfield area is consistent with the NCRP calculation for the exposure contribution from natural elements nationally of 6.8 uR/hr.

The NRC has developed "ad hoc" cleanup criteria for decommissioning nuclear facilities that involves operations with uranium and thorium. NRC has considered the cost of soil analyses for radionuclides in the uranium and thorium series and accepts combination soil sampling and instrument survey methods that demonstrate compliance.

Based on previous analytical results of contaminated soil samples and source material slag at the Newfield, New Jersey site, Th-232 is the dominant radionuclide. For natural thorium with daughters in equilibrium, Radium-228 (Ra-228) or Actinium-228 (Ac-228) are used as the dominant radionuclides because of the easily measurable gamma peak from Ac-228. Radionuclides in the thorium series are strong gamma emitters; NRC has criteria for direct gamma radiation that limit exposure to less than 10 uR/hr above background measured at 1 meter above the surface. By analyzing soil samples for Ra-228 and developing a correlation between soil sample activity and SPA-3 readings (see Section 2.3), a relationship between Ra-228 soil activity concentrations and survey instrument readings (in areas less than twice background only) will be demonstrated. The NRC criteria establishes 10 uR/hr above background as the dose detriment from soil activity levels of Ra-228. If the correlation factors developed support this activity to dose relationship, direct gamma radiation measurements will be used to demonstrate surface soil compliance.

Therefore, a 5 pCi/gm criterion of Radium-228 for decontamination, in accordance with the NRC criterion, is equivalent to an external whole body gamma dose measured at one meter above the ground of 10 uR/hr (exclusive of background). With Thorium as the dominant element found in the source material slag on the site, an exposure rate criterion of 17 uR/hr (10 uR/hr for Ra-228 plus 7 uR/hr for background) will be utilized to identify areas for unrestricted use.

Concern has been raised by NJDEP about the contribution of Radium-226 to the possible exposure problem at the site. Criteria developed by the NRC are specific in their reference to the level of residual activity being dependent on the existence of Thorium and Uranium in equilibrium with their daughters. Analytical evidence gathered by ORAU specific to the ferrocolumbium high ratio and standard slag piles indicates that the concentration of thorium is greater than uranium by several orders of magnitude. Therefore, the derived standard for identification of areas for decontamination is valid, and will include the possible contribution of radium to the derived exposure rate. Application of standards relating solely to the concentration of Radium-226 at the site is not appropriate. Those standards promulgated in 40 CFR 192, Health and Environmental Standards for Uranium and Thorium Mill Tailings are not applicable to this facility.

4.0 QUALITY CONTROL AND QUALITY ASSURANCE

This section of the characterization plan presents a concise overview of the measures that will be taken by ENSR and its subcontractors to assure that the work performed will be of proper quality to assure accuracy, adequacy and precision of the data that will be collected.

The project will be organized in a matrix fashion with established responsibilities at each level of project management. Overall on site control will rest with the ENSR Site Manager who will be responsible for project execution in the field. This Site Manager will interface with the ENSR Project Manager and client representatives to assure that the activities are conducted in a manner consistent with ENSR's quality control objectives. Project communications which will be incoming to the project will be routed to the Project Manager for distribution and filing. Project outgoing correspondence will as a minimum be reviewed and signed by the Project Manager prior to transmittal. Copies of all incoming/outgoing material will be maintained in the project central files.

ENSR will follow an internal Quality Assurance program to provide a means for control and review so that the work performed is of the highest professional standards. Data will be gathered or developed in accordance with procedures appropriate for the intended use of the data. The data will be of known or acceptable precision, accuracy, representativeness, completeness, and comparability within the limits of the project. To achieve this end, deficiencies will be prevented through planning and design, use of standard procedures, and use of qualified personnel.

Subcontractor performance will be monitored by the Site Manager on a regular basis to assure adherence to the established plans and procedures. Field documentation will be maintained in field notebooks inclusive of all site specific progress summaries and problems.

Sample control and chain of custody procedures will be in accordance with the guidelines established by the EPA office of Enforcement as of May 1986. Included in these guidelines will be those for sample identification and chain of custody procedures. Upon initiation of field activities, all personnel will be provided with a project Quality Assurance Plan (QAP), outlining the specific sampling methods and coincident decontamination protocols that will be utilized. It should be noted that the solubility of the contaminant is extremely low and therefor decontamination between sampling events will involve primarily gross removal of any residual material.

The quality control parameters for the fixed point exposure rate survey will entail obtaining a single quality control measurement for every ten field measurements that are taken. The quality control measurement will be one minute in duration. This value will be recorded coincident to the other values in the data tables for these measurements. The instrumentation that will be used to conduct both the walkover and fixed point survey will have been calibrated within the previous six months against a National Bureau of Standards calibrated source of a nuclide similar in energy emission to those existing at the Newfield site. In addition, this instrumentation will be source checked twice daily to assure response within 10 percent of the given source value. The sources used to complete this daily check will be of similar energies to those existing at the site.

Samples of the remaining media comprising soil, sediment, and water will be obtained using decontaminated sampling devices. This device will be decontaminated using distilled water between sampling events. Each sample will be placed in an individual eight-ounce wide mouth container, sealed and submitted to the laboratory for analysis.

Precision will be assessed by the collection of duplicate samples. Field duplicates of the identified media samples will be obtained on a frequency of 10 percent for the soil, sediment, and water. These duplicates will not be labeled as such but will be submitted to the laboratories as blind samples to eliminate bias. Field blanks will be included for those days when any water samples are obtained.

In addition to field duplicates, extra sample material will be collected in order that samples may be split due to the possibility for future chemical analyses of these materials. For the isotopic analyses of the soil and sediment no sample preservation will be required. Water samples will utilize a small amount of nitric acid in the containers to prevent isotope dissolution to the sides of the sample container.

The analytical laboratory will be licensed by the NRC to receive, handle, and store radioactive materials and must participate in a radioactivity analysis intercomparison program. All samples will be received by the lab and logged in and inspected. Shieldalloy will utilize the services of an accredited laboratory to perform the required analyses. Teledyne Isotopes in Westwood, New Jersey, will be the lab utilized to perform the necessary analytical services for the characterization effort. This lab participates in the CLP program as well as complying with the quality assurance guidelines established in NRC Regulatory Guide 4.15.

All of the soil samples will be analyzed for the identified isotopes using the technique of gamma spectrometry based on the methods described in Radiochemical Analytical Procedures for Analysis of Environmental Samples (EMSL-LV-0539-17, USEPA, Las Vegas, NV, 1979). Samples will be counted using an intrinsic germanium detector coupled to a multi-channel analyzer. Due to spectral interferences, it will be necessary to analyzed the soil and sediment samples using alpha spectrometry specific to the Uranium series isotopes. Radium-228 gross alpha, and gross beta analyses will be performed utilizing radiochemical methods.

The analysis of the water samples will utilize the method as cited in Section 2.0 in accordance with EPA SW-846. These samples will have been preserved in the field prior to their placement into the containers. The filtrate will be analyzed for both dissolved and suspended alpha activity.

Method sensitivity is defined as the minimum detectable activity (MDA), the smallest amount of activity above background that can be measured at the 95 percent confidence limit. MDA's may vary dependent on sample weights volume or instrument used but the MDA's for gross alpha and gross beta analyses are expected to be within the range of 0.3 to 3 pCi/L.

The lab instrumentation will be source checked using the same criteria as the field instruments. Quality control samples associated with lab analysis will be conducted as well. Method blanks will be analyzed at a frequency of one per analytical batch or one every 20 samples whichever is more frequent. Lab duplicates will be counted on the same frequency.

Corrective action will be taken if the analytical instrumentation is outside tolerance limits, results of the lab blank analyses are above background or the QC data is outside the window for precision or accuracy. Data will be documented and duplicate records maintained.

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APPENDIX A

NEWFIELD PLANT RADIOLOGICAL PRE-SURVEY (September 1990)

ENSR

Formerly ERT

ENSR Consulting
and Engineering
Liberty Center, Ninth Floor
1001 Liberty Avenue
Pittsburgh, PA 15222
(412) 261-2910

25 February 1991
ENSR Project No. 5990-006-200

Mr. David R. Smith
Director of Environmental Services
Shieldalloy Metallurgical Corporation
12 West Boulevard
Newfield, NJ 08344

SUBJECT: Newfield Plant Radiological Survey/Characterization

Dear Dave:

Please find attached as Exhibit 1 the report entitled "Method Validation and Instrument Calibration for Radiological Survey/Characterization: Shieldalloy Metallurgical Corporation, Newfield Plant." This report documents the data and results, conclusions, and recommendations from this investigation. It has been revised to reflect our discussions and the consensus reached in our 17 January 1991 meeting.

ENSR is in the process of rescoping the program for the site-wide radiological survey/characterization in accordance with this work and the pre-survey calibration study, which you should have received under separate cover. ENSR should have the site-wide program rescoped within the week. If you have any questions, please call me or Ray Holmes.

