B. KOH & ASSOCIATES, INC.

Environmental Restoration
Radioactive Waste Management

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October 21, 1999

Mr. Dan Wesolowski, Manager
Environmental, Health and Safety
Westinghouse Electric Company
Specialty Metals Plant
RD #4, Box 333
Blairsville PA 15717-8904

Subject: Feasibility Analysis of Uranium Impacted Soil at the Westinghouse Electric Company Specialty Metals Site, Blairsville, Pennsylvania

Dear Mr. Wesolowski:

In response to your request dated June 18, 1999, enclosed is the feasibility analysis for the subject facility (Enclosure 1). Following your review, we would be happy to discuss any comments you may have. If appropriate, changes resulting from our discussion can be incorporated into the document.

Also enclosed, is our review and validation of the Westinghouse Blairsville Clean Dirt Pile Statistical Evaluation (Enclosure 2).

We believe the feasibility analysis provides a path forward for the remediation of the Blairsville site. B. Koh & Associates would be pleased to assist you in undertaking this remediation.

If you have any questions regarding the feasibility analysis or our review and validation of the clean soil pile, please don't hesitate to call Barry Koh at (410) 356-6612 or me at (716) 592-3431.

Very truly yours,

Theodore G. Adams
Vice President

Enclosure

cc: B. Koh, w/enclosure
J. Nardi, w/enclosure

DA99-102.Westinghouse

Enclosure 2 attached

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DA99-102.Westinghouse

ENCLOSURE 2

B. Koh & Associates, Inc.

Review of Westinghouse Blairsville
Clean Dirt Pile Statistical Evaluation

As requested, a review of the "Radiological Evaluation of the Clean Dirt Pile at Blairsville" was performed. The review included a comparison of the data presented in the "report" with the statistical evaluations presented in the "Manual for Conducting Radiological Surveys in Support of License Termination", draft NUREG/CR-5849 June, 1992 and the "Multi Agency Radiological Survey and Site Investigation Manual", NUREG-1575, December, 1997.

In addition, B. Koh & Associates, Inc. has performed a similar evaluation using the guidance presented in draft NUREG/CR-5849 at the Metcoa facility located in Pennsylvania. The evaluation was acceptable to the Pennsylvania Department of Environmental Protection (DEP) for permitting the disposal of soil/slag material containing radioactive (thorium) contamination at a "non-radioactive" disposal facility. The only additional criteria imposed by the DEP was that the upper limit for concentrations used in performing the statistical evaluations were less than or equal to 2 times the unrestricted use limit. A review of the "clean dirt pile" analytical results has indicated that all of the data (53 pCi/g total uranium, maximum) is below 2 times the unrestricted use limit (30 pCi/g total uranium).

As a result of the data review and based on previous experience, it was determined that both statistical evaluations (i.e., draft NUREG/CR-5849 and MARSSIM) support the conclusion that the total uranium concentrations in the clean dirt pile are less than the United States Nuclear Regulatory Commission unrestricted use criteria of 30 pCi/g total uranium.

FEASIBILITY ANALYSIS OF URANIUM IMPACTED SOIL

WESTINGHOUSE ELECTRIC COMPANY
SPECIALTY METALS PLANT

BLAIRSVILLE, PENNSYLVANIA

OCTOBER 21, 1999

Prepared for

WESTINGHOUSE ELECTRIC COMPANY

By

— B. KOH & ASSOCIATES, INC. —

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Springville, New York 14141

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FEASIBILITY ANALYSIS OF URANIUM IMPACTED SOIL
WESTINGHOUSE ELECTRIC COMPANY
BLAIRSVILLE, PENNSYLVANIA

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

TABLES

TABLE OF CONTENTS
(Continued)

FIGURES

1.0 INTRODUCTION

1.1 PURPOSE

This Feasibility Analysis responds to the Westinghouse request dated June 18, 1999 to evaluate the feasible options for remediating uranium impacted soils at the Westinghouse Specialty Metals Plant, Blairsville, Pennsylvania.

1.2 SCOPE

The specific scope of this analysis was to:

- Review existing data and identify any additional data needs.
- Evaluate the feasibility of selected remediation options (Section A - Scope of Work) based on cost, technical and regulatory feasibility, risk and public acceptance, and schedule duration.
- Provide ranking and recommendation, as to the preferred remedial option(s).
- Evaluate and validate the Westinghouse conclusion of the "Radiological Evaluation of the Clean Dirt Pile at Blairsville."

This feasibility analysis evaluated the following remedial options:

- **In-Situ Characterization**. This technique involves thorough characterization of the contaminated soil in place. As a result of the investigation, specific areas are identified for removal (> release criteria) while all other areas remain in place (< release criteria). This technique minimizes excavation, offsite disposal and reduces final survey requirements.
- **Ex-Situ Characterization**. This technique involves excavation of areas of potential contamination (based on available data), staging the soil in piles suitable for disposal. The piles are then sampled and analyzed to determine final disposition (i.e., offsite if > criteria, onsite if < criteria). This technique minimizes offsite disposal.
- **Site Specific Dose Analysis**. This technique involves the use of computer codes (pathway analysis) to demonstrate that the dose from leaving the contaminated soil in place meets the NRC release criteria.
- **Physical Separation - Soil Processing.** This technique involves the use of physical and/or chemical processes to separate the contaminated fraction of the soil from the uncontaminated fraction of soil. This evaluation examined three separate soil processing techniques: screening and rinsing, screening and washing, mechanical separation via radiation detection instruments. This technique reduces the volume of contaminated soil requiring disposal and/or further treatment.
- **Onsite Disposal**. This technique consists of the excavation, consolidation and subsequent placement of the contaminated soil in a permanent containment cell which meets USNRC and

state regulatory requirements. The containment cell will be covered with a multi-layer cap of clay and fill.

Section 2.0 presents each remedial option along with its related estimated cost, technical and regulatory feasibility, potential for success and public acceptance, and implementation schedule.

A ranking of each remedial option is provided in Section 3.0.

Section 4.0 presents the references used in the feasibility analysis.

Supporting information is included in the Attachments.

2.0 EVALUATION OF REMEDIAL OPTIONS

2.1 IN-SITU CHARACTERIZATION

2.1.1 GENERAL

This remedial technique involves a systematic sampling of the potentially impacted areas in accordance with the requirements of the final survey plan. Samples are removed and analyzed consistent with the needs of demonstrating compliance with guideline values for release of the areas. Typically, this involves establishing a grid system for the site and removing a representative sample from each grid. The results of the sample analyses are compared to the guideline requirements. In those instances when contamination limits have been established, the remedial action involves excavating the grids for which the sample result exceeded the limit. When statistical based guidelines have been used, grids are designated for removal so that the resulting analysis of the site will demonstrate compliance with the guidelines.

2.1.2 USNRC UNRESTRICTED RELEASE CRITERIA

Concentration Based Limit

Soil concentration limit would be consistent with Option 1 of USNRC SECY-81-576.

Maximum average concentration 30 pCi/gm
Maximum sample concentration 90 pCi/gm

- AND -

Exposure rate limit would be consistent with USNRC SECY-92-106

Maximum exposure rate 10 μR/hr above background.

- OR -

Derived Limit Based on Dose Assessment

Soil concentration limit based on Subpart E of 10 CFR 20

Maximum average concentration 35 pCi/gm
Maximum sample concentration 175 pCi/gm

2.1.3 IMPLEMENTATION

As has been done in the past at various sites, we overlaid the impacted area with a 5-meter by 5-meter grid. Referring to the Westinghouse Survey Grid shown on Figure 1 of the Data Summary Report, the impacted area is defined by three sub-areas as follows:

Sub-area A (E20 to E70) x (N0 to N100)

Sub-area B (E70 to E110) x (N30 to N100)
Sub-area C (E110 to E140) x (N30 to N100)

The areas of A, B and C are 5000 meter^2, 2800 meter^2 and 2100 meter^2, respectively, for a total area of 9900 meter^2. As a result, we calculated that the 5-meter by 5-meter overlay will encompass 396 25-meter^2 grids. Table 1 and Figure 2 of the Data Summary Report indicate that the depth of the fill, i.e., the potentially impacted material, varies from nothing to the north (SC-1) to 12 feet to the south (SC- 44). Based on this setting, we assumed that each grid location would yield, on average, two, 2.5-foot soil samples. Hence, *in-situ* characterization would necessitate gamma spectroscopy analysis of at least 792 samples. A Geoprobe would be used to extract the samples, but alternate techniques might be necessary in areas where rubble has been disposed on the site.

After the soil samples are collected, a 100% walkover gamma scan will be conducted to confirm that no residual radioactive materials remain on the surface of the property. Also, measurements would be taken at the center of each grid to verify that the exposure rate at one-meter above the ground is consistent with regulatory guidelines.

The results of the surveys and soil sample analyses would be evaluated to identify any grids that exceed the guidelines. The identified grid would be excavated to a depth consistent with the sample results and field measurements. A sample from the bottom of the excavation would then be analyzed to verify that the residual concentration is consistent with the guidelines.

2.1.4 ESTIMATED COST

Specific costs for this remedial option consist of onsite survey and sample collection, sample analysis, excavation of grids, waste disposal, and site restoration. We can estimate onsite survey and sample collection, as well as excavation based on our past experience. Excavation and waste disposal are estimated based on our evaluation of the site data available in the Data Summary Report, as well as, the sample results provided to us separately. Our analysis indicates that between 5 and 20 grids would have to be removed to fulfill the guideline criteria. We reached this conclusion based on the following:

> The data from the recently tested composite samples indicates that concentrations are generally less for composite samples than for the original 2 or 3-inch samples from the same boreholes. Nevertheless, concentrations exceeding guideline values were detected. Of the 32 composite samples, 3, all from sub-area A, exceeded the guideline maximum concentrations of either 90 pCi/gm or 175 pCi/gm. If we assume the same distribution as in our characterization in sub-area A, this would indicate that 20 grids require excavation. Using 2-feet as the average depth of excavation, this is equivalent to about 402 yard^3 which may require excavation. It is our understanding that the contaminated soils within the original footprint of the Zircaloy Burn Area have already been excavated. Hence, no further excavation is anticipated for this area. Under this circumstance, assuming 20 grids to be excavated may be conservative.

If the 20 grids are excavated, the estimated cost for this remedial option is:

Item	Costs
Onsite Radiological Support	$65,000
Geoprobe	25,000
Analytical services (800 samples)[1]	56,000
Mobilization	10,000
Excavation (402 yd)[2]	4,020
Waste disposal (10,854 ft^3)[3]	542,700
Site restoration (402 yd)[4]	3,216
Total	**$705,936**

Notes:

[1] 800 samples x $70 each = $56,000
[2] 402 yd x $10/yd = $4,020
[3] 10,854 ft^3 x $50/ft = $542,700
[4] 402 yd x $8/yd = $3,216

2.1.5 DISCUSSION

Technical Feasibility

In-situ characterization is most appropriate when no contamination exceeding guideline values is to be left on site and it is imperative to have an accurate estimate of disposal costs prior to excavation. It also results in the least disturbance to the site for those cases where the contaminant is heterogeneously distributed. There should be some idea of the extent of the contamination before selecting this remedial technique because other techniques are more appropriate if the contaminant is widely distributed.

