SHIELDALLOY METALLURGICAL CORPORATION

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June 29, 1990

Mr. Gary Comfort
United States
Nuclear Regulatory Commission
Division of Industrial and Medical Safety
Washington, DC 20555

SUBJECT: NEWFIELD FACILITY RADIOLOGICAL CHARACTERIZATION

Dear Mr. Comfort

Shieldalloy intends to conduct a radiological characterization at the the Newfield facility. This effort will be conducted under the auspices of Shieldalloy's current U.S. NRC license SMB-743. The report entitled "Work Plan for the Radiological Characterization of the Shieldalloy Metallurgical Corporation Newfield Facility" is enclosed.

The enclosed document outlines the technical aspects of the planned work. Shieldalloy intends to begin the characterization work early in August 1990. The site work and subsequent reporting is planned for completion during the fourth quarter 1990, contingent upon the actual time required to conduct the site characterization.

It should be noted that Shieldalloy has incorporated into its Remedial Investigation Work Plan soil sampling and chemical analysis of the NCR Controlled Material Storage Yard. This work will be conducted in accordance with appropriate NCR safety procedures.

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Please feel free to call me to discuss any questions or comments that you might have.

Sincerely,

David R. Smith

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SHIELDALLOY METALLURGICAL CORPORATION

NEWFIELD FACILITY
NEWFIELD, NJ

ENSR

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

ENSR Consulting and Engineering

June 1990

Document Number 5990-006-100

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1.0 INTRODUCTION

1.1 Site Historical Review

A single radiological survey of the Shieldalloy Metallurgical Corporation (SMC), Newfield, New Jersey site has been conducted to date. This survey, "Radiological Survey of the Shieldalloy Corporation, Newfield, New Jersey", was conducted in October and December of 1988, 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 (EPA).

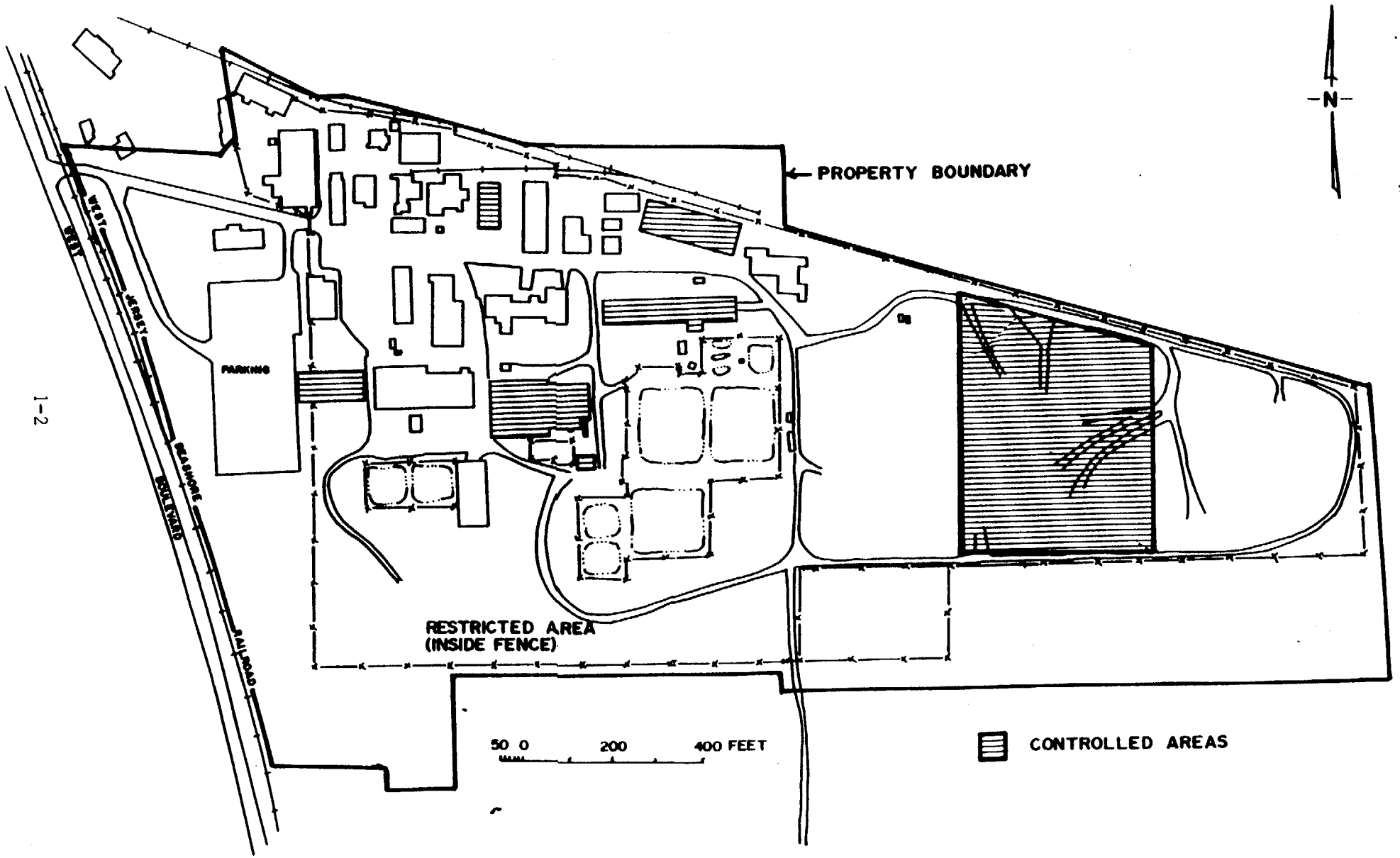
This survey provided information for a preliminary assessment of the radiological impact of the site. Data were provided with respect to area exposure rates, potential areas of contamination, and isotopic composition of soils, sediment, surface water and groundwater. A site plan for the facility is provided as Figure 1-1. This survey partially characterized the radiological conditions that existed at the facility but did not provide sufficient data to design or cost the extent of remediation necessary to reduce the radiological risk to an acceptable level.