Yours truly,

John P. Fillo, Ph.D.
Senior Program Manager

Attachments

cc: D. Brandon
J. Englick
R. Holmes
C. Rieman

59900691.jpf

EXHIBIT I

METHOD VALIDATION AND INSTRUMENT CALIBRATION FOR RADIOLOGICAL SURVEY/CHARACTERIZATION: SHIELDALLOY METALLURGICAL CORPORATION NEWFIELD PLANT

Background

This work was undertaken to support the survey and characterization effort required to determine the nature and extent of radiological contamination on site and in the immediate vicinity of the Newfield Plant. ORAU identified in July of 1988 that radioactivity from source materials was not being adequately controlled and segregated, consistent with acceptable license conditions. The ORAU survey accomplished its purpose of screening the radiological impacts of Shieldalloy's activities to the environment. They concluded that the pattern of contamination in the drainage pathways suggested that the mechanism of contamination was predominately dispersal of fine particulates by surface runoff. They did not, however, accurately characterize the detailed extent of this off site dispersal of source material. A possible secondary source of activity is the use of source material as a construction material in and around the facility property.

Under the NRC materials license provisions established in SMB-743, Shieldalloy has the responsibility and authority to conduct radiological surveys and decontamination activities to ensure proper management of source materials and associated byproducts resulting from its operations. Subsequently, additional inquiries in May 1990 from NRC, NJDEP, and EPA, reinforced interest relating to off-site contamination. This has led to the development of a Work Plan to conduct a radiological characterization of this contamination. Incorporated into this document were radiological survey techniques and methodologies that had been employed with success and NRC endorsement at other facilities including Shieldalloy's Cambridge Ohio Plant. In these instances, direct instrument measurement of contamination was an efficient and effective method to radiologically characterize large areas for the presence of radiological contamination.

The Newfield Plant presents site conditions that may require changes in the technical approach to the radiological characterization. Direct measurement utilizing survey instruments is desirable for a large portion of the site. This same technique may have to be replaced or supplemented by soil sampling in those areas where gamma radiation emissions from Ferrocolumbium (FeCb) and Ferrovanadium (FeV) stockpiles interfere with the direct reading instrumentation. The presence of these stockpiles and their coincident shine have the potential for misrepresenting the activity associated with surficial and subsurface contamination that may exist both in and outside the facility licensed boundaries.

Therefore it is necessary to conduct a series of measurements to determine whether and to what extent the proposed radiological survey methods will accurately identify the activity associated with the contaminated soil. This report discusses the objectives/approach, methodology and results from the method validation and instrument calibration effort.

Objectives and Approach

The objective of the study is to develop an understanding of where specifically, both on and off site, instrument surveys, soil sampling and analysis, or a combination of these techniques will be used to conduct the characterization. As a result, an approach was developed to obtain a series of targeted instrument measurements in conjunction with soil sample isotopic analysis to determine a relationship, if any, between (1) the dose rate as measured by the instruments and the specific activity that exists in the soil, and (2) dose rates measured by the direct-reading instruments. In this manner it would be possible to determine the appropriate survey techniques to be used to characterize the potential of elevated activity associated with the facility. In addition, these measurements were expected to provide data to cross-calibrate the instruments for application to the survey.

Eight locations were identified to represent varying conditions that might be encountered. Two locations off site were chosen to provide a background reference to the areas of elevated activity. Two locations were chosen based on prior knowledge that contamination was present, with no other contributions from source materials. The balance of the four measurements was chosen at locations equidistant from the FeV and FeCb stockpiles, yet with expected differences in soils activity. The purpose of locating the readings equidistant from each of the piles was to allow for the effects of shine from each of the piles to be roughly equivalent. The choice of the two individual locations associated with each stockpile were based on observed differences in activity as seen by direct instrument measurement.

The instruments utilized to conduct these measurements were a Pressurized Ion chamber (PIC) and a gamma scintillator (SPA-3), which was configured in one of three modes based on industry accepted measurement techniques. The SPA-3 survey instrument was coupled with a compatible ratemeter/scaler (model PRS-1). The three configurations of the SPA-3's were:

- unshielded;
- collimated with 3/8 inch thick lead, with the lead wrapped around the entire SPA-3 leaving exposed only the end of the detector; and
- a cone shield, which is a shield apparatus in the shape of a cone with the bare detector suspended in the middle of the cone, with the bottom of the detector aligned with the bottom edge of the cone shield.

The instruments record the gamma emissions from the isotopes of Uranium-238 and Radium-226. Thorium-232 is an alpha emitter and as such is not readily detected by these field measurement techniques.

Methodology

The method verification involved a series of measurements that were taken at eight separate locations at the facility boundaries and in adjacent properties. The individual locations were selected in accordance with variations in their expected soil activity as seen by direct measurement, as well as how these measurement locations may be affected by the nearby stockpiled material. An attempt was made to vary the measurement locations so as to represent the expected possible measurement conditions that may be encountered.

The intended combinations included:

- background activity, with no shine:
- surficial activity, with no shine;
- no surficial activity, with shine; and
- surficial activity, with shine.

Figure 1-1 identifies the approximate locations of the six samples taken related to the site. Due to the scale of the drawing the two background locations do not appear. Table 1 provides detail relating to the individual measurement locations and how they correlate to each of the measurement combinations. Cursory instrument readings were taken at each of these locations to determine if there was any detectable contribution from other sources.

At the locations associated with the FeCb piles, it was unknown if any differences in activity could be detected due to the high level of general area exposure that should exist near these piles. Measurements were taken at locations that appeared to represent sediment that had run off from the site.

At each of the identified locations a total of twenty measurements were obtained. Two measurements were obtained using the Pressurized Ion Chamber (PIC) resulting in values in microroentgen per hour (uR/hr). PIC measurements are continuously integrated over time to reduce measurement variation and randomness. The first PIC measurement was taken after two minutes of the instrument being positioned, and the second measurement was taken five minutes after to assure precision. Sixteen SPA-3 measurements were obtained at each location, four at contact and four at one meter in height, using both the unshielded and collimated SPA-3. The unshielded and collimated SPA-3 measurements at contact were taken approximately three feet away from the center point of the PIC. The one meter in height readings were taken at these same locations, one meter above ground surface.

Two cone shield measurements were also obtained at the location of the PIC reading. There was no specific measurement duration. The SPA-3 readings for all configurations were 30 seconds in duration, which were displayed on the scaler readout as counts per minute. The results of each of these series of measurements were then averaged to a single value.

Soil samples were obtained at each of the eight measurement locations. Each sample was a composite of four discrete surface samples, corresponding to the individual SPA-3 measurement locations obtained adjacent to the PIC. Each of the eight composite samples were isotopically analyzed for the nuclides of Thorium-232, Uranium-238, and Radium-226.

Results

The data from the survey effort are presented in Tables 2 and 3. Table 2 presents the instrument measurement data for the PIC, shielded and unshielded SPA-3, and cone shielded SPA-3. The location designations for the unshielded and shielded SPA-3 readings refer to the four sides of the PIC measurement location at which these measurements were obtained. These four measurements were then averaged to a single value for each of the sample locations. Averaged values were also obtained for the PIC and cone shield measurements. The 6.1 to 6.3 uR/hr values obtained for sample locations LOC-1, and LOC-2 were consistent with those obtained by Oak Ridge Associated Universities (ORAU) in their July 1988 site survey. The ORAU background results were 6 to 8 uR/hr. The value for LOC-3 was 40.5 uR/hr. The corresponding ORAU value would be located roughly at perimeter grid location 1840 meters, and was 33 uR/hr.

The measurements obtained using the SPA-3 were consistent at each of the locations. This is demonstrated by the low variability in measured dose rates associated with each group of measurements, as evidenced by the low relative standard deviations for these values.

Table 3 presents a summary of specific activity results for the eight sample locations. These results were compared to the values obtained by ORAU, in their previous site survey. The background measurements for LOC-1 and LOC-2 are consistent with the results obtained by ORAU, which were Th-232, 0.1 to 0.6 pCi/g; Ra-226, 0.2 to 0.9 pCi/g; and U-238, 0.3 to 1.3 pCi/g. The isotopic result obtained at LOC-4 associated with Hudsons branch is consistent with the ORAU result for their sample location #20, Figure 7, and the corresponding activity result in Table 13 of the July 1988 report. This value was Th-232, 33.6 pCi/g; U-238, 20 pCi/g; and Ra-226, 15.5 pCi/g. ORAU also obtained a series of surface soil samples from the plant perimeter. The results obtained at LOC-5 are consistent with the ORAU values corresponding to the sample locations in this area. The ORAU values are listed in Table 4, page 32, of the July 1988 report. Perimeter grid location 1920 meters is roughly at the same location as the ENSR sample. The specific activities obtained by ORAU at this location are Th-232, 9.1 pCi/g; U-238, 4.5 pCi/g; and Ra-226, 2.4 pCi/g.