Preliminary characterization indicates that the contamination at the Blairsville site is quite spotty, both in occurrence and concentration. *In-situ* characterization would be a suitable choice in that it is likely to minimize the amount of excavation. On the other hand, if the contamination is more wide spread than suspected, the *in-situ* characterization will yield a highly accurate remediation cost estimate. ***Technical Feasibility - HIGH***

Regulatory Feasibility

Regulations regarding residual contamination are in transition as the USNRC begins to implement the new 10 CFR 20, Appendix requirements. Furthermore, there have always been questions as to how to evaluate and verify subsurface contamination. *In-situ* characterization has been successfully implemented

at other sites and should be applicable at the Blairsville site. ***Regulatory Feasibility – MODERATE TO HIGH***

Potential for Success

The major risk associated with *in-situ* characterization is discovery of considerably more material that requires offsite disposal than anticipated. Developing an accurate estimate of disposal costs before a commitment to excavate is made offsets this risk. The remedial action itself involves standard earthmoving equipment and techniques. Contracting procedures and project management can be effective in controlling costs. ***Potential for Success – MODERATE TO HIGH***

Public Acceptance

Due to the isolated nature of the site, and compliance with regulations, no issues of public acceptance are foreseen for this remedial alternative. ***Public Acceptance - HIGH***

Implementation Schedule

Conduct Additional Characterization	2 Months
Prepare Remediation Plan and Related Radiological, Safety and QA Supporting Documentation	3-4 Months
Regulatory Approval	4-6 Months
Conduct Excavation, Stockpiling	1-2 Months
Ship Contaminated Material Offsite	2 Months
Final Release Survey Report	2 Months
USNRC Release for Unrestricted Use	3 Months
Total	**17-21 Months**

2.2 EX-SITU CHARACTERIZATION

2.2.1 GENERAL

In this remedial technique, all of the material identified as being potentially contaminated is excavated and staged onsite in units suitable for transportation to the disposal site. The staged units can be truckload, roll-off, or hopper car size or multiples thereof. Samples are taken from each unit to determine its ultimate disposition. Soils exceeding guideline values would be disposed of offsite, other soils can either be retained onsite or disposed of as clean material. The number and location of the samples is specified to be consistent with disposal facility requirements or with guideline values established for unrestricted release of the site.

2.2.2 USNRC UNRESTRICTED RELEASE CRITERIA

Concentration Based Limit

Soil concentration limit would be consistent with Option 1 of USNRC SECY-81-576.

Maximum average concentration 30 pCi/gm
Maximum sample concentration 90 pCi/gm

- AND -

Exposure rate limit would be consistent with USNRC SECY-92-106

Maximum exposure rate 10 μR/hr above background.

- OR -

Derived Limit Based on Dose Assessment

Soil concentration limit based on Subpart E of 10 CFR 20

Maximum average concentration 35 pCi/gm
Maximum sample concentration 175 pCi/gm

2.2.3 IMPLEMENTATION

Referring to the Westinghouse Survey Grid shown on Figure 1 of the Data Summary Report, the impacted area is defined by three sub-areas as follows:

Sub-area A (E20 to E70) x (N0 to N100)
Sub-area B (E70 to E110) x (N30 to N100)
Sub-area C (E110 to E140) x (N30 to N100)

Based on the soil sample results, the soils from sub-areas A and B would be excavated and staged for analysis. It appears that, at worst, sub-area C is only slightly contaminated and that little would be

gained by excavating the material. A final survey and sampling would be needed to identify any residual contamination. If contamination exceeding the guidelines was found it would be excavated and staged with the material from sub-areas A and B.

The area of sub-areas A and B are 5000 meter^2 and 2800 meter^2, respectively, and the average depth of contamination is about 2 feet. Hence, approximately 6800 yards^3 would be excavated and staged for sampling. With regard to the size of the individual sampling piles, there are several reasons to keep the volume small. First, it minimizes the danger of a small volume of highly contaminated material, compromising clean or other slightly contaminated material. Second, disposal cost can be managed by judiciously combining small volumes into larger composite units. Finally, if disposal were required, the sampling necessary for approval from the landfill would be complete. Using the volume of a dump truck, 20 cubic yards, approximately 340 samples would be analyzed.

If the sample results exceed a predetermined guideline, the staged material would be directly disposed of offsite. In all other cases, the sample results would be combined with the others from the site and a determination made as to which stockpiles required offsite disposal. The remaining stockpiles would be available for reuse onsite, be combined with other stockpiles to adjust the radioactive concentration of the composite piles, or disposed of as solid waste.

2.2.4 ESTIMATED COST

The amount of excavation and sampling required for this remedial option is known from the start since it is based on excavating and sampling all potentially contaminate material. We have elected to modify the usual procedure in that sub-area C will not be excavated. Instead, it will be sampled in the same fashion as would be done for *in-situ* characterization. The uncertainty in the estimate is the amount of material to be disposed of offsite. Considering the material is enriched uranium, there are presently no options for disposal other than a radioactive waste disposal facility, i.e., Envirocare. Sample analysis will be required for the individual stockpiles as well as the characterization samples. Our analysis indicates that between 0 and 400 yard^3 would have to be disposed of offsite to fulfill the guideline criteria. We reached this conclusion based on the following:

> About 35 percent of the composite samples exceeded 30 pCi/gm. If this were to hold for the material after excavation (6800 yards^3), the potential quantity for offsite disposal would be about 2380 yards^3. We know from our experience at other sites that concentrations usually are less after excavation. Also, 30 pCi/gm is the limit for the maximum average concentration. Since this is the case, it is likely that the disposal quantity will be significantly less based on the calculated average or by judicious management of the staged waste.

Assuming that 15 percent of the potential amount is a likely volume that would require offsite disposal, the estimated cost for this remedial option is:

Item	Costs
Onsite Radiological Support	$65,000
Geoprobe	8,000
Analytical services (400 samples)[1]	28,000
Mobilization	10,000
Excavation (6800 yd)[2]	68,000
Waste disposal 9639 ft^3)[3]	481,950
Site restoration (6800 yd)[4]	54,400
Total	**$715,350**

Notes:

[1] 400 samples x $70 each = $28,000
[2] 6,800 yd x $10/yd = $68,000
[3] 9,639 ft^3 x $50/ft = $481,950
[4] 6,800 yd x $8/yd = $54,400

2.2.5 DISCUSSION

Technical Feasibility

Ex-situ characterization is most appropriate when there is an expectation that the contaminant is widely dispersed and much of the material will be disposed of offsite. In that circumstance there is little to be gained by extensive *in-situ* characterization. It is important that there be flexibility in the remedial budget before undertaking *ex-situ* characterization because there is no assurance of the amount of disposal prior to sampling the excavated material. Once the material is excavated in must be dealt with either as radioactive waste, solid waste or clean soil.

Preliminary characterization indicates that the contamination at the Blairsville site is quite spotty, both in occurrence and concentration. Under this circumstance *ex-situ* characterization would result in a great deal of clean material handling. Also, an accurate estimate of the amount that will be disposed of offsite cannot be complete before onsite excavation begins. This leaves the project vulnerable to escalating offsite disposal costs. ***Technical Feasibility – HIGH***

Regulatory Feasibility

Since *ex-situ* characterization involves removal of all materials exceeding guideline values, there should be no regulatory issues. Some questions may arise concerning the techniques to verify that guideline

values have been met but these should be able to be resolved by discussion with the regulators. ***Regulatory Feasibility – HIGH***

Potential for Success

Ex-situ characterization always poses the threat of unanticipated contamination that must be dealt with once it is discovered. Such circumstances can have profound effects on project budgets if they result in more offsite disposal. If these budget effects are too great, it may require stopping the project and reconsidering the remedial plan. ***Potential for Success – MODERATE***

Public Acceptance

Since the remedial action results in removal of all materials contaminated in excess of regulatory guidelines, there should be no issues of public acceptance. ***Public Acceptance - HIGH***

Implementation Schedule

Prepare Remediation Plan and Supportive Radiological, Safety and QA Documentation	3-4 Months
Regulatory Approval	4-6 Months
Conduct Excavation Stockpiling, Sampling	2-3 Months
Ship Contaminated Soil Offsite	2-3 Months
Final Release Survey Report	2 Months
USNRC Release for Unrestricted Use	3 Months
Total	**16-21 Months**

2.3 SITE SPECIFIC DOSE ASSESSMENT

2.3.1 GENERAL

The purpose of performing a site specific dose assessment is to provide the justification for leaving concentrations of uranium "in place" which are below a regulatory approved limit.

The site specific dose assessment option involves performing a review of hydrogeological parameters/characteristics and concentrations of total uranium (pCi/gm) in the Blairsville site soil. The site specific hydrogeological parameters and soil concentrations are then used, along with default parameters, as input into computer codes for estimating potential exposures and subsequent dose (mrem) to an individual.

2.3.2 USNRC UNRESTRICTED RELEASE CRITERIA

Derived limit based on initial dose assessment:

Maximum average concentration 35 pCi/gm
Maximum sample concentration 175 pCi/gm

2.3.3 IMPLEMENTATION

The initial site specific dose assessment was evaluated by first reviewing the "Radiological Dose Assessment for Blairsville Facility" (TLG Project No. 1263). The "TLG" dose assessment was performed utilizing the computer code RESRAD Version 5.61. RESRAD is a code developed by the Environmental Assessment Division of Argonne National Laboratory for the Department of Energy (DOE). It is designed to evaluate doses from residual contamination in soils for exposure pathways associated with a residential farmer scenario. The TLG assessment was performed using unit concentrations (i.e., 1 pCi/gm) of Th-232, U-234, U-235 and U-238. For this evaluation, a site specific average concentration (35 pCi/gm Total Uranium) was developed.

Because many of the soil sample results used in developing the average concentration were reported as below the detection limit (BDL) for the analytical technique, the actual average concentration will be less. The average concentration was developed utilizing analytical data from Sub-areas A and B of the site which are shown on Figure 1 of the Data Summary Report. Sub-areas A and B are defined as follows: Sub-area A (E20 to E70) x (N0 to N100) Sub-area B (E70 to E110) x (N30 to N100). Data utilized in determining the site specific average are provided in Attachment 1.

The isotopic ratios were determined based on a Total Uranium to U-235 ratio of 25:1. The site specific average concentration along with the TLG parameters were used as input for the computer code RESRAD Version 5.81. The analysis was performed assuming and average depth of contamination of 1 foot. The resulting dose is 11.7 mrem which is below the current USNRC cleanup criteria of 25 mrem presented in 10 CFR 20 Appendix E.

2.3.4 ESTIMATED COST

Specific costs for this remedial option consists of additional sample collection and analysis. The additional data will be used to further define the average soil concentration and determine the areas that contain concentrations "hot spots" above the maximum allowable concentration. In addition, the dose assessment model will be revised to include the additional soil data and to develop an acceptable upper concentration limit.

The estimated cost for this remedial option is:

Item	Costs
Onsite radiological support	$65,000
Geoprobe	25,000
Analytical services	56,000
Mobilization	10,000
Site Remediation Plan - Radiological Dose Assessment	50,000
Excavation	3,250
Technical/Regulatory Support	50,000
Waste Disposal[1] (~~53,792~~ ft^3)	268,960
Site Restoration 5,379.2 ft^3	2,600
Total	**$530,810**

Note:

[1] Waste disposal based on removal of 10 - 16.4 ft x 16.4 ft grids to a depth of 2 feet (53,792 ft^3). 53,792 ft^3 x $50/$ft^3$ for shipment an disposal = $268,960

2.3.5 DISCUSSION

Technical Feasibility

Although the initial dose assessment (11.7 mrem) is below the USNRC 25 mrem "cleanup" criteria, it is B. Koh's experience that elevated areas of contamination (i.e., greater than 3 times the limit) known as "hot spots" require a more rigorous evaluation. The evaluation may include additional sampling and analysis to further determine the concentrations and extent of the "hot spots". The additional data can be used to further perform "hot spot" dose assessments and/or determine if removal and subsequent disposal is more effective in reaching unrestricted release status. In addition, the evaluation may include selection of computer codes and/or models which more accurately represent conditions at the Blairsville site. ***Technical Feasibility - LOW TO MODERATE***

Regulatory Feasibility

Current USNRC regulations (10 CFR 20, Appendix E) state that "a site will be considered acceptable for unrestricted use the residual radioactivity that is distinguishable from background radiation results in a Total Effective Dose Equivalent (TEDE) to an average member of the critical group that does not exceed 25 mrem per year, (within the first 1000 years after decommissioning) including that from groundwater sources of drinking water, and that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA).

Based on previous experience at the Harvard Avenue, Bert Avenue and BP Chemicals remediation sites, performance of dose assessments using computer codes have been accepted by the USNRC for determining potential doses to an average member of the public. ***Regulatory Feasibility - LOW TO MODERATE***

Public Acceptance

As stated in 10 CFR 20.1405, "Upon receipt of a License Termination Plan or Decommissioning Plan from the licensee, or a proposal by the licensee for release of a site, or whenever the commission deems such notice to be in the public interest, the commission shall:

Notify and solicit comments from:

- Local and State governments in the vicinity of the site and any Indian nation or other indigenous people that have treaty or statutory rights that could be affected by the decommissioning; and
- Publish a notice in the Federal Register and in a forum such as local newspapers, letter to State or local organizations, or other appropriate forum, that is readily accessible to individuals in the vicinity of the site, and solicit comments from affected parties."