On May 2, 1990 representatives of the of New Jersey Department of Environmental Protection (NJDEP), the U.S. Environmental Protection Agency, Region II (EPA), and the U.S. NRC completed an inspection of the facility and adjacent areas. This inspection confirmed some of the original findings of the ORAU report regarding the presence of activity outside of the license established restricted areas for this facility. Since the completion of this site visit by representatives of these agencies, SMC has received comments from NJDEP requiring that SMC conduct a radiological characterization.

As a result of the ORAU effort and the subsequent inquiries received from the state and federal agencies, SMC has agreed to complete a radiological characterization of the facility and, to the extent possible, the adjacent property. This characterization will be conducted under the authority of the existing U.S. NRC facility license SMB-743. The facility will continue to operate using source material as part of their manufacturing operation. This survey will not include building interiors because these operations are monitored in accordance with the existing source material licence.

FIGURE 1-1

SITE PLAN FOR THE SHIELDALLOY METALLURGICAL CORPORATION NEWFIELD, NJ FACILITY



1.2 Objective

The objective of this plan is to identify a program of work to radiologically characterize the facility and any adjacent land which may have been contaminated with radioactive materials. Data will be developed to determine the feasibility and estimated cost of decontaminating uncontrolled areas to the extent necessary to conform to state and federal regulations and guidelines. This program will determine the areal extent and estimated depth of contamination that is present at those areas identified as being above levels for unrestricted use as defined by Federal Regulations.

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.