Discussion

The primary objective of the overall site survey/characterization is to determine the extent of radiological contamination at locations external to buildings on, and in the immediate vicinity of the Newfield facility. The contamination resulted from either radioactive materials associated with surficial soils and sediments that have been mobilized via surface runoff and erosion, or radioactive slags that may have been used as construction materials on and in the immediate vicinity of the facility. Identifying the location of this contamination is confounded by direct gamma radiation from FeCb and FeV slag accumulations in the source material storage yard, which may also contribute to the direct gamma dose at and beyond the Plant's boundaries. Shieldalloy are required to identify and quantify sources of contamination and/or exposure in order to plan and implement eventual cleanup/control.

Characterization first requires the measurement of the magnitude of direct whole body exposure to gamma radiation. This can be measured at any location and time using portable instrumentation. Inaccuracies can result from the varying sensitivity of portable direct reading dose rate meters to gamma energy. At this facility, the gamma radiation was expected to exhibit wide variance of energy due both to differences in the isotopic composition of the various radiation sources and to the effects of energy spectral degradation through shielding and self absorption. The PIC instrument when calibrated correctly measures dose rate over the range of significant gamma energies expected at this site. Its use however is more time consuming than the SPA-3 direct reading probe. One objective of this preliminary study was to determine the extent to which the SPA-3 probe could be used for the determination of whole body gamma dose during characterization.

The second objective is to determine the location and extent to which radioactive slags have been used for construction purposes. In the absence of gamma shine from the large accumulation of slags stored in the source materials storage yard, this could readily be achieved utilizing direct reading SPA-3 equipment. Experience at the Shieldalloy Cambridge facility indicated that measurements made at one meter above the surface could readily detect radioactive slags at concentrations in excess of 10 pCi/gm when used on roads or as surficial fill. Systematic survey with this equipment proved cost effective in characterizing the extent of slag mislocation. At Newfield, it was realized initially that the shine from the slag accumulations would limit the use of this technique.

In order to alleviate this type of problem, radiation detectors are manufactured with gamma shielding whereby the background dose from shine is attenuated, leaving a directional unshielded window. The efficiency of the shielded collimators was not predictable in this instance because of the lack of data on incident gamma energies, nor was the reduction in efficiency due to geometric reduction of the windows predictable.

Accordingly, the preliminary site work was designed to determine by direct comparison with the PIC whether any or which of the collimated versions of the SPA-3 could be utilized for identifying mislocated slags. Consequently, this effort was designed to determine areas within which the standard SPA-3 probe could be utilized for survey in the manner utilized at the Cambridge facility.

A third objective was to determine the extent to which either the shielded or collimated equipment could be utilized to determine the direct reading of dose rate, including that from surficial contamination resulting from erosion processes, in excess of 10 pCi/gm. Two factors were considered in the preliminary site tests. First, the practicability and potential time penalty of utilizing shielded versus unshielded direct reading probes and secondly the extent (and therefore cost) of areas which could not be assessed by direct measurement but which could only be determined by sampling and laboratory analyses.

A significant factor in this preliminary study was cost. A comprehensive study of these factors would not have been cost effective, therefore measurements were targeted to encompass the major combinations of surface contamination and shine. The whole objective was to minimize the overall characterization costs. To have conducted a comprehensive screening at this time would not have been cost effective. In consequence, the site team utilized subjective judgement when necessary to determine the most probable answers.

Review of the data obtained from this focused calibration/validation study lead to several observations regarding the use of instrument measurement techniques for the intended site wide survey and characterization. The potential effect of gamma shine on confounding the effective use of instrumentation is significant for most locations surveyed. The only locations where shine did not affect the measurement to some degree were the two background readings (i.e., locations #1 and #2), Location #4, and possibly Location #3.

There was not a consistent linear relationship between PIC and SPA-3 readings, shielded or not, across the range of measurements taken. There were discontinuities in the measured dose rates between these instruments. This phenomenon was likely due to the different combinations of sources of the detected energies at the various measurement locations (i.e., shine, buried slag, surficial soil/sediment).

None of the direct reading instruments provided a consistent correlation between soil specific activity and measured gamma radiation. Although the soil activity at Location #4 could be discerned from background, intercomparison between instrument readings and all soil activity measurements did not show a consistent relationship.

This is likely due to two factors. First, shine is significant for most of the instrument readings. For example low soils specific activities at Locations #7 and #8 correspond with the highest instrument readings in all cases. In addition, although soil specific activity values are higher at Location #4 than #3, the instrument readings are higher at Location #3. There are several other inconsistencies that are apparent from these data.

Secondly, the potential presence of slag buried beneath the surface could be affecting some of these measurements. For example, the relative levels of measured gamma radiation at Locations #3, #5 and #6 may be the result of slag used as base fill materials along the plant fenceline. If present, buried slag would affect instrument readings but this can not be confirmed because subsurface instrument scan or sampling was not conducted

Conclusions and Recommendations

The primary conclusions that can be drawn from the pre-characterization study are as follows:

- Radiological risk from whole body gamma radiation can only be determine with calibrated PIC instrumentation. The SPA-3 probes indicate significant non-linear variance in apparent dose response. This is most probable due to non-linear energy response.

- The location of buried slag utilizing an unshielded SPA-3 probe for systematic survey is feasible for all areas of the facility where dose rate from shine at one meter is less than twice the natural background.

- The location of buried slag within areas of excessive shine (i.e., greater than twice background) cannot be determined with certainty utilizing the commercial shielded probes. These probes indicated excessive non-linear variance with does rate suggesting either non-linear energy response and/or inadequate sensitivity in the collimated mode.

- The determination of surficial radioactive contamination can be characterized in areas where the dose rate from shine is less than twice the natural background utilizing the unshielded SPA-3 instrument.

- The determination of surficial radioactivity utilizing any of the commercial shielded probes tested is not practicable in areas where the dose rate from shine exceeds twice the natural background.

The recommendations resulting from this study are summarized as follows:

- The site-wide survey/characterization program should be supplemented with a pre-survey calibration at the grid intersections, using the PIC. The grid measurements should be taken at radii extended outward from the fenceline until the dose rate at one meter above the surface is not detectably above background. In this manner contours of gamma dose can be defined as the basis for dictating methods to be used for the site-wide survey and characterization.

- The characterization plan should be modified to require that the technique for locating buried slag utilizing the SPA-3 probe at one meter be limited to the area determined to meet the dose rate from shine limitation. The limits of shine influence will be determine utilizing a calibrate PIC prior to the commencement of the contamination survey.

- Within the areas of excessive shine, the characterization plans should be modified to require:

  1) a systematic survey of the fenced area utilizing an unshielded SPA-3 probe at near contact above the ground surface,

  2) excavation utilizing a backhoe of suspect areas for subjective direct surface measurement using an unshielded SPA-3 probe for suspect materials, and

  3) the selection of a limited number of suspect samples for laboratory determination of specific activity and isotopic determination.

- Determination of surficial radioactive contamination with an unshielded SPA-3 in areas where dose rate from shine is less than twice background should be supplemented by soil samples selected in a statistically random basis. A minimum of 30 samples are recommended for laboratory analyses including total alpha activity in pCi/gm and isotopic composition including isotopes from the uranium and thorium series.

- Surficial contamination in areas where dose rate from shine exceeds twice natural background should be characterized by the collection of samples for laboratory analyses. The number of samples taken in each "area" should be statistically significant and selected at random. Laboratory analyses should be utilized to determine total alpha activity and the isotopic composition for the uranium and thorium series.

TABLE 1

SAMPLE LOCATION DESCRIPTIONS

Location 1:	LOC-1	Background sample location obtained immediately south of Arbor Way, in an open area approximately one mile southwest of the facility. Sandy soil, with no aggregate present. Background activity, no source material contribution.
Location 2:	LOC-2	Background sample location obtained immediately north of Weymouth Road. One mile east-southeast from the facility. Soil sample obtained in a field, no aggregate present. Background activity , no source material contribution.
Location 3:	LOC-3	Sample obtained at an area of elevated activity at the southwest corner of the facility immediately outside the fenceline. The soil was a different color than the surface soil in the adjacent wooded area. Sandy in composition. Their was no contribution from other sources of activity at this location, except for slag buried during construction of the fence.
Location 4:	LOC-4	Sample obtained just south of the channel of Hudson's Branch. Location approximately due south of above location. Sample very wet and muddy. Black sediment finely grained. Sample obtained at a bend in the creek where channel deposition was likely. No other contribution to the identified activity existed at this location. Source material present from surficial dispersion.
Location 5:	LOC-5	Sample obtained in the field immediately south of the FeV stockpile, approximately 500 ft. east of the corner fencepost adjacent to the B lagoon. Approximately 30 ft. south of the FeV pile. Location had no vegetation associated with it, sediment pathway lead back to the site. Measurement affected by gamma shine, source material contribution expected.
Location 6:	LOC-6	Sample obtained inside the tree line immediately south of the FeV stockpile. Location is an additional 20 ft. east of the LOC-5 sample point, same distance south of the pile. Soil more loamy in nature with some sandy sediment material present as well. Measurement affected by gamma shine, no source material contribution expected.
Location 7:	LOC-7	Sample obtained immediately outside the fenceline across from the FeCb pile. Approximately 40 ft. north and 500 ft. west of the northeast facility fenceline corner. No vegetation present, soil finely grained and sandy in texture. Measurement affected by gamma shine, no source material contribution expected.