Experience has shown that public and political obstacles can be overcome by frequent, open dialogue among all the interested parties. It is best to look to the local elected officials to take the leadership role between the factions. Local elected officials can have the most influence over the outcome of the decommissioning because of the unique authority afforded by their positions. ***Public Acceptance - LOW TO MODERATE***

Potential for Success

The risks related to the site specific dose assessment option are project delays due to regulatory and public concerns. Because the USNRC, 10 CFR 20, Appendix E, 25 mrem remedial dose criteria is relatively new, there has been no precedence set for this remedial approach. ***Potential for Success - LOW TO MODERATE***

Implementation Schedule

Additional Site Characterization	2 Months
Development of Site Remediation Plan including Radiological Dose Assessment	2 Months
Regulatory Acceptance	14-26 Months
Remediation/Final Surveys	1 Month
Final Survey Report	2 Months
USNRC Release for Unrestricted Use	3 Months
Total	**24-36 Months**

2.4 SOIL PROCESSING

2.4.1 GENERAL

The soil processing remedial option involves treating contaminated soil by a variety of physical and/or chemical separation techniques. The main purpose of these techniques is to segregate the contaminated fraction of the soil from the non-contaminated fraction, thereby reducing the volume of contaminated soil requiring disposal and/or further treatment.

The soil processing remedial option was evaluated by examining 3 soil processing techniques. The techniques included:

- Mechanical Separation via Field Measurements
- Mechanical Separation and Rinsing (2 cases)
- Mechanical Separation and Washing

2.4.2 USNRC UNRESTRICTED RELEASE CRITERIA

The unrestricted release criteria for the soil processing remediation option will be a soil concentration limit consistent with Option 1 of USNRC SECY-81-576:

Maximum average concentration 30 pCi/gm
Maximum sample concentration 90 pCi/gm

2.4.3 IMPLEMENTATION AND ESTIMATED COST

1. Mechanical Separation via Field Measurements

The segregation of contaminated soil via mechanical separation as directed by radiation detection measurements was used at the West Valley Demonstration Project to reduce the volume of contaminated soil (98% reduction) which was stored in B-25 boxes onsite awaiting disposition.

The automated soil sorting system, known as the segmented gate system (SGS), was used by Thermo Nutech under contract to West Valley Nuclear Services, Inc.

The Thermo NuTech SGS is a combination of screen/hammermill plant and conveyor systems, radiation detectors (beta and gamma) and related computer controls that separate contaminated soil from a moving feed supply on a conveyor belt. Contaminated soil is diverted by segmented gates to a conveyor belt which deposits the soil on an appropriate ground cloth or other container system for stockpiling and later disposition.

A conceptual design of the SGS is provided in Figure 2.4-1.

A more detailed discussion of the SGS is presented in the "Final Report for the Automated Soil Sorting Demonstration Project, WVDP-286, October 1997.

Estimated Cost

The major costs associated with the SGS remedial option is the soil processing, engineer/operations support and disposal of remaining contaminated soil. The estimated cost for this remedial option is:

Item	Costs
Excavation and stockpiling of contaminated soil (115,884 ft^3)[1,2]	$42,920
System set-up, checkout and soil processing (115,884 ft^3)[3]	4,322,044
Operations support (waste management, radiation protection maintenance engineering)	160,000
Equipment rental	50,000
Disposal of contaminated soil (11,588 ft^3) at Envirocare[4]	579,400
Clean fill placement and grading (164,889 ft^3)[5]	48,856
Seeding and mulching	10,000
Total	**$5,213,220**

Notes:

[1] 164,889 ft^3 (total Blairsville site) - 49,005 ft^3 (clean soil pile) = 115,884 ft^3 to be processed
[2] 115,884 ft^3 ÷ 27 ft^3/cy x $10/cy excavation/stockpiling = $42,920
[3] 115,884 ft^3 ÷ 27 ft^3/cy x $1,007/cy soil processing = $4,322,044
[4] 115,884 ft^3 x .90 removal efficiency = 104,296 ft^3 clean soil
115,884 ft^3 - 104,296 ft^3 = 11,588 ft^3 contaminated soil to be disposed at Envirocare
11,588 ft^3 x $50/$ft^3$ to ship/dispose at Envirocare = $579,400
[5] 164,889 ft^3 ÷ 27 ft^3/cy x $8/cy backfill and grade clean soil = $48,856

The $1,007/cy was based on WVNS final report for the automated soil sorting demonstration project dated October 1997 - $719,000 Total Cost/714 cy Processed = $1,007/cy

2. Mechanical Separation and Rinsing

Mechanical separation and rinsing involves the physical screening of contaminated soil with a selected size power screen (i.e., .25") followed by a rinsing of the <.25" sized soil particles with water and further screening using selected mesh (i.e., 40, 100, 200) screens.

Case 1: Westinghouse Soil Screening and Rinsing Treatability Tests

Soil screening/rinsing feasibility testing, including bench scale tests, was performed by Westinghouse on several contaminated soil piles/area (~6,300 cys) from within the Blairsville site between June 1 and June 10, 1999.

Based on the bench test results, an average of 30% of the Blairsville site which represents the +.25" material can be recovered through dry screening. Additional removal ranging from 30 to 59% of the -.25" material can be realized using a rinse and screen (i.e., 100, 200 mesh) step.

A conceptual design for the full scale soil screening and rinsing operation is shown in Figure 2.4-2.

Estimated Cost

The major costs associated with the screening and rinsing option is the soil processing system, system support and the disposal of remaining radioactive waste.

Item	Costs
Excavation and stockpiling of contaminated soil (115,884 ft^3)[1,2]	42,920
System set up and operation	400,000
Equipment rental	50,000
Disposal of contaminated soil to Envirocare (59,101 ft^3)[3]	2,955,042
Radiological coverage	50,000
Placement of clean fill and grading (164,889)[4]	48,856
Seeding and mulching	10,000
Total	**$3,556,818**

Notes:

[1] 164,889 ft^3 (total Blairsville site) - 49,005 ft^3 (clean soil pile) = $115,884 ft^3 to be processed
[2] 115,884 ft^3 ÷ 27 ft^3/cy x $10/$cy^3$ excavated/stockpiled = $42,920
[3] 115,884 ft^3 x .51 removal efficiency = 56,783 ft^3 clean soil
115,884 ft^3 - 56,783 ft^3 = 59,101 ft^3 contaminated soil to be disposed at Envirocare
59,101 ft^3 x $50/$ft^3$ transport/dispose = $2,955,042
[4] 164,889 ft^3 ÷ 27 ft^3/cy x $8/cy backfill/grade = $48,856

An estimate of the costs (and potential savings) resulting from the screening and soil rinsing operation on the Blairsville site soils, as developed by Westinghouse, are presented in Table 2.4-1.

Case 2: East Asia Screening and Rinsing

In a similar fashion to the approach presented by Westinghouse, a soil screening and rinsing methodology was considered by the Malaysian government to address uranium/thorium contaminated monazite sand (40,000 to 100,000 cys).

A conceptual design of the screen and rinse operation is shown in Figure 2.4-3.

Estimated Cost

As in the soil screening and rinsing remedial option evaluated by Westinghouse, the major components of this screening and rinsing option include Plant Capital expenditures, materials and construction/operation support and disposal of remaining contaminated soil.

The estimated cost for the soil screening and rinsing (Malaysia) is:

Item	Costs
Plant capital expenditure	$450,000
Operating materials/supplies	90,000
Construction/operations	50,000
Excavation and stockpiling of contaminated soil (115,884 ft^3)[1,2]	42,920
Equipment rental	50,000
Disposal of contaminated soil to Envirocare (46,354 ft^3)[3]	2,317,700
Radiological support	50,000
Place clean soil and grade (164,889 ft^3)[4]	48,856
Seed and mulch	10,000
Total	**$3,109,476**

Notes:

[1] 164,889 ft^3 (total Blairsville site) - 49,005 ft^3 (clean soil pile) = 115,884 ft^3 to be processed
[2] 115,884 ft^3 ÷ 27 cy/ft^3 x $10/cy excavation and stockpiling = $42,920
[3] 115,884 ft^3 x .60 removal efficiency = 69,530 ft^3 clean soil
115,884 ft^3 - 69,530 ft^3 = 46,354 ft^3 shipped/disposed at Envirocare
46,354 ft^3 x $50/$ft^3$ = $2,317,700
[4] 164,889 ft^3 ÷ 27 ft^3/cy x $8/$ft^3$ = $48,856

3. Soil Screening and Washing

Unlike soil screening and rinsing discussed previously, soil screening and washing is an *ex-situ* water-based process that combines chemical and physical extraction and separation process to remove organic, inorganic and radioactive contaminants.

RMI Titanium Company, Ashtabula, Ohio, as part of the US Department of Energy weapons production program, operated a uranium (depleted, normal, slightly enriched) extrusion process. As a result of these operations, buildings and surrounding soil were contaminated with uranium.

From August 1996 through February 1997, as part of their remedial investigation/feasibility studies, soil washing was evaluated as a remedial option Feasibility and pilot tests were conducted to validate that soil washing was an economical way to treat uranium contaminated soil. The selected soil washing technology was based on a soil washing carbonate leaching system. A more detailed description of the

soil washing process is presented in a paper entitled "Soil Washing", Industrial Wastewater July/August 1998.

A conceptual design of the soil washing carbonate system is presented in Figure 2.4-4.

Estimated Cost

The cost estimate for the RMI soil washing remediation option is:

Item	Costs
Treatability studies	$50,000
Excavation and stockpiling of contaminated soil (115,884 ft^3)[1,2]	42,920
Onsite soil screening and washing (115,884 tons)[3]	2,403,520
Disposal of remaining contaminated soil at Envirocare (11,588 ft^3)[4]	579,400
Radiological/health and safety coverage sampling/analysis and management support (provided by RMI Environmental Services)	included
Placement and grading of clean soil onsite (164,889 ft^3)[5]	48,856
Seeding and mulching	10,000
Total	**$3,134,696**

Notes:

[1] 164,889 ft^3 (total Blairsville site) - 49,005 ft^3 (clean soil pile) = 115,884 ft^3 soil to be processed
[2] 115,884 ft^3 ÷ 27 ft^3/cy x $10/cy excavation/stockpile = $42,920
[3] 115,884 ft^3 ÷ 27 ft^3/cy x 1.4 tons/cy x $400/ton = $2,403,520
[4] 115,884 ft^3 x .90 removal efficiency = 104,296 ft^3 clean soil
115,884 ft^3 - 104,296 ft^3 = 11,588 ft^3 contaminated soil to be disposed at Envirocare
11,588 ft^3 x $50/$ft^3$ shipping/transporting = $579,400
[5] 164,889 ft^3 ÷ 27 ft^3/cy x $8/cy placement = $48,856

The $400/ton was provided by RMI Environmental Services in letter dated October 15,1999 (Attachment 2).

2.4.4 DISCUSSION

Technical Feasibility

Soil processing, as a viable remedial technology, has been well established for both chemical and radioactive contaminated soils throughout the remediation/waste management arena. This remedial option favors large contaminated soil volumes in which the contamination is comprised of discrete (separatable) particle size and with minimal chemical (i.e., chelating, anion/ion) interferences.

Feasibility studies can be conducted to identify and eliminate issues such as chemical interferences, and physical particle size differences.

Pilot plant operations can be conducted to identify and address operational problems such as soil conditions, soil size, feed rate, operational performance, removal efficiencies, and production rates.

Soil processing systems for both the physical (screening) and chemical (washing) are readily available.

In summary, the technical potential issues related to soil processing that would need to be addressed for the Blairsville site include:

- Location of soil processing (onsite vs. offsite)
- Ability to derive an acceptable soil screening/rinsing/washing approach from the feasibility studies
- Optimizing the operational parameters
  - Soil Handling/Conditions
  - Soil Size
  - Feed Rates
  - Operational Performance/Plant and Detection/Monitoring Systems
  - Removal Efficiencies
  - Production Rates
- Establishing Radiological/Health and Safety Requirements
- Reviewing nuclear criticality potential and concerns

Technical Feasibility - MODERATE TO HIGH

Regulatory Feasibility

The regulatory issues pertinent to soil processing (whether conducted onsite or offsite) primarily relate to permitting/licensing of the processing facility.