2.0 CHARACTERIZATION ACTIVITIES

2.1 Grid System

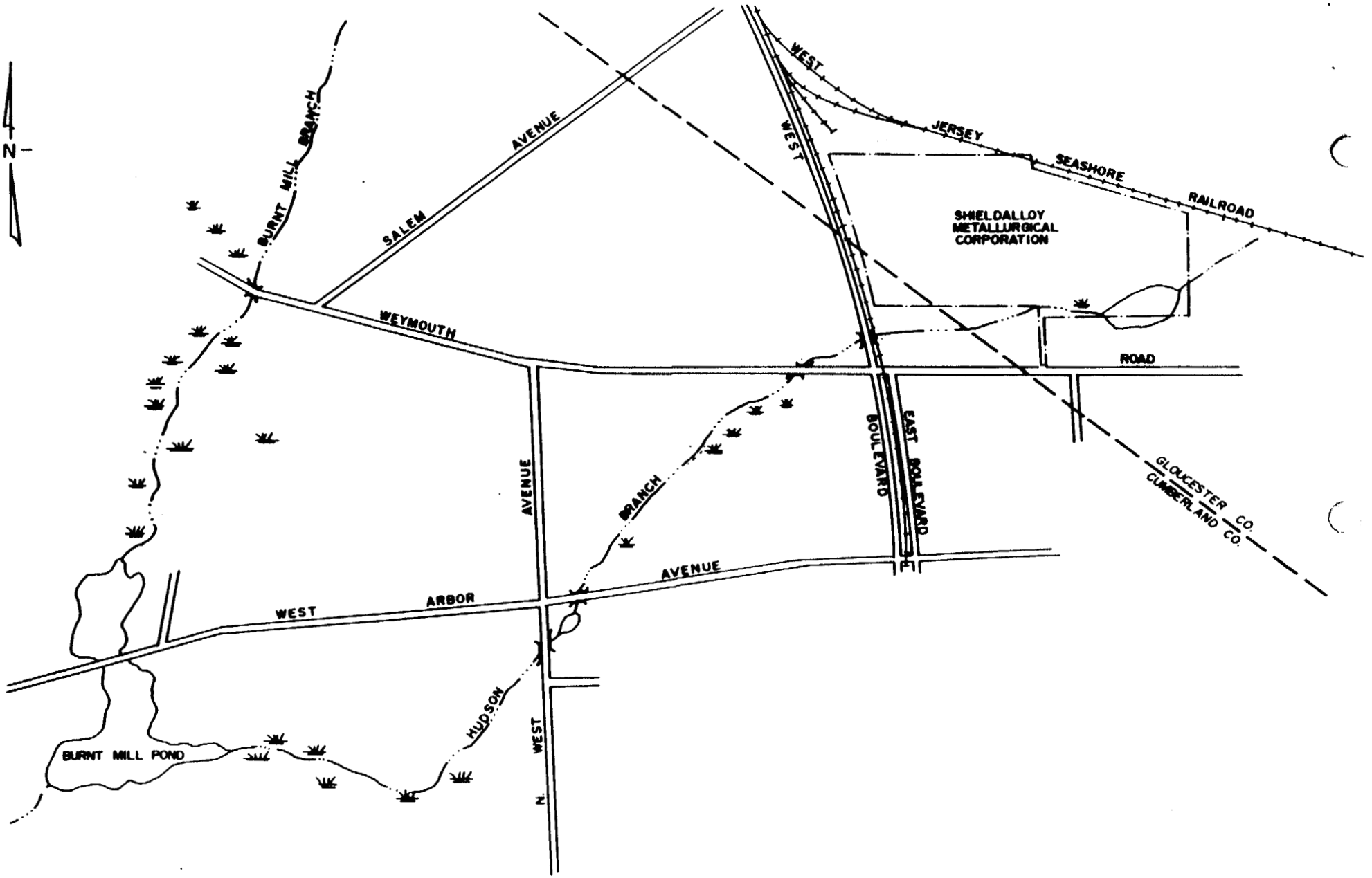
A 10 meter grid will be established over the entire site as it is currently defined by the facility fenceline. A map showing the Newfield facility and adjacent property is presented in Figure 2-1. The grid will be established where legal access can be obtained to a distance of 30 meters outside the existing facility fenceline. 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.

This grid will have its origin located at the southwest corner of the facility. The x-axis will continue in an easterly direction roughly parallel to the facility fence line. The y-axis will extend in a north-south direction along the western boundary of the property. This y-axis will extend south so as to intersect Hudsons Branch and provide a point of reference for measurements in this area. Due to the topography and field conditions, a second x-axis will be extended along the nominal centerline of the channel of this small tributary. The grid will then be extended 20 meters to each side of this established center-line. The axis will be labelled with an alpha-numeric system as a means of reference. The linear distance of this axis will be determined in the field, but at a minimum it will extend from the holding pond to the east and westward to the culvert passing underneath West Boulevard.

The grid will be established on 10 meter centers. The grid will be established using this metric system 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. If property boundaries are included they will be located and marked. 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 area to be considered for future decontamination.

FIGURE 2-2

SHIELDALLOY METALLURGICAL CORPORATION NEWFIELD FACILITY AND ADJACENT PROPERTY



2.2 Background Measurements

Background measurements will be obtained to determine:

1. natural background concentrations of uranium, thorium, and radium in uncontaminated soils and sediments 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 one foot of soil.