TABLE 1 (Cont'd)

Location 8:	LOC-8	Sample obtained 15 ft. west of LOC-7. Location was chosen due to the sandy appearance of the soil, with no vegetation present. Measurement affected by gamma shine, no source material contribution expected.

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TABLE 2

Radiological Field Measurements

Sample I.D.	Instrument	Type Measurement	East	North	West	South	Average	Relative St. Dev. %
LOC - 1	Bare SPA-3	contact	5120	5150	4862	5140	5068	2.7
		1.0 meter	5264	4906	5138	5070	5094	2.9
	Shield SPA-3	contact	1460	1427	1288	1443	1405	5.6
		1.0 meter	1444	1416	1430	1430	1430	0.8
	PIC	1.0 meter			6.0	6.1	6.1	
	Cone	contact			2808	2742	2775	
LOC - 2	Bare SPA-3	contact	5823	5980	5772	5748	5831	1.8
		1.0 meter	5728	5470	5550	5728	5619	2.3
	Shield SPA-3	contact	1760	1822	1670	1636	1722	4.9
		1.0 meter	1806	1670	1578	1678	1683	5.6
	PIC	1.0 meter			6.2	6.3	6.3	
	Cone	contact			3136	3309	3223	
LOC - 3	Bare SPA-3	contact	74356	71872	68540	78966	73434	6.0
		1.0 meter	42192	58922	55030	53646	52448	13.7
	Shield SPA-3	contact	28050	24452	25252	28014	26442	7.0
		1.0 meter	17504	19822	20266	20630	19556	7.2
	PIC	1.0 meter			40.5	40.4	40.5	
	Cone	contact			55332	55648	55490	
LOC - 4	Bare SPA-3	contact	26892	30072	30344	32684	29998	7.9
		1.0 meter	23506	23794	23750	24228	23820	1.3
	Shield SPA-3	contact	8942	10594	9892	11142	10143	9.4
		1.0 meter	7122	6910	7108	7426	7142	3.0
	PIC	1.0 meter			17.3	17.3	17.3	
	Cone	contact						
LOC - 5	Bare SPA-3	contact	55778	38854	48422	48508	47891	14.5
		1.0 meter	59610	53050	50350	50598	53402	8.1
	Shield SPA-3	contact	13862	9758	9750	10824	11049	17.6
		1.0 meter	11146	13700	11330	11030	11802	10.8
	PIC	1.0 meter			30.0	30.9	30.5	

Footnote: SPA-3 Measurements in units of counts per minute (cpm)
PIC Measurements in units of uR/hr.

TABLE 2

Radiological Field Measurements

Sample I.D.	Instrument	Type Measurement	East	North	West	South	Average	Relative St. Dev. %
	Cone	contact			23530	24514	24022	
LOC - 6	Bare SPA-3	contact	34290	32788	34056	30914	33012	4.7
		1.0 meter	36792	37588	39014	38354	37937	2.5
	Shield SPA-3	contact	5196	5254	4958	4490	4974	7.0
		1.0 meter	7494	8252	7788	6190	7431	11.9
	PIC	1.0 meter			21.6	21.7	21.7	
	Cone	contact			9490	9492	9491	
LOC - 7	Bare SPA-3	contact	151220	156754	131632	150882	147622	7.4
		1.0 meter	188082	179252	190148	197968	188862	4.1
	Shield SPA-3	contact	21854	21896	20010	23534	21824	6.6
		1.0 meter	40884	33140	35774	37322	36780	8.8
	PIC	1.0 meter			110.7	112.5	111.6	
	Cone	contact			33212	33736	33474	
LOC - 8	Bare SPA-3	contact	142302	153510	152528	136442	146196	5.6
		1.0 meter	185630	178820	188078	183332	183965	2.1
	Shield SPA-3	contact	17610	21204	20438	15366	18655	14.4
		1.0 meter	32984	33090	42142	38536	36688	12.2
	PIC	1.0 meter			111.2	109.9	110.6	
	Cone	contact			30944	30268	30606	

TABLE 3

Summary of Specific Activity Results

Sample I.D.	Description	Th-232	U-238	Ra-226
LOC-1	Background	0.4 ± 0.2	0.9 ± 0.2	0.5 ± 0.1
LOC-2	Background	0.6 ± 0.3	1.4 ± 0.2	0.7 ± 0.2
LOC-3	SW facility corner Activity - no shine	13 ± 1	6.9 ± 0.7	2.8 ± 0.4
LOC-4	Hudson's branch Activity - no shine	31 ± 2	11 ± 1	23 ± 1
LOC-5	FeV pile Shine - high activity	6.2 ± 0.6	2.4 ± 0.3	1.6 ± 0.3
LOC-6	FeV pile Shine - low activity	1.0 ± 0.4	1.1 ± 0.2	0.7 ± 0.3
LOC-7	FeCb pile High shine	0.7 ± 0.5	1.8 ± 0.4	0.7 ± 0.2
LOC-8	FeCb pile High shine	1.8 ± 0.3	2.4 ± 0.5	0.7 ± 0.3

Footnote: Units of Measurement are pCi/gm.

APPENDIX B

NEWFIELD PLANT RADIOLOGICAL PRE-SURVEY (February 1991)

SHIELDALLOY METALLURGICAL CORPORATION

West Boulevard
Newfield, NJ 08244

Newfield Plant Radiological Pre-Survey

ENSR Consulting and Engineering

February 1991

Document Number 5990-006-210

CONTENTS

NEWFIELD PLANT RADIOLOGICAL PRE-SURVEY

1.0 OBJECTIVES AND DELIVERABLES

The objectives of this survey are as follows:

- Quantitatively define the magnitude and extent of radiological exposure associated with shine from the slag piles in the SMSY, at the fenceline, and beyond.

- Determine those areas that can effectively be surveyed utilizing the portable SPA-3 instrumentation. The SPA-3 will be used in areas not affected by shine as an accurate means of determining the extent of soil contamination versus soil sampling and isotopic analysis to achieve the same result.

- Obtain radiological survey data that will be used to develop a site-specific correlation between the portable SPA-3 instrumentation and the more precise Pressurized Ion Chamber.

- Utilize this radiological survey data to develop dose isopleths of twice the background dose rate and an isopleth of the background dose rate to aid in the graphic determination of those areas that can be surveyed using the portable instrumentation.

- Conduct a preliminary walkover of the intermittent stream, Hudson's Branch, of the area to the west of West Boulevard to assess the potential extent of radioactive material deposition.

The deliverables that ENSR will provide to SMC as part of this work scope include the field data obtained during the course of the survey effort, the values represented in cpm and uR/hr, a map depicting both the field measurements in uR/hr as appropriate at specific grid intersections, and as far as practicable, the two dose isopleths and the written report documenting what was surveyed at the Hudson's Branch location.

2.0 INSTRUMENTATION

ENSR utilized two radiological survey instruments to conduct this pre-survey. The exposure rate meter used to determine the dose in microreontgen per hour (uR/hr), was the Rueter-Stokes RSS-112 Pressurized Ion Chamber (PIC). The Eberline SPA-3 gamma scintillator with an Eberline PRS-1 ratemeter/scaler provided radiological activity measurements in counts per minute (cpm).

The PIC consists of two main components: an electronics enclosure and the High Pressurized Ion Chamber with an interconnecting cable to allow for data readout. The ion chamber utilized for this survey covered the range of 0 to 100 mR/hr. The chamber is an 8 liter spherical ionization chamber, and has an omni directional response. There is a nearly flat energy response to gamma photons from 0.07 to 10 MeV to energy emissions

The spherical ionization chamber is filled to a pressure of 25 atmospheres with high-purity argon. When radiation is incident upon the chamber, ion pairs are produced in the active volume and are swept to the electrodes by a collecting potential. The resulting current is measured by an electrometer and is related directly to the free air exposure rate. The instrument is calibrated for gamma energy response using a 1 mCi Cobalt-60 source. Due to the flat energy response for the emissions of concern, it is not necessary to apply additional correction factors to account for response to lower energy emissions.

The gamma scintillator used was an Eberline SPA-3 model in conjunction with an Eberline ESP-1 ratemeter/scaler. The SPA-3 has a 2-inch by 2-inch sodium iodide (NaI) crystal equipped with a photomultiplier tube. The photon energies incident upon the crystal create light impulses that are photomultiplied by the tube and converted to current that is recorded on the ratemeter/scaler in counts per minute (cpm). The SPA-3 was calibrated against a Cesium-137 source (Reference Attachment 2) and source-checked daily.

3.0 METHODOLOGY

Utilizing the civil survey that established a 10-meter grid system over the property, a series of radiological measurements were obtained throughout the site and adjacent properties. At each of the selected grid intersections, two measurements were obtained; one with the PIC and one with the SPA-3, each at 1-meter in height above the ground surface. The PIC constantly integrates its measurements, at 5-second intervals. The count time was reset at each location to 0, and the measurement recorded at 1 minute. Concurrent with this measurement the SPA-3 was reset to 0 and allowed to count for 1 minute. Each data point value for the PIC measurement was recorded in uR/hr, and the SPA-3 measurements were recorded in cpm.