Due to the potential for airborne releases, rinse water treatment and discharges, Westinghouse may be required to obtain a state permit to operate the soil processing system. However, it is not anticipated that a USNRC license would be required. The effort to obtain the required permit would include the preparation of the application and the establishment of any required monitoring. ***Regulatory Feasibility - HIGH***

Potential for Success

Risks and public acceptance related to soil processing appear to be favorable. Risks (i.e., cost, technical performance) can be controlled through the Westinghouse procurement/contract process. However, lack of technical performance could cause schedule delays and cost increase due to the need to select a different soil processing contractor or an alternative remedial option. ***Potential for Success - HIGH***

Public Acceptance

There would appear to be no major public acceptance issues since the soil processing will be performed in a controlled fashion, in a isolated location (either onsite or offsite). The public should find the process which separates the contaminated material from the clean material with the contaminated material being disposed offsite, fully acceptable. ***Public Acceptance - HIGH***

Implementation Schedule

Prepare Remediation Plan and Supporting Radiological, Safety and QA Documentation	2 Months
Regulatory Approval	3-4 Months
Process Soil	3-4 Months
Ship Contaminated Soil Offsite	3-4 Months
Final Release Survey Report	2 Months
USNRC Release of Site for Unrestricted Use	3 Months
Total	**16-19 Months**

2.5 ONSITE DISPOSAL

2.5.1 GENERAL

The onsite disposal remedial option involves the excavation and placement of all potentially radiologically contaminated soil in an engineered cell. The cell would be constructed and the waste placed in a manner that will meet the USNRC design criteria *(10 CFR 20.2002)* for onsite disposal of contaminated material and will result in the release of the site for unrestricted use.

Specifically, the design of the cell will be based on USNRC criteria that requires that the top of the buried materials must be at least four feet below the surface *(USNRC SECY-81-576)*. In addition, the buried materials must have a soil cover designed to resist water infiltration and the buried materials must be at least 10 feet above the groundwater table *(NUREG-1101)*.

2.5.2 USNRC UNRESTRICTED RELEASE CRITERIA

The USNRC release for unrestricted use criteria for the onsite disposal option are:

Approach 1: Concentration Based

Soil

Enriched Uranium *(USNRC SECY-81-576)*

30 pCi/gm - Option 1
250 pCi/gm - Option 2 (Insoluble)
100 pCi/gm - Option 2 (Soluble)

Exposure

10 μR/hr Above Background One Meter Above the Soil Surface *(USNRC SECY-92-106)*.

APPROACH 2: Dose Assessment Based

25 mRem/yr total effective dose equivalent (TEDE) (10 CFR 20, Subpart E)

2.5.3 IMPLEMENTATION

Design

The design of the cell will be in compliance with 10 CFR 20.2002, SECY-81-576 and NUREG-1101 and will consist of:

- Clean Soil Layer (subgrade).

- Waste Material Layer (appropriate thickness based on volume and dimensions of cell). Material will be placed in lifts and compacted. A contaminated volume of 184,530 ft^3 will be used for design basis.

- Clay Barrier Layer (compacted)

- Select Fill Layer (compacted)

- Grading, Seeding and Mulching

Figure 2.5-1 presents a conceptual containment cell with typical cap and cell layers.

Construction Activities Sequence

The construction activities will consist of the following components:

- Excavation and stockpiling of radiologically contaminated soil and clean overburden.

- Installation and operation of temporary stormwater controls.

- Cell excavation and stockpiling of clean excavated material.

- Placement and compaction of contaminated material. Final survey and sampling of individual lifts.

- Placement of a clay barrier (compacted) over the contaminated material.

- Placement and compaction of select fill to achieve final grades.

- Final grading and establishment of a vegetative cover. Perform final release survey and sampling of cover and surrounding area.

- Removal of temporary stormwater controls.

Final Release

Final release surveys to demonstrate compliance with NUREG/CR-5849 or the Multi-Agency Radiation Survey and Site Investigation Manual *(NUREG 1575)* (MARSSIM) and, hence, release of the site for unrestricted use will include:

- 100% walkover gamma scan of each contaminated soil layer (lift) and final clean soil layer.

- Soil samples obtained at a frequency approved by the USNRC/PADEP and analyzed for uranium via gamma spectroscopy to demonstrate compliance with the release limit of 30 pCi/gm.

- Waste Material Layer (appropriate thickness based on volume and dimensions of cell). Material will be placed in lifts and compacted. A contaminated volume of 184,530 ft^3 will be used for design basis.
- Clay Barrier Layer (compacted)
- Select Fill Layer (compacted)
- Grading, Seeding and Mulching

Figure 2.5-1 presents a conceptual containment cell with typical cap and cell layers.

Construction Activities Sequence

The construction activities will consist of the following components:

- Excavation and stockpiling of radiologically contaminated soil and clean overburden.
- Installation and operation of temporary stormwater controls.
- Cell excavation and stockpiling of clean excavated material.
- Placement and compaction of contaminated material. Final survey and sampling of individual lifts.
- Placement of a clay barrier (compacted) over the contaminated material.
- Placement and compaction of select fill to achieve final grades.
- Final grading and establishment of a vegetative cover. Perform final release survey ar sampling of cover and surrounding area.
- Removal of temporary stormwater controls.

Final Release

Final release surveys to demonstrate compliance with NUREG/CR-5849 or the Multi-Agency Radia Survey and Site Investigation Manual *(NUREG 1575)* (MARSSIM) and, hence, release of the sit unrestricted use will include:

- 100% walkover gamma scan of each contaminated soil layer (lift) and final clean so layer.
- Soil samples obtained at a frequency approved by the USNRC/PADEP and analyzed f uranium via gamma spectroscopy to demonstrate compliance with the release limit of pCi/gm.

Missing
Page 24

2.5.4 ESTIMATED COST

Specific costs associated with the onsite disposal remedial option consist of design, engineering and regulatory support, construction of the cell, placement of the waste in the cell, and radiological support. For each of these items can be estimated based on our experience with onsite disposal at the two Chemetron sites, (Bert Avenue and Harvard Avenue) located near Cleveland, Ohio and the BP Chemical Site in Lima, Ohio. The volume of contaminated soil and hence the size of the cell is based on our evaluation of the site data available in the Data Summary Report, as well as the sample results provided to us by Paragon Analytical Laboratory.

Our analysis indicated that approximately 184,530 ft^3 of contaminated soil is available to be placed in the onsite cell.

This volume was derived by estimating the quantities of contaminated soil from Sub-areas A and B using the available Westinghouse and Paragon Laboratory analytical data. The derived contaminated soil volume includes:

Sub Area A	118,309 ft^3 [1]
Sub Area B	66,253 ft^3 [1]

Based on this approach, 184,530 ft^3 of contaminated soil is available for on-site disposal.

This derived volume is consistent with the 164,889 ft^3 determined by Westinghouse to be contaminated and available for soil washing. Westinghouse Electric Company results of Blairsville Soil Washing Bench Tests dated June 15, 1999.

The estimated costs associated with the onsite disposal option include:[2]

Item	Costs
Design, Engineering Support, Regulatory Support	$ 341,000
Construction of Cell, Waste Placement Clean Fill Placement and Site Restoration	470,000
Radiological Support	351,175
Management and Regulatory Support Site Characterization	150,000
Total	**$1,312,175**

Notes:

1 Sub Area A = 5,000 m^2 area x .67 m (2 ft) depth x 1.308 yd/m^3 x 27 ft^3/yd = 118,309 ft^3
Sub Area B = 2,800 m^2 area x .67 (2 ft) depth x 1.300 yd/m^3 x 27 ft^2/yd = 66,253 ft^3
Total 184,562 ft^3

2 These costs were based on costs associated with the Chemetron Harvard Avenue Cell and reflect actual or best estimated expenditures.

2.5.5 DISCUSSION

Technical Feasibility

The onsite disposal remediation option for the Blairsville Site consists of the removal, consolidation and subsequent placement of the contaminated material in a permanent containment cell which meets the 10 CFR 20.2002 and NUREG-1101 constructed on the site. The containment cell will be covered with a multi-layered cap of clay and fill.

The technical basis of the design of the below ground cell has been demonstrated through the successful onsite disposal at the Chemetron, Inc. Harvard Avenue and Bert Avenue Sites near Cleveland, Ohio. Like wise the basis for an above ground disposal has been demonstrated at the BP Chemicals, Inc. Site in Lima, Ohio. Both designs (above and below ground) have been approved by the USNRC and state regulatory agencies.

The Blairsville site does have a relatively shallow water table (i.e., ~5 feet deep). This could pose an issue with the USNRC requirement (NUREG 1101), that the bottom of the waste be at least 10 feet above the groundwater. From a design standpoint, this shallow water table may dictate an above ground containment cell.

It should also be noted that with a dose analysis approach to onsite disposal (i.e., 25 mRem from all pathways including groundwater) it is not clear whether the 10 foot separation requirement would still be applied. ***Technical Feasibility - MODERATE***

Regulatory Feasibility

The remediation of the Blairsville site will require the preparation of a Remediation Plan and related safety (Radiological Control Plan and Procedures) and QA (QA Plan) support documentation. At the present time it is uncertain as to whether the USNRC will approve the remediation of the site under the "grandfathered" requirements or under the new 10 CFR 20 Subpart E).

The remedial option of onsite disposal will require design of the containment cell. The remediation plan and design will need to be approved by the USNRC and PADEP.

Regulatory issues related to onsite disposal include:

- Release Criteria
  - Grandfathered - concentration based - 250 pCi/gm insoluble, 100 pCi/gm soluble
  - Current - 10 CFR 20 Subpart E (25 mRem)

- Design (above ground or below ground)
  - Cover and requirement
  - Separation of waste from groundwater

- Characterization - Sampling

- Hot Spots

- Final Survey Protocol

- Dose Assessment
  - Input parameters
  - User scenarios

Based on previous experience with the Chemetron and BP Chemical Sites, the approval for the onsite disposal option will require a fair amount of technical/regulatory support effort and time to obtain approval. ***Regulatory Feasibility - MODERATE***

Potential for Success

The risks related to the onsite disposal remediation option are common to all of the remediation option, costs increases and unsatisfactory performance. Each of these parameters are due to "unknown" that need to be addressed.

Costs increases can be minimized by:

- Determining the volume of contaminated/clean soil to be excavated, a priori, through a thorough *in-situ* characterization program

- Selecting a contractor and/or consultant who is experienced in the technical, regulatory and public acceptance aspects of onsite disposal

- Obtaining USNRC approvals (up front) regarding remediation, option, release criteria, design, final surveys, dose assessments including scenario.

- Controlling the work and related costs through contract/procurement process (i.e., lump sum/fixed price verses time and materials).

Unsatisfactory performance can be minimized by:

- Maintaining close control over the remediation contractor and/or consultant.

- Selection of a contractor/consultant with demonstrated experience and performance.

- Maintaining close communication with contractor/consultant through weekly meetings, teleconferences and status reports.

The risks regarding the onsite disposal option are directly related to "unknown". By identifying and addressing these unknowns (through characterization, regulatory approvals, public input), the risk can be managed and cost increases, and poor performance of the contractor minimized. ***Potential for Success - - MODERATE***

Public Acceptance

The option of onsite disposal will be scrutinized by the general public. Westinghouse will need to take action to meet with the local residents and government officers to present the technical, safety and public acceptance aspects of onsite disposal option.