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 specific 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 surface water and two sediment samples will be obtained and analyzed for the isotopes of interest.

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 18 months in accordance with the 1988 Administrative Consent Order (ACO) Radiological Constituents. No significant radiological impact has been observed to date. This monitoring program will continue.

The soil sampling will involve obtaining a single sample at each location composited over the top one foot of soil. The sample will be identified by location and sent for isotopic analysis using both alpha and gamma spectrometry, for the isotopes of Uranium-238, Thorium-232, and Radium-226. Refer to Section 4.0 for the referenced analytical procedures. Upon receipt of the sample results from each of these areas a mean 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 Rueter Stokes Pressurized Ion Chamber (PIC). This instrument will have been calibrated within the previous six months against a National Bureau

of Standards (NBS) traceable source of similar energies. In addition it will be required that the portable field instrumentation be cross calibrated against this ion chamber to establish a counts per minute per microroentgen per hour (cpm/uR/hr) value for determining the presence of potential contamination during the exposure rate survey of the facility.

Details of the instrumentation are as follows. The instrumentation utilized to establish the exposure rate correlation will be the PIC in conjunction with Eberline SPA-3 gamma scintillation probes with compatible Eberline PRS-1 and ESP-1 ratemeter/scalers. 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 SPA-3 gamma scintillators are low energy gamma detection instruments utilizing a two-inch by two-inch sodium-iodide, tantalum [NaI(TL)] detector in conjunction with a photomultiplier tube providing impulses directly to the ratemeter scaler. 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 uncertainty 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.

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 SPA-3 measurements in cpm for each of the gamma scintillators to be used in the field will be obtained. The SPA-3's will 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.

In addition, 12 other locations will be chosen on site to complete the correlation of the instruments. The locations will be chosen at points of varying surface activity to provide a full response range for the instruments. The previously described method shall be used.

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 equation for this determination is expected to be:

$$y = mx + b$$

where: y = value in uR/hr
x = value in cpm obtained using the SPA-3
m = slope of the line (a constant)
b = y intercept (a constant)

By this means a relationship can be developed for each of the SPA-3 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.

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 potential exposure rates that may be present. The exposure rates at the facility fenceline will be recorded and included in a final report.

2. The exposure rate survey will facilitate determination of the extent of potential contamination and will define those areas for possible subsequent decontamination.

The first technique that will be employed will be that of a "walkover" gamma survey to produce a complete survey of each grid block. This survey will be accomplished by walking in a series of parallel paths over a gridded area while slowly swinging the SPA-3 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 in 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. 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.

Due to the presence of the material stockpiles that contain elevated levels of activity, it will be necessary to utilize a collimated or shielded probe in certain areas. The collimated probe will be utilized in the same manner as the unshielded probe for the "walkover" survey. The use of a shielded instrument will involve placement of the gamma scintillation probe into a mobile carriage that will suspend the instrument immediately above the ground surface while providing shielding to the sides of the probe. Walkover data will be recorded on data sheets specific to this technique. At some locations, the existing topography may make it difficult to employ the technique of using the shielded probe. The use of this equipment will be done where practical and at those locations wherein it cannot be used, the "walkover" technique will be employed and supplemented by soil samples.

Immediately adjacent to the source material and ferrovanadium slag stockpiles it will be necessary to obtain soil samples for isotopic analysis to accurately determine the possible contamination present. An estimated 18 soil samples (six per pile) will be obtained over a depth of one foot and composited from areas outside the Source Material Storage Yard.

At the completion of the walkover survey, measurements will be taken at each of the grid intersection points at 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 SPA-3 probes either shielded or unshielded. Within each of the grids there will be five measurement locations. The first measurement corresponds to the southeast corner (location #1) and moving in a "Z" pattern to the southwest corner (location #2), then diagonally through the center of the block (location #3) to the northeast corner (location #4), and finishing in the northwest corner (location #5). 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 correlation developed in the background and exposure rate method is not valid for measurements in areas covered by materials such as asphalt and concrete that will provide shielding to any potential activity beneath the surface. In such locations, measurements will be taken through the use of borings below the surface.

Twenty shallow borings will be used to determine the possible presence of activity. The depth of these borings will be six inches incrementally, and the depth of the holes will be to six inches past the limit of elevated activity. These hole locations will be selected to cover this surface area in a systematic fashion to assure complete coverage.