Measurement locations were concentrated in those areas where slag accumulations of source material were known to have an affect on off-site exposure. Measurement locations were initiated at the fenceline of the SMSY, which also serves as the facility license boundary. Additional measurements were taken at graduated distances away from the licensed area to the north, south, east, and west to determine the point at which direct reading portable instrument survey techniques could be used to provide accurate radiological assessment in lieu of soil sampling.

In the Hudson's Branch area, the portable SPA-3 gamma scintillator was used. The instrument was suspended approximately 5 to 10 centimeters above the ground surface and activated in the scaler mode to directly read the count rate from any activity that may have been present on the surface. The scaler was then read to indicate any areas that were above the twice background rate in cpm.

4.0 RESULTS

4.1 Data Tables

The results of the survey are presented in tabular form as Attachment 1. The individual tables are organized by the date when the data was obtained, and are referenced as such in this report. The table representing the measurements taken on February 5, 1991, along the north fenceline of the SMSY requires additional explanation. Because exact grid points did not fall on the fenceline locations, ENSR began with the fixed point at S72, located at the northeast corner of the property. Using the fenceposts on 10-foot centers, ENSR calculated 20-meter measurement locations proceeding west along the fenceline. At each 20-meter location, the measurements were taken to determine the exposure rate.

4.2 Grid Map

Measurement locations and data values are presented on the site grid map as Attachment 3. Included on this grid map are the isopleths representing the twice background and background activity readings. Three background measurements were taken that resulted in an averaged value of 6.9 uR/hr. The first background measurement was taken in a field approximately 50 feet from Weymouth Road, one mile east-southeast of site. The second measurement was taken in a field along West Boulevard approximately 4 miles west of the site. The third background measurement was taken in a field adjacent to the facility along West Boulevard, south of the site.

4.3 Data Anomalies

It is necessary to explain certain data points that appear to be inconsistent. The measurement at G44 of 75.2 uR/hr is higher than the immediately adjacent points. This is due to the fact that this point is located in an area that is draining the surface water for the SMSY, funnelled at this point, and likely concentrating the activity here. Point K72, 54.8 uR/hr is located outside the fenceline, but inside the fence, approximately 3 to 4 meters away is a small pile of material containing some source material slags. Sediment from the area has collected at the base of this pile as well. The series of measurements adjacent to the thermal pond were taken on grass that is topographically higher than the SMSY. No visual evidence of slag was present here. To the north of the SMSY, data was collected to an approximate distance of 140 meters off site. While the readings were still at twice background, ENSR did not proceed further north due to concern relating to damaging the field that had been recently planted.

4.4 Hudson's Branch Survey

A walkover survey using the SPA-3 gamma scintillator was conducted of the Hudson's Branch stream bed to determine the extent of activity deposited in stream sediments. Representatives of the State of New Jersey, Department of Environmental Protection, Bureau of Environmental Radiation, as well as SMC were present during this survey. The survey was conducted outside of the established gridded area. Activity that was initially detected extended in approximately a 20-meter-radius from the outfall of the culvert underneath West Boulevard. As the survey progressed west down the channel beyond the 20-meter radius from the outfall, the activity detected was inconsistent. Spots of localized activity were noted with varying ranges up to five times background, but no consistent distribution of activity in magnitude or location could be determined. As the survey continued west, several small spots of elevated activity above twice background were noted, largely confined to within 5 meters to either side of the existing channel. The survey extended approximately 100 meters from the West Boulevard culvert to the junction of Hudson's Branch and Weymouth Road, where continued access was not possible.

ATTACHMENT 1

DATA TABLES

TABLE 1

GAMMA-RAY EXPOSURE RATE SURVEY

PROJECT NUMBER 5990-006-210

SITE Shieldalloy LOCATION Newfield, NJ

DATE 2-4-91 SURVEYED BY Rieman, Englick

GRID POINT	SPA-3 * cpm	PIC µR/hr	GRID POINT	SPA-3 * cpm	PIC µR/hr
G51	39,700	16.8	G54	42,000	18.7
E51	29,000	11.7	E54	29,700	11.9
C51	21,600	9.5	E56	29,200	11.9
A51	17,200	8.6	G56	41,600	19.0
-b51	13,600	7.7	G58	52,700	27.3
-b45	14,900	7.6	E58	28,200	12.5
B45	20,300	9.5	E58 QC	28,000	12.1
D45	25,800	11.2	C58	21,500	10.0
F45	54,300	27.3	A58	16,200	8.4
F44	34,700	15.8	E60	24,400	11.0
F44 QC	34,600	15.9	G62	36,300	17.9
G44	131,000	75.2	E62	22,300	10.5
G46	53,300	23.6	E66	17,400	8.6
G48	39,200	16.2	G66	25,700	12.6
G52	41,400	17.9	G66 QC	25,600	12.8

PIC
CALIBRATION DATE 1-25-91

SERIAL NO. G-8250 ______ mR/hr/cpm

SCINTILLATION METER (SPA-3) CALIBRATION DATE 8-14-90

SCALER MODEL ESP-1 DETECTOR MODEL SPA-3

SERIAL NO. 2325 SERIAL NO. 407332

BACKGROUND OFF-SITE

SPA-3 ______ cpm PIC ______ µR/hr

* 1 meter from ground surface

TABLE 2

GAMMA-RAY EXPOSURE RATE SURVEY

PROJECT NUMBER 5990-006-210

SITE Shieldalloy LOCATION Newfield, NJ

DATE 2-4-91 SURVEYED BY Rieman/Englick

GRID POINT	SPA-3 * cpm	PIC μR/hr	GRID POINT	SPA-3 * cpm	PIC μR/hr
G68	29,400	16.8	M34	28,400	14.8
G73	17,900	10.9	O34	30,600	14.9
E73	12,500	7.8	Q34	32,300	15.6
E71	15,880	8.5	S34	37,500	20.3
K72	83,000	54.8	V33	33,800	20.4
K72 QC	81,900	62.8	X35	45,900	24.1
K74	15,700	8.5	X35 QC	44,800	24.5
Q72	21,700	10.5	X37	58,100	32.4
O72	24,500	13.8	Z37	51,900	28.9
Q74	15,200	8.4	BB37	27,700	14.6
S72	18,200	9.8	AA38	27,500	15.9
			Y39	74,100	37.6
I34	26,900	14.7	W39	74,100	37.9
K34	28,300	14.9	U39	106,000	64.4
M35	47, 400	24.9	S38	52,900	24.9

PIC
CALIBRATION DATE 1-25-91

SERIAL NO. G-8250 ______ mR/hr/cpm

SCINTILLATION METER (SPA-3) CALIBRATION DATE 8-14-90

SCALER MODEL ESP-1 DETECTOR MODEL SPA-3

SERIAL NO. 2325 SERIAL NO. 407332

BACKGROUND OFF-SITE

SPA-3 ______ cpm PIC ______ μR/hr

* 1 meter from ground surface

TABLE 3

GAMMA-RAY EXPOSURE RATE SURVEY

PROJECT NUMBER 5990-006-210

SITE Shieldalloy LOCATION Newfield, NJ

DATE 2-4-91 SURVEYED BY Rieman/Englick

GRID POINT	SPA-3 * cpm	PIC µR/hr	GRID POINT	SPA-3 * cpm	PIC µR/hr
S37	44,500	21.5			
Q37	48,600	22.8			
N37	50,600	23.5			
K37	44,400	21.9			
H35	38,700	21.1			
G34	29,300	13.3			
G36	28,300	13.7			
G36 QC	28,300	14.0			
G39	37,700	16.5			
G42	39,700	17.5			
F43	34,400	14.1			
D43	24,300	10.9			
A43	14,400	8.3			
A40	15,100	8.4			
A37	13,200	8.1			

PIC
CALIBRATION DATE 1-25-91

SERIAL NO. G-8250 ____________ mR/hr/cpm

SCINTILLATION METER (SPA-3) **CALIBRATION DATE** 8-14-90

SCALER MODEL ESP-1 **DETECTOR MODEL** SPA-3

SERIAL NO. 2325 **SERIAL NO.** 407332

BACKGROUND OFF-SITE

SPA-3 ____________ cpm **PIC** ____________ µR/hr

* 1 meter from ground surface

TABLE 4

GAMMA-RAY EXPOSURE RATE SURVEY

PROJECT NUMBER 5990-006-210

SITE Shieldalloy LOCATION Newfield, NJ

DATE 2-5-91 SURVEYED BY Rieman/Englick

GRID POINT	SPA-3 * cpm	PIC µR/hr	GRID POINT	SPA-3 * cpm	PIC µR/hr
CC47	72,600	34.4			
CC46	70,800	32.9			
CC44	56,400	23.5			
CC42	47,500	20.5			
CC40	44,100	26.4			
DD41	46,800	24.1			
EE40	31,100	16.7			
FF39	24,500	14.6			
EE36	25,200	13.4			
AA46	10,500	48.1			
AA50	112,000	51.7			
CC50	72,100	31.3			
EE50	53,700	22.1			
GG50.	39,600	17.2			
II50	2,850	13.8			