If 10 CFR 20 Subpart E is the governing cleanup standards, then Westinghouse will need to provide for the formation of a local citizens group. This group will be directly involved on the onsite disposal remediation option development. They will have opportunity to review and comment on the remediation planning document. The fact that the Blairsville Facility is located in a more remote area may temper public interest and involvement. ***Public Acceptance - LOW TO MODERATE***

Implementation Schedule

Additional Characterization	2 Months
Development of Site Remediation Plan and Supporting Radiological, Safety and QA Documentation	3-4 Months
Regulatory Acceptance	12-20 Months
Construction of Cell and Placement of Material	4-5 Months
Final Survey Report	1 Month
USNRC Release for Unrestricted Use	3 Months
Total	**25 to 35 Months**

3.0 RANKING AND RECOMMENDATION

3.1 GENERAL

As shown on Table 3.1-1, the five remedial options have been evaluated in the following five categories:

- Cost
- Technical Feasibility
- Regulatory Feasibility
- Potential for Success
- Public Acceptance

3.2 RANKING

3.2.1 Soil Processing

It is clear from our evaluation that soil processing is not cost effective for the Blairsville site. It appears that efficient systems, ones that minimize the amount of material disposed of offsite, are expensive to operate, and the less efficient systems have lower operating costs and high disposal costs. In either case, overall costs for soil processing (screening and rinsing/washing) is about two to three times higher than the other remedial options. However, a "screening only" approach may be combined with our recommended remedial option to further reduce the amount of material requiring offsite disposal. Soil processing is rated "High" in all other evaluation categories.

3.2.2 Onsite Disposal

Onsite disposal is the next most costly remedial option but not so much so that it should be ruled out on the basis of cost alone. Unfortunately, it is rated only "Moderate" in the other categories. The particular concerns are the technical feasibility and public acceptance. Because of the relatively high water table at the Blairsville site, an engineered disposal cell may have to be elevated. Elevating the cell could result in design and land use issues that may be incompatible with the facility.

It is uncertain at this time whether the NRC would require compliance with NUREG-1101 which requires a 10 foot separation between the waste and the groundwater or regulate the disposal under 10 CFR 20 Subpart E. In contrast to USEPA, there is no specific NRC dose limit for groundwater. Dose from groundwater is incorporated into the 25 mRem limit. However, NRC may insist on ALARA to minimize dose from the groundwater. Until this is resolved, final design of onsite disposal cannot proceed.

With respect to the public, there is an awareness of radioactive contamination in western Pennsylvania as a result of publicity surrounding the Apollo facility. Onsite disposal could catch on as an issue in the local media. Because there are other remedial options that are more suitable to the Blairsville site, onsite disposal is not considered an effective remedial option.

3.2.3 Dose Assessment

While a dose assessment in accordance with 10 CFR 20, Appendix E, is the lowest cost remedial option, it is rated "Low – Moderate" in all other evaluation categories. Our preliminary dose analysis, based on the earlier TLG work, indicates that the site meets the regulatory requirement with regard to TEDE. Unfortunately, many uncertainties remain as to proper inputs for the analysis, casting some doubt as to the result. Also, there are specific issues related to the Blairsville site that would have to be resolved before acceptance of the dose analysis could be assured. These uncertainties are related to the actual level and extent of the contamination, as well as the geotechnical and hydrological setting of the site. The concerns about these matters can only be resolved by a much more thorough characterization of the site which leads directly to the two highest ranked options, *in-situ* and *ex-situ* characterization.

3.2.4 In-situ and Ex-situ Characterization

As can be seen from Table 3.2-1, *in-situ* and *ex-situ* are the highest ranked remedial options for the Blairsville site. The estimated costs are practically the same and their rankings in the other evaluation categories are similar.

3.3 RECOMMENDATION

Our evaluations in this report are based on the information in the Data Summary Report and the recently analyzed samples. It is a minimum amount of data and therefore our estimates cannot be considered precise. Nevertheless, the estimates are correct in the ranking of the remedial options and in the order of magnitude differences in cost and other evaluation categories. This enables us to recommend a remedial plan.

The Blairsville site is relatively small and the contamination is low-concentration. Hence, elaborate efforts to reduce volume by soil processing (screening and rinsing/washing) are inherently unsuitable. As shown in the rankings, direct removal of contaminants exceeding guideline values is cost effective and should pose no particular problems in terms of regulatory or public acceptance.

Both *in-situ* and *ex-situ* characterizations are highly ranked as remedial options. However, *ex-situ* poses much greater cost uncertainty for the Blairsville site in that there is insufficient preliminary characterization. Once excavation begins, it will be difficult to halt the process if unanticipated contamination that seriously impact the cost of the remediation is found. Furthermore, unless wide scale soil removal is anticipated, *ex-situ* characterization results in unnecessary excavation and disturbance of the property.

Our preference therefore is for *in-situ* characterization, and we recommend that it be pursued as the option for the Blairsville site. We base this recommendation on the following:

- The dose analysis reveals that average concentration of uranium to comply with the 25 mRem TEDE limit is relatively high, especially compared to the guidelines of SECY 81-576.

- The characterization data that is presently available indicate the general location and level of contamination at the site. Most of the sample concentrations are compatible with the guideline values derived from the dose calculations.

- Based on the derived guideline values, and the existing characterization data, we believe that relatively little soil will have to be excavated for offsite disposal.

- Any unanticipated contamination will be discovered before people and equipment will be mobilized to the site. If the characterization reveals that further development of this remedial option is not warranted, the remedial plan can be directed to a more suitable one.

- The commitment of funds for site investigation itself is relatively small. If the data reveals that the contamination is within the original estimate, work can proceed without concern. If, on the other hand, a large amount of unanticipated contamination is found, plans can be reevaluated before field personnel and funding are committed.

It should be noted that the cost estimate for *in-situ* characterization is very dependent on the amount of material destined for offsite disposal. Our estimate in this regard is based on limited data. From what we have seen at this point, we think the amount sent to a disposal facility will be small. Nevertheless, we recommend that for planning purposes, significant contingency be added to our estimate. Once the characterization is complete, a much more accurate estimate is possible.

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TABLES

TABLE 2.4-1

WESTINGHOUSE ESTIMATES OF SOIL WASHING SAVINGS

	Soil Processing Option	Soil Processing Option	Disposal Only Option	
Assumptions				
Density	1	1	1	ton/yd^3
Clean Level	<1.15	<2.3	NA	cpm/gm
Cost of disposal at Evirocare	$ 1,000	$ 1,000	$ 1,000	$/ton
Cost of transportation to Envirocare	$ 227	$ 227	$ 227	$/ton
Cost of soil washing rental (6 months)	$ 400,000	$ 400,000	$ 400,000	
Cost of modifications for soil washing	$ -	$ -	$ -	
Cost of dry screening setup	$ 50,000	$ 50,000	$ 50,000	
Processing cost (water only processing)	$ 100	$ 100	$ 100	$/ton
Processing cost (dry screening only)	$ 10	$ 10	$ 10	$/ton
Dirty Pile				
Volume of contaminated soil	130	130	130	yd^3
Clean +.25"	38%	38%	0%	
Volume of contaminated soil -.25"	80	80	130	yd^3
Clean +100 mesh	59%	59%	0%	
Volume of contaminated soil -100 mesh	33	33	130	yd^3
Screening Cost	$ 1,296	$ 1,296	$ -	
Washing Cost	$ 2,037	$ 2,037	$	
Final Disposal Cost	$ 40,441	$ 40,441	$ 159,091	
Total Cost Dirty Pile Screen and Wash	$ 49,774	$ 49,774	$ 159,091	
Screen Only Disposal Cost	$ 98,636	$ 98,636	$ 159,091	
Total Cost Dirty Pile Screen Only	$ 99,933	$ 99,933	$ 159,091	
Clean Pile				
Volume of contaminated soil	1,815	1,815	1,815	yd^3
Clean +.25"	25%	25%	0%	
Volume of contaminated soil -.25"	1,361	1,361	1,815	yd^3
Clean +200 mesh	40%	71%	0%	
Volume of contaminated soil -200 mesh	817	395	1,815	yd^3
Screening Cost	$ 18,146	$ 18,148	$ -	
Washing Cost	$ 136,111	$ 136,111	$ -	
Final Disposal Cost	$1,002,273	$ 484,432	$2,227,273	
Total Cost Clean Pile Screen and Wash	$1,156,532	$ 638,691	$2,227,273	
Screen Only Disposal Cost	$1,670,455	$ 1,670,455	$2,227,273	
Total Cost Clean Pile Screen Only	$1,688,603	$ 1,688,603	$2,227,273	
Fenced Area West and Excavated Area				
Volume of contaminated soil	2,081	2,081	2,081	yd^3
Clean +.25"	40%	40%	0%	
Volume of contaminated soil -.25"	1,249	1,249	2,081	yd^3
Clean +200 mesh	0%	73%	0%	
Volume of contaminated soil -200 mesh	1,249	337	2,081	yd^3
Screening Cost	$ 20,810	$ 20,810	$ -	
Washing Cost	$ -	$ -	$ -	
Final Disposal Cost	$1,532,358	$ 413,737	$2,553,930	
Total Cost Fenced Area	$1,553,168	$ 434,546	$2,553,930	
Screen Only Disposal Cost	$1,532,358	$ 1,532,358	$2,553,930	
Total cost fenced area screen only	$1,553,168	$ 1,553,168	$2,553,930	
Fenced Area, Central				
Volume of contaminated soil	2,081	2,081	2,081	yd^3
Clean +.25"	30%	30%	0%	
Volume of contaminated soil -.25"	1,457	1,457	2,081	yd^3
Clean +100 mesh	30%	30%	0%	
Volume of contaminated soil -100 mesh	1,020	1,020	2,081	yd^3
Screening Cost	$ 20,810	$ 20,810	$ -	
Washing Cost	$ 145,669	$ 145,669	$ -	
Final Disposal Cost	$1,251,426	$ 1,251,426	$2,553,930	
Total Cost Fenced Area	$1,417,904	$ 1,417,904	$2,553,930	
Screen Only Disposal Cost	$1,787,751	$ 1,787,751	$2,553,930	
Total cost fenced area screen only	$1,808,561	$ 1,808,561	$2,553,930	
Overall Costs for Various Options				
Screen and wash, Clean and Dirty piles and Central Fenced Area and dispose of residues; Screen only West Fenced Area and Excavated Area; No action East Fenced Area	$4,627,378	$ 2,990,916	$7,494,224	
Screen only, Clean and Dirty piles, Central Fenced Area, West Fenced Area and Excavated Area and dispose of residues; No action East Fenced	$5,200,264	$ 5,200,264	$7,494,224	

TABLE 3.2-1

SUMMARY OF EVALUATION OF REMEDIAL OPTION FOR BLAIRSVILLE SITE

Remedial Option	Cost	Technical Feasibility	Regulatory Feasibility	Potential for Success	Public Acceptance	Implementation Schedule	Comments
In-Situ Characterization	$705,936	High	Moderate-High	Moderate-High	High	1½-2 years	
Ex-Situ Characterization	$715,350	High	High	Moderate	High	1½-2 years	
Dose Assessment	$530,810	Low-Moderate	Low-Moderate	Low-Moderate	Low-Moderate	2-3 years	
Physical Separation							
- SGS System	$5,213,220	Moderate-High	High	High	High	6 months	Operational costs based on $1,007/ft^3 at WVDP. Larger soil volume may reduce unit cost
- Soil Screening/ Rinsing							
Case 1	$3,556,818	Moderate-High	High	High	High	6 months	
Case 2	$3,109,476	Moderate-High	High	High	High	6 months	
RMI Soil Screening/washing	$3,134,696	Moderate-High	High	High	High	6 months	Soil processing would be performed at the Blairsville site
Onsite Disposal	1,312,175	Moderate	Moderate	Moderate	Low-Moderate	2-3 years	