Collation of the data for both the walkover and point survey will be presented under separate sections of the follow-up report. Duplicate measurements of the gamma survey readings will be taken for every tenth data point.

It should be noted that the facility building interiors will not be a part of this characterization effort due to the ongoing process and manufacturing operations that continue. These buildings will simply be referenced on the site map.

2.4 Depth of Activity Determination

An additional objective of the characterization effort will be to determine the approximate depth of activity for the surface areas identified as potentially contaminated. This will be accomplished using a collimated SPA-3 probe inserted into a predrilled borehole or small trench to determine the depth of activity present at a given location. The use of the shielded probe is necessary due to the change in geometry of the area being surveyed as well as to eliminate the potential activity contribution from the sidewalls of the borehole. Note that all borings and trenches will be backfilled immediately following completion of the survey.

In areas that will allow, such as those not covered by blacktop or obviously underlain by slag, a two man power auger will be advanced into the soil in six inch increments. Depth of the holes will be to six inches past the limit of elevated activity. ORAU determined that the limits of activity in their study did not exceed one meter in depth. At each of these locations, a one minute count will be obtained using the shielded probe. In those areas not capable of using the auger, the surficial material shall be removed by other means. If this material removal allows for use of the auger it will be employed otherwise a small trench shall be excavated to a nominal depth of one foot and the sidewalls checked for the presence of any activity.

At each of the borehole locations, a tripod with a collimated SPA-3 probe suspended from it will be positioned over the hole. Six inch graduations will be established over the length of the cable prior to measurements being obtained. The probe will be lowered into the hole for the one minute count to the limit of elevated activity. One this depth is reached the probe will be retracted slowly until deflection at or above criteria is detected to accurately estimate the depth of activity.

The number of holes that will be placed to determine the depth of activity will be determined by the surface areas identified as being above criteria. For each area that is equal to or less than 400 square meters, a hole will be placed at the nominal corners of the defined area of contamination. In addition, there will be a single hole placed in the center of the area as determined by the intersection of lines drawn from opposite corners of the elevated area. If the surface area exceeds 400 square meters and is not adjacent to an area of the same size, then a maximum of six holes will be placed along the periphery of the area in an equivalent distance from each corner and two holes will be place equidistant from the center of the area. This description is generic and allowance for some field application of the above method will be required.

A total of 40 borings are provided in unshielded areas. This will bring the total number of borings to determine the depth of activity to 60 (i.e., 20 in the shielded areas and 40 in the balance of the identified elevated activity areas).

2.5 Environmental Media Sampling and Analysis

For each of the areas that are identified as being contaminated during the exposure rate survey, it will be necessary to sample for isotopic activity to plan decontamination. 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 Thorium-232, Radium-226, and Uranium-238.

Initial analysis of water samples will be for dissolved and suspended gross alpha activity only. Isotopic analysis of water samples will be performed if the gross alpha activity exceeds the screening value of 15 pCi/liter. Ten surface water samples will be obtained. The analysis will be conducted by an independent laboratory selected for protocols/procedures acceptable to NRC.

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 sampling locations. A total of four samples will be obtained during the storm event. A one liter sample will be obtained and subsequently filtered. The filtrate and filter will be analyzed for dissolved and suspended gross alpha activity, respectively.

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 composited from each of the area-specific borehole locations. The compositing will occur with the cuttings obtained from each of the boreholes with a single sample being sent for analysis. At this time it is estimated that less than 20 soil samples will be required from the depth determination activity.

Analysis of sediments will follow the same protocols established for soils. A total of ten sediment samples will be obtained during the characterization task.

A total of ten composited samples will be obtained from the ferrovanadium slag stockpile using conventional excavation techniques. From each of these large volume samples an aliquot of approximately 500 grams will be obtained. These samples will be crushed onsite using available SMC equipment. The crushed samples will be identified by the nearest proximity grid location and sent to the lab for isotopic analysis in accordance with the previously identified methods.

Air sampling will not be conducted under the characterization. Air sampling has been implemented by SMC in conjunction with the requirements established under the facility source material license. During any excavation for the grab sampling or the depth determination, a lapel sample will be obtained for the purposes of determining the potential risk from inhalation of radioactive particles.