PIC
CALIBRATION DATE 1-25-91

SERIAL NO. G-8250 ________ mR/hr/cpm

SCINTILLATION METER (SPA-3) CALIBRATION DATE 8-14-90

SCALER MODEL ESP-1 DETECTOR MODEL SPA-3

SERIAL NO. 2325 SERIAL NO. 407332

BACKGROUND OFF-SITE

SPA-3 ________ cpm PIC ________ µR/hr

* 1 meter from ground surface

TABLE 5

GAMMA-RAY EXPOSURE RATE SURVEY

PROJECT NUMBER 5990-006-210

SITE Shieldalloy LOCATION Newfield, NJ

DATE 2-5-91 SURVEYED BY Rieman/Englick

GRID POINT	SPA-3 * cpm	PIC µR/hr	GRID POINT	SPA-3 * cpm	PIC µR/hr
S72	17,400	9.9	* 240W QC	208,000	113.9
* 20 W	23,900	13.1	* 260W	223,000	124.0
T68	29,900	15.7			
* 60 W	38,100	18.9			
* 60 W QC	37,600	18.6			
* 80W	43,400	19.8			
*80W, 20N	32,900	13.4			
* 100W	58,800	27.1			
* 120W	78,400	34.8			
* 140W	126,000	59.7			
* 160W	194,000	102.8			
* 180W	228,000	131.1			
* 200W	205,000	106.8			
* 220W	189,000	95.1			
* 240W	208,000	113.7			

PIC
CALIBRATION DATE 1-25-91

SERIAL NO. G-8250 ________ mR/hr/cpm

SCINTILLATION METER (SPA-3) CALIBRATION DATE 8-14-90

SCALER MODEL ESP-1 DETECTOR MODEL SPA-3

SERIAL NO. 2325 SERIAL NO. 407332

BACKGROUND OFF-SITE

SPA-3 ________ cpm PIC ________ µR/hr

* 1 meter from ground surface

* Not map grid coordinates, distances along fenceline west from coordinate S72

TABLE 6
GAMMA-RAY EXPOSURE RATE SURVEY

PROJECT NUMBER 5990-006-210

SITE Shieldalloy LOCATION Newfield, NJ

DATE 2-6-91 SURVEYED BY Rieman/Englick

GRID POINT	SPA-3 * cpm	PIC µR/hr	GRID POINT	SPA-3 * cpm	PIC µR/hr
Background	6,420	7.5	H,4	5,630	6.2
Background	6,240	6.8	F,4	5,980	6.4
Background	5,820	6.4	F,4 QC	6,170	6.2
			C,4	6,370	6.3
A,Ø	8,110	8.5	A,4	18,900	21.1
C,Ø	5,640	5.9	A,6	25,300	24.6
E,Ø	5,930	6.6	A,8	11,700	9.3
E,Ø QC	5,780	6.2	A,11	12,000	9.2
G,Ø	5,790	6.3	C,11	18,700	13.8
H,10	6,210	6.6	C,8	6,870	6.7
I,Ø	5,850	6.5	C,6	6,760	6.4
K,Ø	5,710	6.0	B,6	7,430	6.8
M,Ø	5,240	6.2	B,4	7,110	6.8
O,Ø	5,960	6.5	I,33	31,100	17.2
K,4	5,800	6.4	H,32	32,400	19.7

PIC
CALIBRATION DATE 1-25-91

SERIAL NO. G-8250 ____________ **mR/hr/cpm**

SCINTILLATION METER (SPA-3) **CALIBRATION DATE** 8-14-90

SCALER MODEL ESP-1 **DETECTOR MODEL** SPA-3

SERIAL NO. 2325 **SERIAL NO.** 407332

BACKGROUND OFF-SITE

SPA-3 ____________ cpm **PIC** ____________ **µR/hr**

* 1 meter from ground surface

TABLE 7

GAMMA-RAY EXPOSURE RATE SURVEY

PROJECT NUMBER 5990-006-210

SITE Shieldalloy LOCATION Newfield, NJ

DATE 2-6-91 SURVEYED BY Rieman/Englick

GRID POINT	SPA-3 * cpm	PIC µR/hr	GRID POINT	SPA-3 * cpm	PIC µR/hr
F32	52,500	31.5	E22	14,200	10.7
C32	28,100	17.2	G22	9,830	7.3
A32	15,400	9.6	F20	9,410	7.4
A30	13,400	8.6	D20	19,700	15.4
A28	12,300	7.9	A20	9,150	7.3
C28	22,100	13.9	A18	8,390	7.5
E28	19,800	12.2	C18	10,700	8.6
G28	20,700	13.5	E18	16,500	15.0
G26	14,600	9.5	G18	9,720	8.0
G24	11,800	8.1			
E24	26,700	19.0			
C24	41,700	25.3			
A24	12,300	8.2			
A22	10,200	7.3			
C22	19,200	13.0			

PIC
CALIBRATION DATE 1-25-91

SERIAL NO. G-8250

_______ mR/hr/cpm

SCINTILLATION METER (SPA-3)

CALIBRATION DATE 8-14-90

SCALER MODEL ESP-1

DETECTOR MODEL SPA-3

SERIAL NO. 2325

SERIAL NO. 407332

BACKGROUND OFF-SITE

SPA-3 _______ cpm

PIC _______ µR/hr

* 1 meter from ground surface

TABLE 8

GAMMA-RAY EXPOSURE RATE SURVEY

PROJECT NUMBER 5990-006-210

SITE Shieldalloy LOCATION Newfield, NJ

DATE 2-7-91 SURVEYED BY Rieman/Englick

GRID POINT	SPA-3 * cpm	PIC µR/hr	GRID POINT	SPA-3 * cpm	PIC µR/hr
EE44	55,000	27.4	-80m S	23,700	17.0
GG44	31,600	13.5	-100m S	30,200	24.1
EE42	31,700	15.3	C33	30,800	18.8
V68	21,200	10.2	E33	63,600	43.6
X68	21,100	10.6	G33	69,500	47.0
X68 QC	21,400	10.7	H35	38,200	20.8
X66	36,100	18.2	H38	113,500	69.2
Z66	21,000	10.7	K76	9,080	7.1
Z64	23,700	11.1	Q76	9,610	7.4
X64	30,400	13.0	C71	10,000	7.5
-a33	36,000	22.4	A71	8,990	6.9
-b33	18,200	12.6	A66	10,400	7.7
-20m South	17,400	11.4	EE48	47,700	19.6
-40m South	18,100	13.4	EE52	55,700	22.0
-60m South	21,800	15.7	EE54	54,800	18.9

PIC
CALIBRATION DATE 1-25-91

SERIAL NO. G-8250 ________ mR/hr/cpm

SCINTILLATION METER (SPA-3) CALIBRATION DATE 8-14-90

SCALER MODEL ESP-1 DETECTOR MODEL SPA-3

SERIAL NO. 2325 SERIAL NO. 407332

BACKGROUND OFF-SITE

SPA-3 ________ cpm PIC ________ µR/hr

* 1 meter from ground surface

ATTACHMENT 2

CERTIFICATE OF CALIBRATION

Eberline — A DIVISION OF Thermo Electron CORPORATION

CERTIFICATION OF CALIBRATION

Instrument ESP1 /SPA-3

Serial No. 2325/20

Type of Source CS-137 S/N 152

Calibration Constant 1.00+00 Dead Time 1.53-05 Over Range 4.56+06 Cnt/min

Range	Calibration Point	* Reading
Cnt/min	0.5 mR/h	7.53+05 Cnt/min
Cnt/min	1.0 mR/h	1.35+06 Cnt/min

*The SPA-3 probe is energy dependent. If direct readout in mR/h is desired, the ESP-1/SPA-3 should be calibrated using gamma radiation with energy comparable to that being measured.

Calibration sources used have calibration traceable to the National Bureau of Standards.