FIGURES

FIGURE 2.4-1

THERMO NUTECH SEGMENTED GATE SYSTEM FLOW DIAGRAM

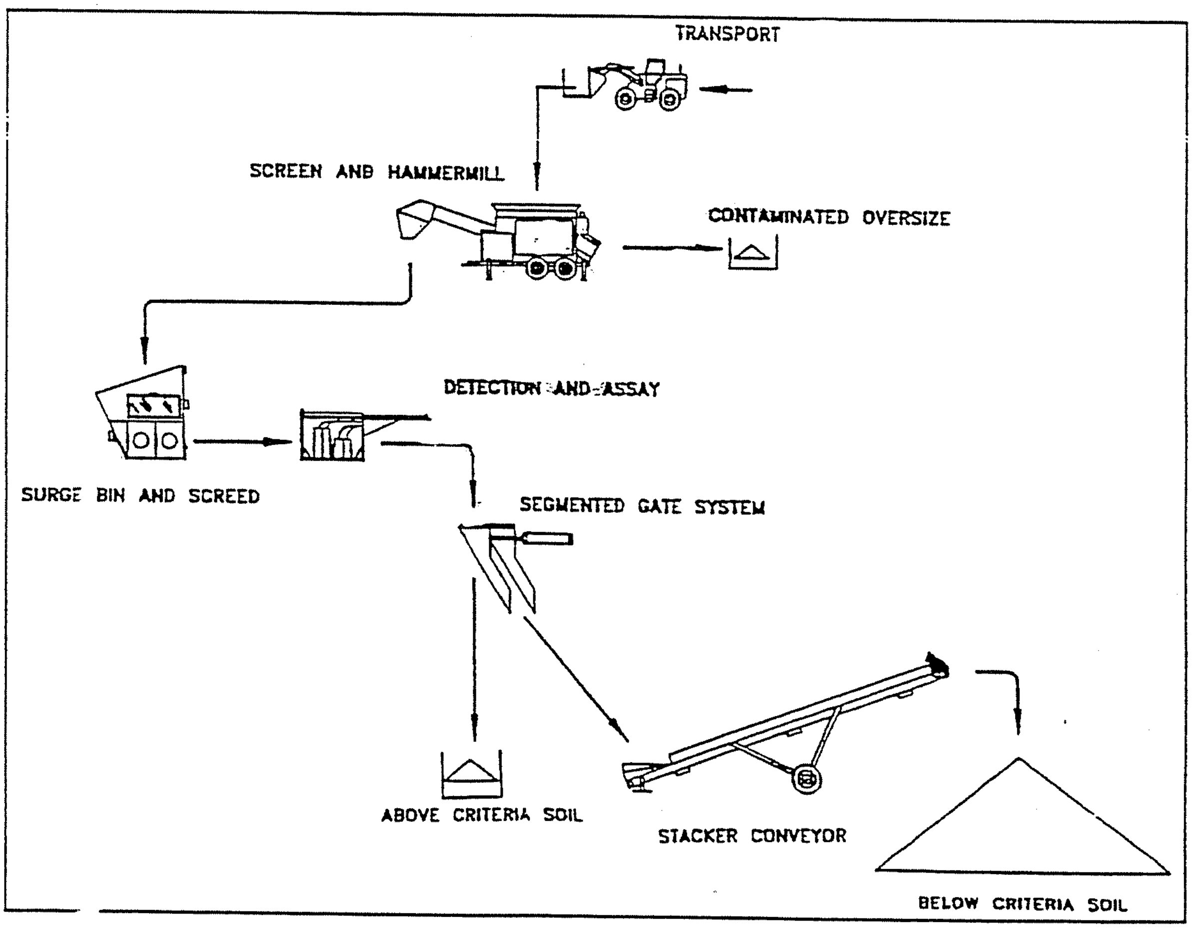
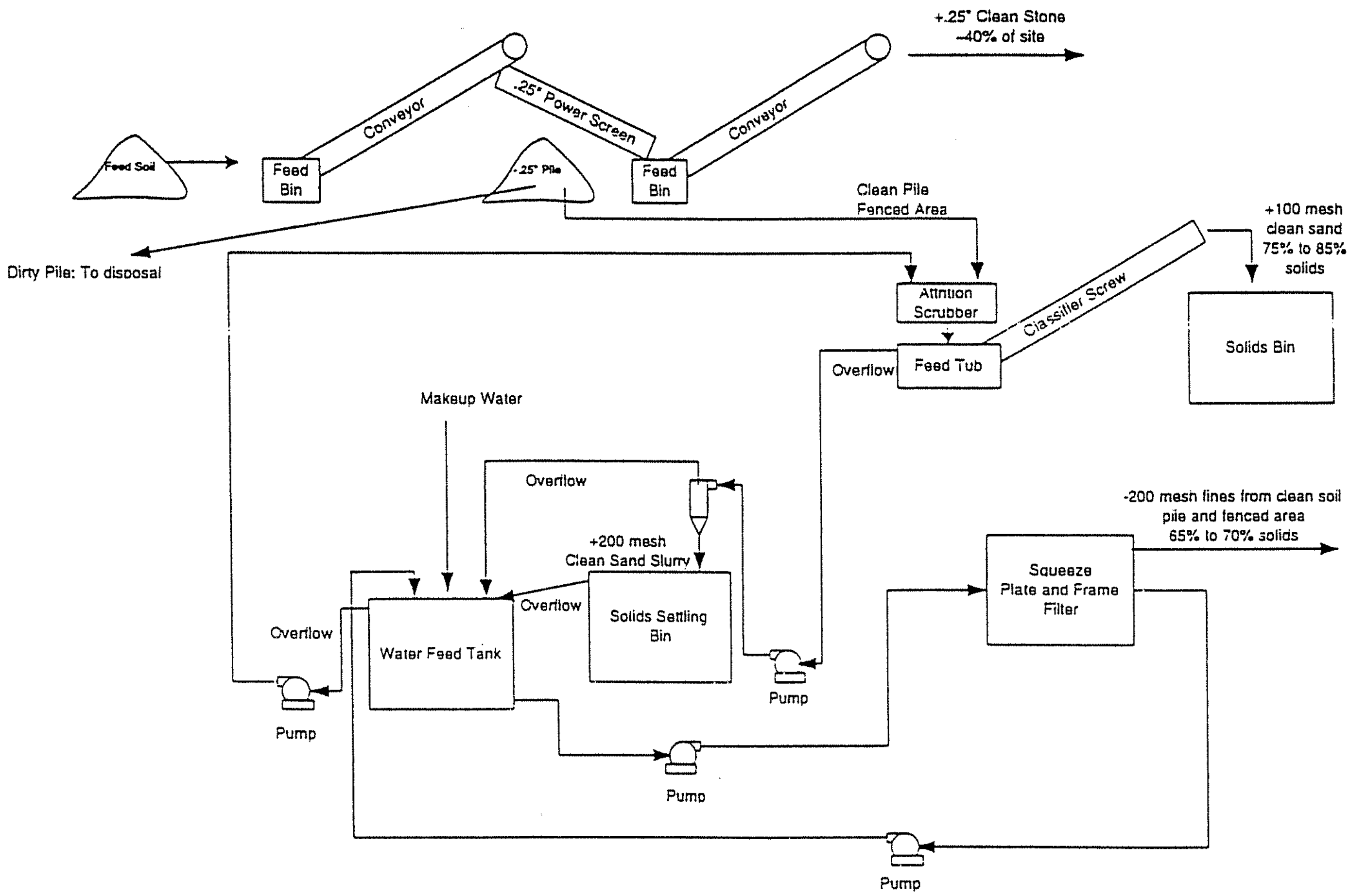