3.0 CRITERION FOR IDENTIFICATION OF CONTAMINATED AREAS

The criterion for identification of areas with elevated levels of radioactive isotopes is 10 pCi/gm in total concentration, including U-238, Th-232, and Ra-226. This value is derived by the NRC, whereby soils with an isotopic content less than this are acceptable for unrestricted use in 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.

This criterion will be used solely for the purpose of determining the presence of areas that may demonstrate elevated activity. Once these areas are identified, they will be included in the evaluation for possible decontamination. This criterion will not imply any final clearance level, as this only can be accomplished through the use of verification soil sampling, followed by isotopic analysis, at the time that decontamination occurs.

Measurements of background exposure rate were conducted by ORAU during their site investigation. At a total of seven locations in the Newfield New Jersey area measurements were obtained resulting in a mean value of 7 uR/hr. This value is consistent with established NCRP data for this area of the country.

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

Th-232 -	0.4 pCi/gm
Ra-226 -	0.5 pCi/gm
U-238 -	0.6 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. Knowing the average concentrations of Uranium and Thorium and their daughter products at this background level, they may be used to estimate whole body dose as summarized in Table 3-1.

TABLE 3-1

AVERAGE CONCENTRATIONS OF URANIUM AND THORIUM AND THEIR DAUGHTER PRODUCTS[a]

Isotope	Natural Concentration µg/g	Exposure Rate with Daughters Per Concentration µR/hr per µg/g	Exposure Rate at One Meter, µR/hr	Dose Rate Per µR/hr per pCi/g	Isotopic Activity pCi/g
U-238	2	0.62	1.2	1.82	0.66
Th-232	8	0.31	2.5	2.82	0.89
Total:			3.7		1.6

[a] Environmental Radiation Measurements, NCRP 50, National Council on Radiation Protection and Measurements, Washington, D. C., 1988, pgs. 17 & 38.

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For the natural elements in the ground, approximately 4 uR/hr of dose rate due to U-238, Th-232 and their daughter products are associated with 1.6 pCi/gm of U-238 and Th-232. This isotopic activity is equivalent to a combined elemental activity of 3.2 pCi/g (i.e., nearly a factor of two when including the daughters U-234 and Th-228). Therefore a residual of 6.8 pCi/gm (total) of either elemental Uranium and Thorium is allowed for decontamination.

Since U-238, as noted above, has a lower dose rate with daughter products per unit activity than Th-232 it will provide a lower threshold for gamma dose rate. For 3.4 pCi/g U-238 (i.e., 6.8 pCi/g Uranium) an incremental dose above background of 6.2 uR/hr is anticipated. For thorium, this incremental dose above background would be 9.6 uR/hr.

Therefore, for a 10 pCi/gm criterion of Uranium or Thorium for decontamination in accordance with the NRC criterion, this is equivalent to an external whole body gamma dose measured at one meter above the ground of 13-17 uR/hr, exclusive of background. Since Thorium is the dominant element found in the source material slag on the site, an exposure rate criterion of $\leq$ 22 uR/hr will be utilized to identify areas for possible decontamination.

The NJDEP has inquired regarding the contribution of Radium-226 to the possible exposure rate 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.

4.0 QUALITY CONTROL AND QUALITY ASSURANCE

This section of the characterization plan presents a concise overview of the measures that will be taken 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 Site Manager who will be responsible for project execution in the field. This Site Manager will interface with the Project Manager and Shieldalloy representatives to assure that the activities are conducted in a manner consistent with 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 at 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.

An internal Quality Assurance program will be followed 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.

The work 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 identification and control and chain of custody procedures will be in accordance with the guidelines established by the EPA office of Enforcement as of May 1986. 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.

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, water, and composite samples of the ferrovanadium slag stockpile 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 8-oz wide mouth container, sealed and submitted to the laboratory for analysis. Field blanks using laboratory distilled water will be collected at a frequency of 10 percent for water samples, with a minimum of one field blank per sampling event.

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, water, and slag stockpile samples. These duplicates will not be labeled as such but will be submitted to the laboratories as blind samples to eliminate bias.

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.

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.

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.

The analysis of water samples will be done in accordance with those methods established by the U.S. EPA (HASL-300) for the isotopic analysis of water. These samples will have been filtered in the field prior to their placement into the containers. The samples 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 these analyses are expected to be within the range of ≤ 1 to 5 pCi/gm.

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 on ever 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 are outside the window for precision or accuracy. Data will be documented and duplicate records maintained.