Date JUN 16 1989 Signature [signature]

P.O.# 71990

407332 DETECTOR DATA

Model Spa 3 Serial No. 20

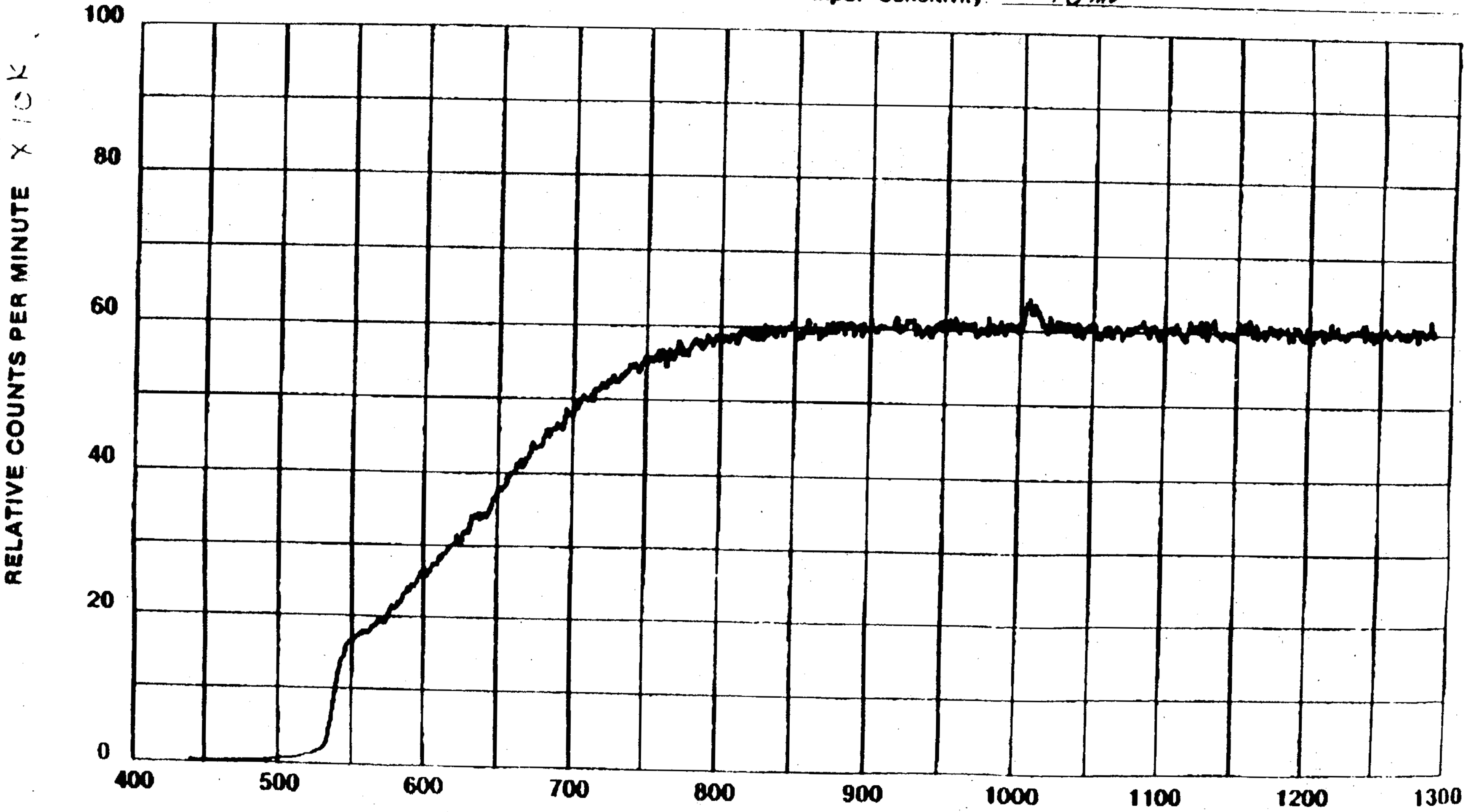
Date JUN 16 1999 By [signature]

Voltage Plateau taken with the following conditions:

Source: Isotope Cs137 Size .5 MR/Hr

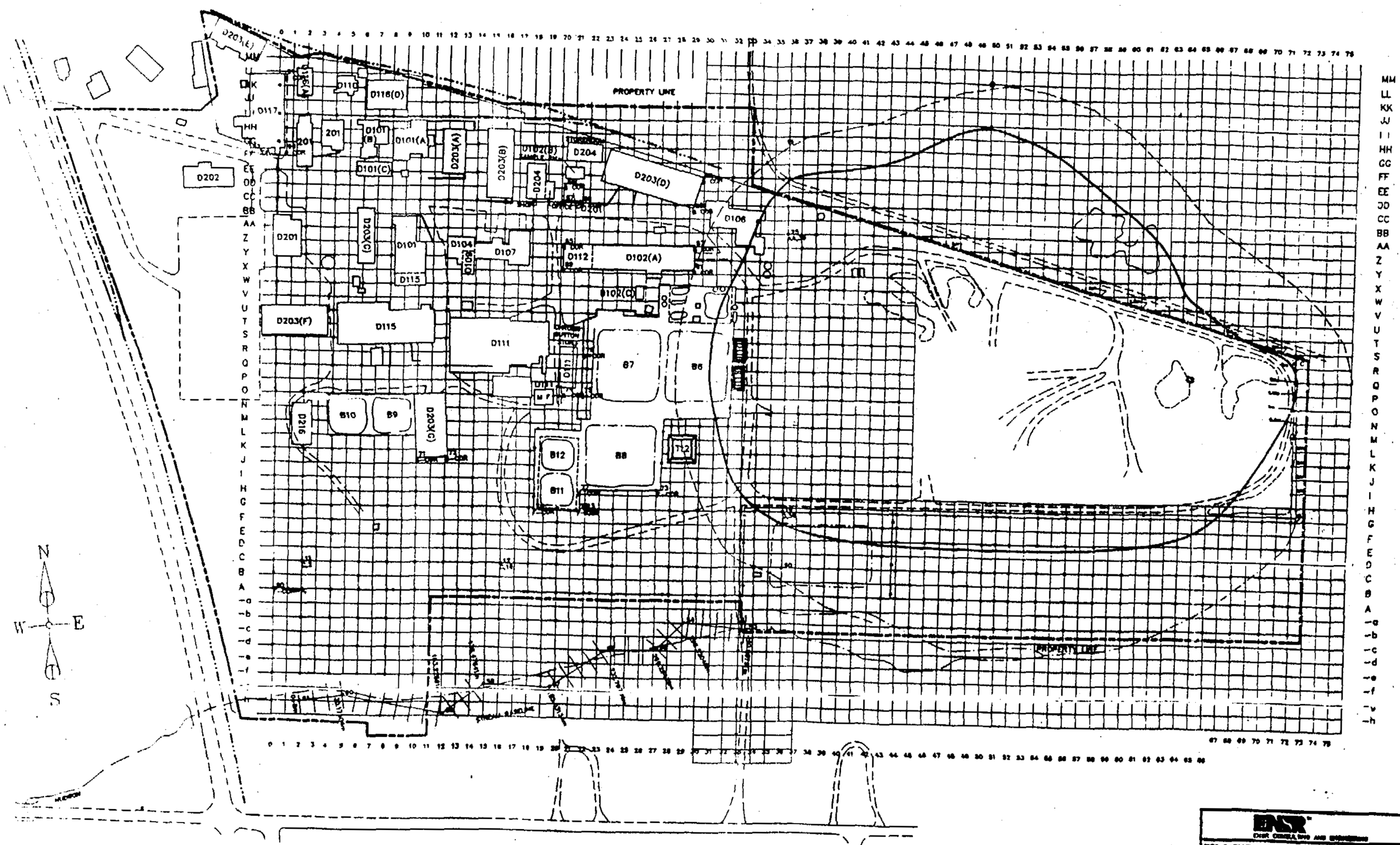
Cable: 36"

Input Sensitivity: 10 mv



ATTACHMENT 3

GRID MAP



GRID SPACING ON 10 METER CENTERS
SEMI PERMANENT POINTS SET ON
20 METER CENTERS
(HUB, IRON PIN, RR SPIKE OR DRILL HOLE)

ENSR

SITE RADIATION MEASUREMENTS AND DOSE ISOPLETHS
SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD TOWNSHIP, NEW JERSEY

674AC

APPENDIX C

NJ DEP COMMENTS TO RADIOLOGICAL WORK PLAN

Let's protect our earth

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF HAZARDOUS WASTE MANAGEMENT
CN 028
Trenton, N.J. 08625-0028
(609) 633-1408
Fax # (609) 633-1454

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
NO. P 905 517 962

Mr. David R. Smith
Director of Environmental Services
Shieldalloy Metallurgical Corporation
P.O. Box 768
Newfield, NJ 08344

24 SEP 1990

Dear Mr. Smith:

Re: Work Plan for the Radiological Characterization of the Shieldalloy Metallurgical Corporation Newfield Facility June 1990

The New Jersey Department of Environmental Protection (Department), the U.S. Environmental Protection Agency (EPA) and the U.S. Nuclear Regulatory Commission (NRC) have completed a review of the Work Plan for the Radiological Characterization of the Shieldalloy Metallurgical Corporation Newfield Facility (Radiological Characterization) and have significant comments. Since the Department has assumed the lead role in coordinating the Radiological Characterization with Shieldalloy Metallurgical Corporation (SMC), comments from all three agencies have been incorporated into this letter. The comments are described below as General Comments and Page-Specific Comments.

General Comments

1. The level of detail in the work plan is insufficient to adequately describe the characterization methodologies to be used or the criteria for identification of areas with elevated levels of activity. This issue is discussed further in the Page-Specific Comments.

2. The figures provided are unacceptable. A figure comparable to Figure 4 of the Remedial Investigation Work Plan is more appropriate. Figure 4 shows the locations of the various slag piles and is of sufficient scale to show proposed sampling points. Figure 4 does not, however, show the location of Hudson Branch which shall be included on the revised figures as discussed in the Page-Specific Comments, below.