FIGURE 2.4-2

FLOW DIAGRAM OF WESTINGHOUSE DESIGNED SOIL SCREENING AND RINSING SYSTEM



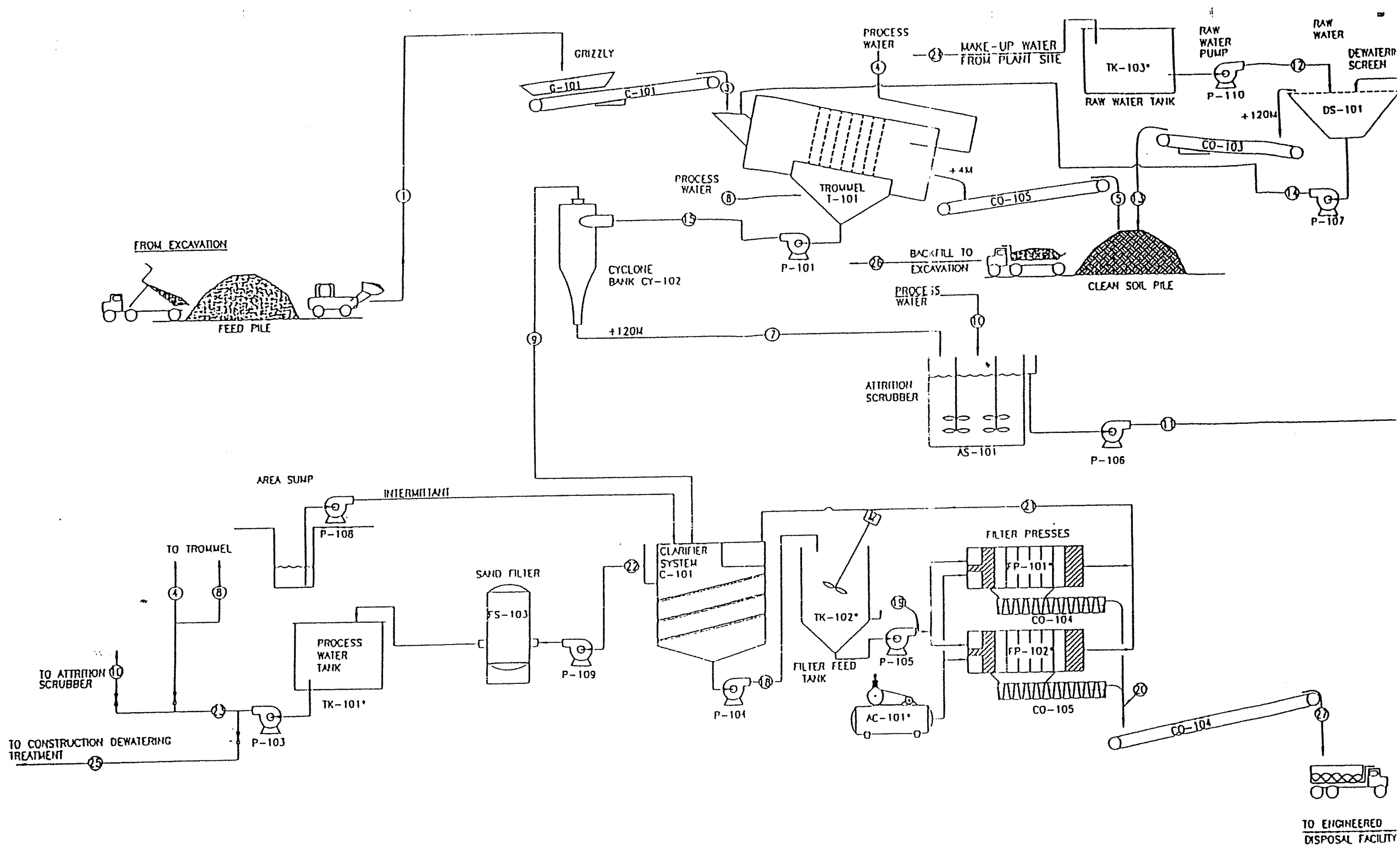


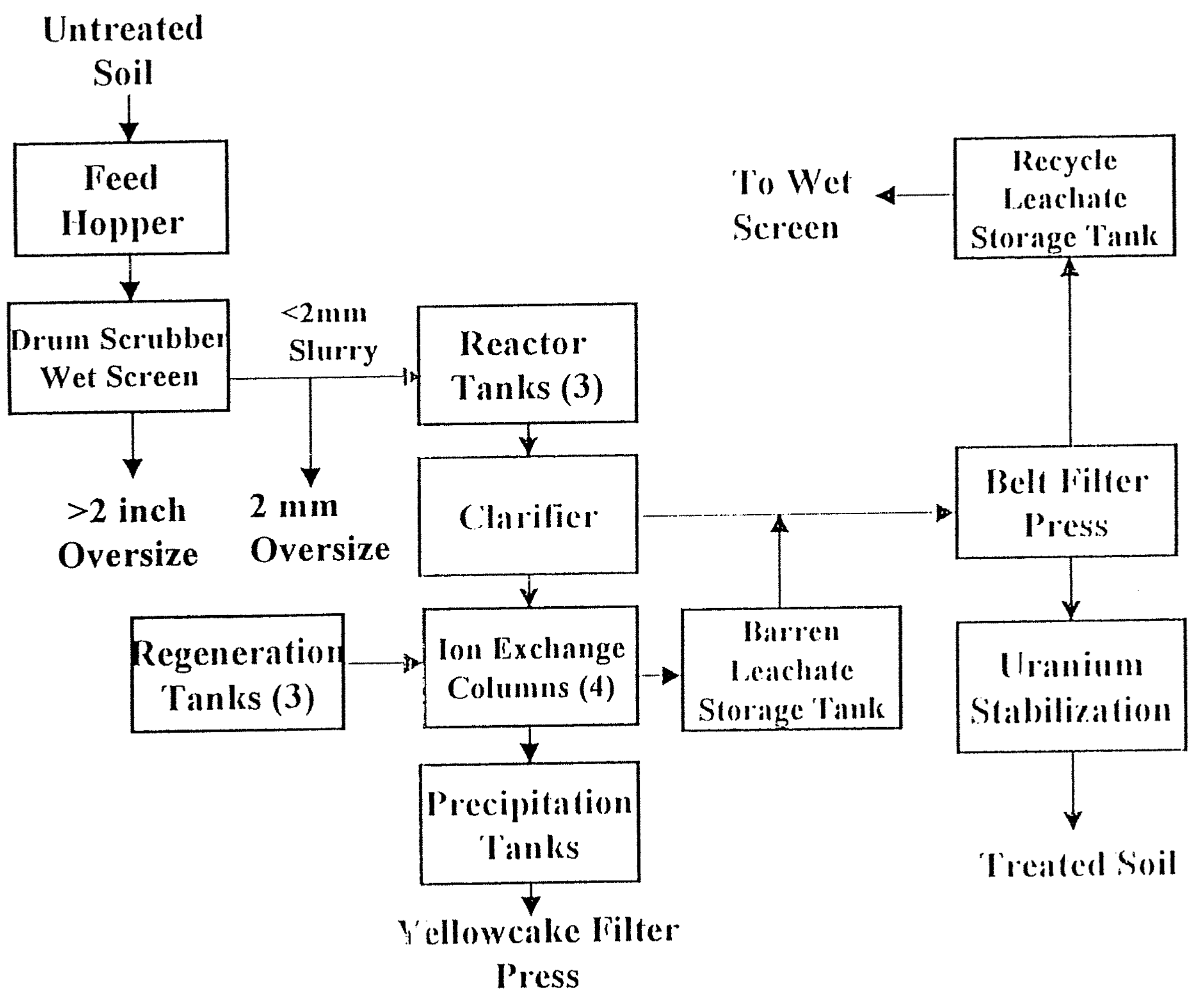
FIGURE 2.4-3

FLOW DIAGRAM OF SOIL SCREENING AND RINSING DESIGNED FOR MALAYSIAN GOVERNMENT

FIGURE 2.4-4

RMI ENVIRONMENTAL SERVICES INC.
SOIL SCREENING AND WASHING

Process Flow Block Diagram



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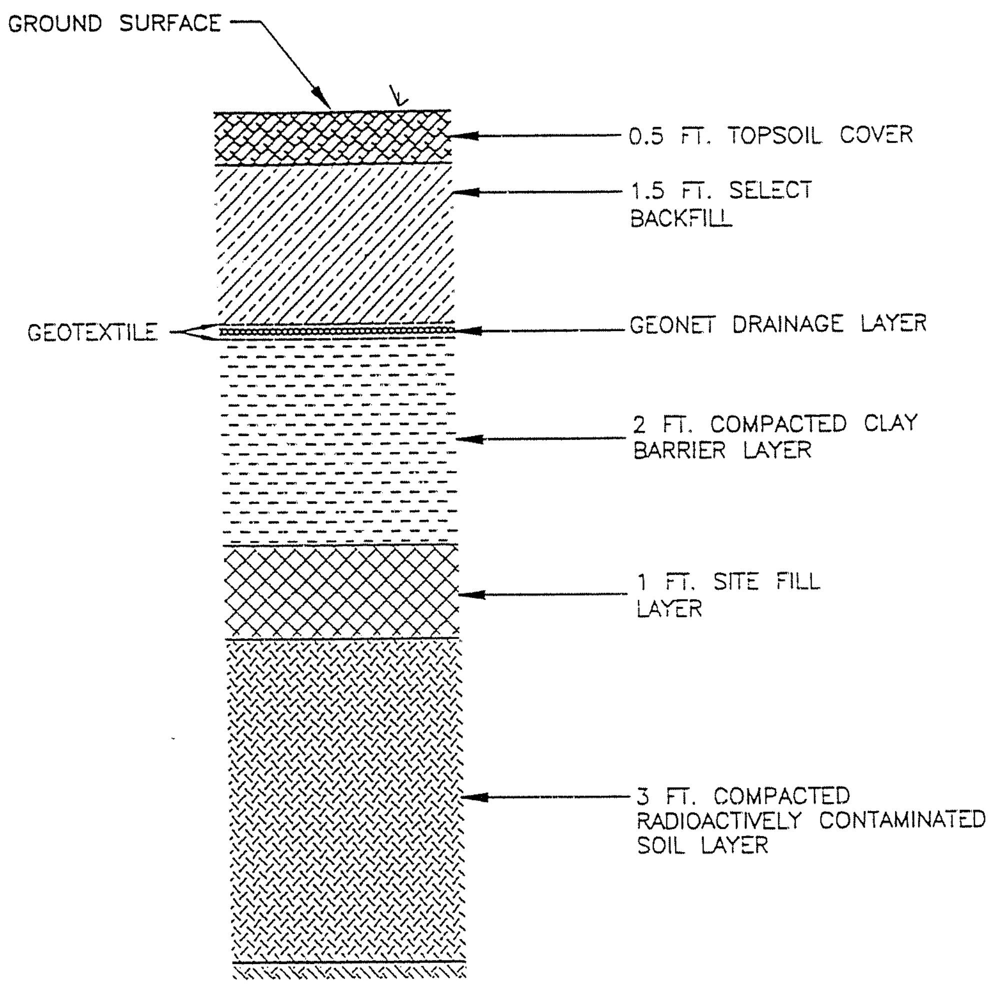

FIGURE 2.5-1

CONCEPTUAL DESIGN OF CLOSURE CELL WITH TYPICAL CAP AND CELL LAYER

B. KOH & ASSOCIATES

ATTACHMENT 1

Attachment 1

CONCENTRATION OF TOTAL URANIUM IN BLAIRSVILLE SURFACE/SUBSURFACE SAMPLES AREAS A AND B

SAMPLE SC-	INTERVAL "	TOTAL U (pCi/g)
1	22-25	18.8
2	29-32	17
3	8"-24	15.8
	11"-13	14.8
4	0-8	4.75
	12"-15	74
	23-25	10.5
5	0-7	3.5
	7"-25	4.25
	18-21	12.3
6	36-38	15
9	0-6	4.25
	6"-28	4.75
	23-25	18.5
	28-48	3.9
	46-48	13
10	0-6	4
	6"-24	10.5
	24-34	3.75
	34-36	16
11	41-43	18.8
	71-73	18.5
14	41-43	16.8
15	12"-14	15.8
16	0-5	4.75
	5"-25	3.75
	23-25	38
17	34-36	13.5
18	17-19	18
	36-39	14
19	24-26	15.8
	36-38	13
20	0-8	29.8
	10"-25	5.25
	27-29	22.1
21	0-8	185
	4"-6	312
	8"-23	3.25
	36-38	15.5
22	6"-24	30
	22-24	14.8
	44-46	13.4
23	16-18	36.8
	23-42	4
	37-39	14
24	4"-6	403
	24-26	16
25	4"-6	202

Attachment 1

CONCENTRATION OF TOTAL URANIUM IN BLAIRSVILLE SURFACE/SUBSURFACE SAMPLES AREAS A AND B

SAMPLE SC-	INTERVAL "	TOTAL U (pCi/g)
25	25-27	14.3
26	47-49	14.5
27	32-34	17
28	24-26	15.8
	36-38	15.5
30	0-8	39.5
	6"-8	43.5
31	8"-10	15.3
	34-36	14.5
32	28-30	15.8
33	18-20	17
	40-42	13.3
34	0-6	43.8
	6"-24	48
	17-19	50.8
	25-38	43.5
	48-50	13.8
35	4"-6	378
	30-32	92.5
	106-108	11.5
36	16-18	21
	60-62	13.8
37	18-20	15.3
38	18-20	25
	60-63	13
39	6"-8	20.3
	22-24	15.3
40	0-5	27.3
	5"-25	103.8
	14-16	139
	25-41	3.5
	36-38	18
	60-73	4.5
	73-97	4.3
41	0-8	30.8
	8"-25	14.5
	16-18	44
	25-47	3.3
	34-36	15.8
	47-68	4
	68-80	3.8
42	26-28	18.5
	108-110	13.5
46	72-74	19.8
	98-100	12.3
47	27-29	17
	71-73	13.3
	AVERAGE	35

ATTACHMENT 2

Environmental Services
A Division of RMI Titanium Company

P.O. BOX 579
ASHTABULA, OHIO 44005-0579
440/992-7442
FAX 440/993-1995

RMIES-ENG:99-032

October 15, 1999

Mr. Ted Adams
B. Koh and Associates
11 West Main Street
Springville, NY 14141

Dear Mr. Adams:

It was a pleasure to have you, Dan Wesolowski and Joe Nardi visit the RMIES facility on September 29, 1999. Based upon your request, RMIES is submitting the following information and comments for your consideration concerning the benefits of soil washing technology to cost effectively remediate Westinghouse' Blairsville facility. This information is preliminary based upon the volumes and characterization information provided at the meeting and in subsequent conversations.

RMIES is currently working with the Ohio Department of Health to modify the RMIES license to permit treatability and pilot scale studies of non critical mass materials. This license modification would allow RMIES to perform treatability studies of the Blairsville soil within the next six months. RMIES also has access to mobile licenses which would allow treatability studies to be performed earlier if desired.

Treatability studies would be required to confirm the applicability of soil washing, the process efficiency, process configuration, quantity and quality of residuals produced and provide a basis of a detailed project cost estimate. A treatability study performed in accordance with the attached workplan could be performed for approximately $50,000 at the RMIES facility. If an expedited schedule is required, this treatability study could also be performed at the Blairsville facility; but would incur some additional mobilization and demobilization costs, as well as travel and per diem charges.

Based upon the preliminary characterization information of the Blairsville facility (i.e., 170,000 ft^3 contaminated soil, nominal activity of 100 pCi/g uranium oxide in soil, 30 pCi/g treatment standard, and current $50/$ft^3$ Westinghouse burial cost), RMIES believes the sodium carbonate/sodium bicarbonate leaching process which is being utilized on RMIDP soils would also be cost beneficial in remediating the Blairsville soil. Due to licensing considerations associated with processing large volumes of soil with enriched uranium at the RMIES facility, and commercial considerations associated with additional transportation and clean soil disposal

RMI Environmental Services
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costs; it is our opinion that on-site treatment at the Blairsville facility is preferred. The costs associated with this approach would be approximately $400 per ton and would include the following:

- Make necessary Blairsville facility and infrastructure improvements
- Mobilize and demobilize soil plant
- Wash Blairsville soil
- Perform process and treated soil free release sampling and analysis
- Manage and dispose of chemical process residuals

For baseline assumptions, 90% of the original soil volume would meet the 30 pCi/g clean soil treatment standard and could be back filled on site. Westinghouse would be responsible for excavation and staging of contaminated soil, clean soil backfilling, and management and disposal of the residual 10% volume which would consist of soil fractions which did not meet the free release criteria. None of the waste would be expected to be profiled as mixed waste.

In addition to soil washing, RMIES would like to discuss other opportunities to support the Blairsville remediation project such providing analytical, engineering or management support. Please review this information and contact me at (440) 993-2804 you have any questions or comments.

Sincerely,

Jeff P. Kupa
Director, Technical & Commercial

JPK/cd

cc: J. Henderson
R. Brewer

Soil Washing Treatability Study Workplan

For evaluation of the applicability of soil washing for a specific site, performance of a treatability study is required. Treatability Study will confirm the applicability of soil washing, the process efficiency, process configuration, quantity and quality of residuals produced and provide the basis for preparation of a detailed project cost estimate.

Scope of Treatability study

The treatability study will determine the basic soil characteristics such as soil particle size distribution, contaminants present and distribution of the contaminants as a function of soil particle size. After determination of basic soil characteristics, bench testing of each of the soil washing unit operations will be performed in order to optimize the selection of key design parameters, prepare a process flow diagram and mass balance for the actual operations.