3. The Work Plan does not include details about the air monitoring program that will be conducted in compliance with the National Emissions Standards for Hazardous Air Pollutants (NESHAPS). This issue is also included in the page-specific comments, below.

4. The Work Plan does not include a schedule for completing the proposed activities. A schedule must accompany the Work Plan.

5. The work plan does not address the offsite radiological characterization of the ferrovanadium slag that was crushed onsite and transported offsite for use as concrete aggregate and road fill. As discussed in our telephone conference on June 12, 1990, SMC proposed to conduct a file review to determine where the slag was transported. This shall be included as part of the work plan. Offsite areas found to contain ferrovanadium slag shall be characterized using approved methodologies in a second phase of investigation.

Page-Specific Comments

6. Page 1-1, fourth paragraph:

The fourth paragraph states: "This characterization will be conducted under the authority of the existing U.S. NRC facility license SMB-743." SMC was informed on numerous occasions that both the Department and EPA have jurisdiction over radiological issues at the site, in addition to the NRC jurisdiction. SMC was also informed that the radiological characterization is part of the site wide remedial investigation (RI) to be conducted pursuant to the Administrative Consent Order dated October 5, 1988 (1988 ACO). This paragraph shall be modified to reflect this. The Department is allowing the radiological characterization to proceed on a separate schedule from the RI, however, the results shall be incorporated into and considered part of the RI.

7. Page 1-3, last paragraph:

As described above, the objective of the radiological characterization work plan is not to "identify" a program of work to radiologically characterize the facility and any adjacent land which may be contaminated with radioactive materials, but to describe in sufficient detail the procedures and methodologies by which characterization will be achieved and the criteria for identification of areas with elevated levels of activities. The objective is also to radiologically characterize offsite properties, in addition to adjacent properties.

8. Page 2-1, second paragraph:

The grid system shall cover the entire property owned by SMC, not only the area 30 meters beyond the existing facility fenceline as proposed. The proposed survey area consists of two grid systems which include the area extending 30 meters beyond the fenceline and the area extending 20 meters on each side of the stream (Hudson Branch). It is assumed that these two grid systems overlap, providing the required coverage, however, the scale and level of detail in Figures

1-1 and 2-2 is insufficient to make the appropriate comparisons. Therefore, a figure of sufficient scale shall be provided which accurately shows the location of the stream in relation to the fenceline and property boundaries, and the complete survey area.

Also, it is recommended that the grid system, or at a minimum several grid points, be surveyed by a licensed surveyor and semi-permanently marked so that it can be readily re-established at future dates.

9. Page 2-3, second and third paragraphs:

The locations of the six soil and two surface water/sediment background samples shall be provided.

10. Pages 2-4 and 2-5:

The correlation between counts per minute (cpm) and microroentgens per hour (uR/hr) may not be linear over the entire range. It is not unusual that the correlation curve flatten out at the high end for a sodium-iodide thallium [NaI(Tl)] detector. A non-linear correlation fit in this case would be acceptable.

In addition, separate correlations are needed for shielded and unshielded probes.

11. Page 2-6, top paragraph:

The term "anomalous measurement" is not defined. The work plan shall specify anomalous measurements, i.e., measurements that are above background, above screening levels or the highest in the grid block.

12. Page 2-6, first paragraph:

The use of the shielded probe is acceptable for the "walkover" survey near the stockpiles that contain elevated levels of activity, however, shielded probes will significantly reduce the count rate and decrease sensitivity. Therefore, longer scanning and measurement times will be required. This further supports the need for separate correlations for the shielded and unshielded probes.

13. Page 2-6, second paragraph:

It is proposed that 18 soil samples (six per pile) from areas outside the source material storage yard (SMSY) will be obtained over a depth of one foot and composited. This approach will not provide a depth profile of potential contamination. These samples shall be changed to borings and will proceed in the same manner as the other proposed borings. Discrete, not composited, samples shall be collected, analyzed and reported. Also, the locations of these borings shall be provided on a figure of sufficient scale and detail.

14. Page 2-7, first paragraph:

It is unclear if the twenty shallow borings identified in this area are restricted to areas covered by materials such as asphalt or concrete. This shall be clarified. Also, the locations of these borings shall be presented on a figure of appropriate scale and detail.

15. Page 2-7, fifth paragraph:

It is often difficult to control the depth and collect representative soil samples for desired intervals using a two man power auger as proposed. It is recommended that an alternate method be proposed in the event of unexpected difficulties.

16. Page 2-7, sixth paragraph:

Be aware that the correlation between downhole gamma logging measurements and the soil concentrations is complex because of the geometry of the borehole. Unless the radionuclide concentrations in the subsurface strata are homogenous, correlation between the soil and gamma measurements are poor. The difficulty with this correlation requires an increased dependance on soil sampling to verify the presence of contamination.

17. Page 2-8, second paragraph:

A total of 40 borings has been proposed in the unshielded (i.e., unpaved) areas. Additional borings may be warranted if these are not sufficient to characterize the extent of contamination for the feasibility study and potential remedial action.

18. Page 2-8, fourth paragraph:

It is unclear if "gross alpha activity" refers to total gross activity (mean plus 2 sigma error). This shall be clarified.

19. Page 2-9, first paragraph:

The compositing of soil samples from each borehole will not provide sufficient information to obtain a profile of the contamination. If samples are to be taken in six inch intervals, each of these shall be analyzed and reported separately to obtain the profile.

20. Page 2-9, third paragraph:

The ten samples to be collected from the ferrovanadium slag pile shall not be composited but analyzed and reported separately to obtain a range of concentrations. Results of samples collected by the Department have determined that the results from this slag vary considerably.

21. Page 2-9, fourth paragraph:

It is stated: "Air sampling will not be conducted under the characterization, but has been implemented by SMC in conjunction with the requirements established under the facility source material license." As discussed during the telephone conference on June 8, 1990, SMC advised the Department that air sampling would not commence as part of the radiological characterization, but instead in compliance with NESHAPS, since one-time monitoring would not provide "useful" data, and NESHAPS required long term monitoring. SMC was advised that this approach was acceptable, but that a detailed description of this scenario must be provided in the work plan since the work plan is a public document and considerable concern exists over airborne releases of radioactive material. SMC shall, therefore, expand the discussion of the air monitoring program and shall include, at a minimum, a discussion of the air sampling that "has been implemented", methodologies for sampling and analysis, schedule of sampling events, and other pertinent information. The results of the sampling and analysis completed at the time of the radiological characterization report is submitted shall be included in that document with an explanation that the project is ongoing.

22. Pages 3-1 through 3-3:

The discussion of the criteria for identification of areas with elevated levels of radioactivity is confusing. It should be noted that the criteria selected to identify the presence of radioactive contamination should reflect the Applicable or Relevant and Appropriate Requirements (ARARs) for the residual materials in areas designated for unrestricted use. Potential ARARs for the site include, but are not limited to, 1) Disposal or Onsite Storage of Thorium or Uranium Wastes From Past Operations, Option 1 of NRC's Branch Technical Position (46 FR 52061) and 2) Health and Environmental Standards for Uranium and Thorium Mill Tailings (40 CFR 192). Such references and appropriate applications shall be made in the work plan.

23. Page 4-1, fifth paragraph:

This paragraph references EPA sample identification and control, and chain of custody procedures. SMC shall also comply with any Department of Transportation (DOT) requirements which apply to radioactive sample transport. Also, the field sampling and decontamination protocols shall be identified.

24. Page 4-2, fourth paragraph:

The analytical laboratory does not necessarily need to be licensed by the NRC unless the quantity of radionuclides is above the limits specified in 10 CFR Part 30. More importantly, the lab must have the capability to perform the required analyses as per the NRC's Regulatory Guide 4.15: Quality Assurance for Radiological Monitoring Programs - Effluent Streams and the Environment, and approved EPA procedures. For EPA validated analytical methods for radionuclides in aqueous samples, please refer to 51 FR 34835, Table 11. The work plan must include the names and qualifications of the laboratories that will be used during the Radiological Characterization.

25. Page 4-2, last paragraph:

HASL-300 is Department of Energy (DOE) methodology, not EPA, as stated.

26. Page 4-3, first paragraph:

The sensitivity of analytical methods must be low enough to demonstrate compliance with the regulatory limit for that particular media and use. For example, a of minimum detectable activity (MDA) of ≤5pCi/g is not appropriate for demonstrating compliance with the regulatory limit for remedial actions of 5pCi/g radium-226 in soil averaged over the first 15 cm of soil below the surface, 40 CFR 192.12.

A revised radiological characterization work plan shall be submitted to the same contacts at the Department, EPA and NRC within thirty (30) calendar days of receipt of this letter. The revised work plan shall address the comments described above.

Be reminded that failure to submit a revised work plan within the specified time frame shall be subject to stipulated penalties pursuant to paragraph 57 of the 1988 ACO.

If you have any questions, please contact me at (609) 633-1455.

Sincerely,

Donna L Gaffigan

Donna L. Gaffigan, Case Manager
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sw

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