Set-Up of Treatability Equipment

The equipment to be used for the study will consist of various laboratory equipment, mixers, wet screens and glassware, ball mill/mixer, and assorted buckets and tubs. The equipment will be set-up in the RMI facility, or at the generating site, as each project plan dictates. Four 5-gallon buckets of soil will normally be used for this study. Herculite will be placed on the floor, counter-tops and fume hood in the work area. The drains will be plugged and all liquid waste will be contained. Any solid waste generated will be placed in the original 5-gallon buckets and returned to the generating site. Liquid wastes will be pumped into 5-gallon buckets and returned to the generating site. When the study is complete, all of the equipment used will be cleaned, by washing with water, or soap and water, and surveyed to insure that no contamination is left behind. The waste generated by this cleaning will be combined with the waste from the study.

Performance of the Treatability Study

Activities conducted in the laboratory will include the bench-scale testing of soil washing unit operations, as well as chemical and radiological analysis of the soil samples. The key activities to be conducted include:

Sample homogenization and preparation of four composite samples (+25 kg each)
Screening to generate an oversize material (>12.5 mm) and a soil fraction (<12.5 mm).
Determination of the soil particle-size distribution through wet screening (0.038, 0.063, 0.125, 0.25, 0.5 and 1.0 mm).
Soil washing bench testing

Sample Homogenization and Preparation of Composite Samples. After each of the soil samples are well mixed, composite samples will be prepared. Mixing procedures will include quartering the combined sample, mixing the individual quarters, followed by re-combining the quarters with further mixing until the sample appears homogenous.

Screening. A total mass of 10 to 15 kg of each of the composite soil samples will be dry screened at 12.5 mm to remove large rocks and debris. This work is conducted using a 12.5 mm screen with mechanical vibration if appropriate. The coarse fraction >12.5 mm and soil fraction <12.5 mm will be weighed.

Chemical And Physical Analysis of the Gross Oversize and the Feed Soil Material. All weights of the bulk soil fractions produced from the dry screening will be obtained on a wet weight basis. Representative aliquots of both fractions will be collected for determination of percent moisture. The coarse fraction >12.5 mm will be crushed and ground for chemical analysis. A representative sample of the soil fraction <12.5 mm will be collected, ground and submitted for chemical analysis.

Wet Screening. Each of the soil fractions (<12.5 mm) will be screened to determine the soil particle size distribution using a modification of ASTM D-2217-85. A series of seven screens will be used which will produce the following five soil particle-size fractions.

Sieve Size	Fraction	Designation
1 mm	>1 mm	Process Oversize Fraction
0.5 mm	0.50 mm to 1 mm	Sand Fractions
0.125 mm	0.125 mm to 0.50 mm	Medium Soil
0.125 to 0.063 mm	0.063 mm to 0.125 mm	Fine Sand
0.038 mm	0.038 to 0.068 mm	Silt
0.020 mm	0.038 mm	Fines

Approximately 200 to 300 grams of material will be used to generate the particle size distribution curve.

Soil Washing Bench Testing
A chemical extraction study will be performed on the size fraction or fractions that contain the contaminant of interest. The purpose of the extraction component of the treatability study is to determine if commercially available approaches to extraction using carbonate/bicarbonate are applicable and effective in remediating the soils. Application of carbonate/bicarbonate leaching is dependent on a number of factors that effect the process efficiency, and the cost of the process. This study will address the key process conditions affecting efficiency and cost, these parameters are listed below:

Reaction Rate
Temperature Affects
Effects of Oxidizing Agents
Effects of Complexing Agents
Use of Ion-exchange and or Ultra-Filtration Technology for the Concentration of the Contaminant and the Recovery of the Leaching Solution
Use of Flocculants for the Dewatering of the Slurry

The following experiments will be conducted as part of the effort.

Extraction with Carbonate Salts
Chemical Oxygen Demand
Strong Oxidant/Carbonate Extraction
Extraction at Varying Temperature (ambient to 60°C)
Complexing Agent/Carbonate Extraction
Evaluation of Ion-Exchange/Ultra-Filtration Processes
Evaluation of Commercially Available Flocculants and Coagulants

An Example of an experimental procedure follows:

EXPERIMENT 1 - SELECTION OF CARBONATE SALT

The purpose of this experiment is to determine the most effective carbonate salt to use in the extraction process. Sodium ions, potassium ions and ammonium ions cause varying degrees of changes in the mineralogical structure of soil minerals. Because of the different behavior, the availability of the plutonium to extraction may be affected depending on whether the cation is sodium, potassium or ammonium. Each of these salts will be used at ambient and elevated temperature to extract plutonium from pretreated sand and fines. This experiment will be conducted using the sand and fines from one sample, considered to be most representative of site conditions.

Equipment

2 6-position Jar Test Stirrers
12 2 Liter Plastic Beakers
Water Bath Capable of Continuous Operation at 60°C
Thermometer
Centrifuge Capable of Accepting 250 to 500ml plastic containers
pH Meter
Balance (0.1g sensitivity)
Transfer Pipettes

Reagents

1 kg Dry Weight Pretreated Sand of the Selected Sample (+38um)
1 kg Dry Weight Pretreated Fines of the Selected Sample (-38um)
4 liters 0.2 M Sodium Carbonate Solution
4 liters 0.2 M Potassium Carbonate Solution
4 liters 0.2 M Ammonium Carbonate Solution
pH Buffers (7.0 and 10.0 SU)
Deionized Water
1 N Hydrochloric Acid
1 N Sodium Hydroxide
1 N Potassium Hydroxide

Obtain the Sand and Fines samples from the designated sample buckets. The % dry solids in the sample must be known prior to beginning this test.

0.2 M Sodium Carbonate Solution. Add 84.8 g anhydrous Na_2CO_3 (FW 106) to 4 Liters of deionized water-. Stir until dissolved. Check pH using a pH meter. The pH should be approximately 11.6.

0.2 M Potassium Carbonate Solution. Add 110.6 g anhydrous K_2CO_3 (FW 138.2) to 4 Liters of deionized water. Stir until dissolved. Check pH using a pH meter. The pH should be approximately 11.6.

0.2 M Ammonium Carbonate Solution. Add 76.9 anhydrous $(NH_4)_2CO_3$ (FW 96.1) to 4 liters of deionized water. Stir until dissolved. Check pH using a pH meter. The pH should be approximately 9.1.

Experimental Procedure

The following experimental procedure is organized in four sections: (1) preparation of soils for extraction, (2) ambient temperature procedures, (3) elevated temperature extraction at 60°C, and (4) preparation of extracted soils for isotopic/elemental/chemical analysis of the contaminant.

Preparing Soils for Extraction

Do not use oven dried samples for the following procedure, you must use sand and fines that have not been allowed to dry. Take 6 aliquots of well mixed wet sand such that each aliquot has a dry solids mass of 120g (should be about 150g wet weight). Place each aliquot in a separate 1.5 or 2 liter beaker. Add 500 ml of the sodium carbonate solution to two beakers, 500 ml of potassium carbonate solution to the second pair of beakers, and 500 ml of the ammonium carbonate solution to the third pair of beakers. Calculate the volume of water included in the wet sand using the following equation:

water volume $_{(sand)}$ (ml) = Sand Mass (wet wt.) x [1-% dry solids / 100]

Calculate the volume of deionized water required to bring the total volume of liquid in each beaker to 1 liter using the following equation:

Volume deionized water = 1,000 ml - water volume $_{(sand)}$ (ml) - volume carbonate (ml)

Add the calculated amount of deionized water to each of the six beakers. The molarity of leaching solution in each extraction is now 0.1M. Place the beakers in the Jar-Test stirrers and stir for 10 minutes, measure and record the pH. If the pH of the resulting mixture decreases from the pH of the original extraction solution by more than 0.5 SU adjust the pH of the sodium carbonate solution with 1N sodium hydroxide and the potassium and ammonium carbonate solutions with 1N potassium hydroxide. If the pH of the solutions has increased by more than 0.5 SU, use 1N hydrochloric acid to reduce the pH. Record the volume of hydroxide or hydrochloric acid solution added.

Repeat this procedure for the six aliquots of wet fines. Assuming about 20% dry solids for the fines, the mass of wet fines required will be about 600 grams.

Ambient Temperature Extraction

Select a set of beakers of sand and fines for ambient temperature leaching such that each the three leaching solutions will be tested for the sand and fines. After the pH is adjusted in the samples, measure and record the temperature in each of the six beakers. Turn on the stirrers and adjust the stirring rate such that the soil is not allowed to settle along the edges of the beakers.

At 1-hour intervals (or longer if no pH change is noted), turn off the stirrers and measure the pH in each beaker. If the pH has changed by more than 0.5 SU from the pH of the original extraction solutions adjust the pH with sodium hydroxide, potassium hydroxide or hydrochloric acid as appropriate. Record the volume of each reagent added. Allow the extraction to continue for approximately 6 hours. Record the time and turn off the stirrer. Measure and record the temperature and pH of the extraction solutions in each beaker.

Elevated Temperature Extraction

Select a set of beakers of sand and fines for elevated temperature leaching such that each the three leaching solutions will be tested for the sand and fines. **Before adding the extraction solution to the soil samples, assemble the water bath**. Set the temperature of the bath to 60°C +/- 2°C. Allow the bath to warm to temperature. If possible, preheat the deionized water and the extraction solutions to near 60°C in the water bath. When pH adjustment of the samples is complete, note and mark the liquid level on the side of the beaker with a permanent marker.

After preparing the samples with the preheated reagents and adjusting the pH as appropriate, place the beakers in the water bath, measure, and record the temperature in each of the six

beakers. Place the Jar Test stirrer in the water bath. Turn on the stirrers and adjust the stirring rate such that the soil is not allowed to settle along the edges of the beakers.

At 1-hour intervals check the temperature in each beaker and note the level of extraction liquid. If the liquid level in the beaker has decreased, add deionized water to return the volume of liquid to its original level. Also, at 1-hour intervals (or longer if no pH change is noted), turn off the stirrers and measure the pH in each beaker. If the pH has changed by more than 0.5 SU from the pH of the original extraction solutions adjust the pH with sodium hydroxide, potassium hydroxide or hydrochloric acid as appropriate. Record the volume of each reagent added. Allow the extraction to continue for approximately 6 hours. Record the time and turn off the stirrer. Measure and record the temperature and pH in each beaker.

Preparing the Extracted Soil for Analysis

The preparation of the extracted soil should begin as soon as possible after the extraction is complete. It is **not** appropriate to allow the soil to remain in contact with the leaching solution overnight.

Allow the sand to gravity settle and then decant the extraction solution from each of the sand beakers through a 38um sieve. Collect the extraction solution in a 1 Liter sample bottle and retain each of the three extraction solutions for possible subsequent analysis. Wash each sand aliquot thoroughly with 2 to 3 aliquots of deionized water. Place the washed extracted sand in tared drying dish and dry it at 105°C.

Separation of the fines from the extraction solution will require the use of a centrifuge. Pour each of the fines slurries into 2 labeled 500ml centrifuge bottles. Centrifuge at medium speed for several minutes or until a clear supernant is generated, decant the supernant from each pair of centrifuge bottles into a 1-Liter sample bottle. Be very careful not to allow any visible solids to be lost to the supernant. Retain the sample bottle containing the extraction solution (supernant) for further analysis. Rinse the fines remaining in the centrifuge tubes with deionized water and centrifuge a second time. Repeat the rinsing process 2 to 3 times to remove residual extraction solution. Transfer the wet fines from the pair of-centrifuge tubes to tared drying pan and dry at 105°C.

Samples for Analysis

Measure and record the weight of the dried soil samples. Submit to the RMI Laboratory the 6 dried and extracted sand samples as well as the 6 dried and extracted fines samples for isotopic/elemental/chemical analysis of the contaminant(s).

Analysis Plan

The analysis program for the project will use two tiers of laboratory analyses:
onsite (XRF, alpha spectroscopy, or other appropriate analysis technique) analyses to support the evaluation of the unit operations and process optimization during the tests,
off-site commercial laboratory analyses to confirm the results of the on-site lab analyses.

Waste Management

All waste fractions and contact water in the treatability study will be collected in a 5 gallon buckets.