Readings performed routinely as part of CSM's radiation protection programs indicate that conditions have not changed significantly since the 1993 surveys.

4.3 REMOVABLE ACTIVITY RESULTS

SEG took smears in all structures and outdoor pads with the potential for residual radioactivity. These results are summarized in Appendix 3 of Reference 6.1, which presents the counting results for these smears. Most portions of the ore processing facilities had activity levels exceeding 200 dpm/l00 cm^2. Results from routine surveys by CSM support those data, so they are assumed to require decontamination. Readings performed routinely as part of CSM's radiation protection programs indicate that conditions have not changed significantly since the 1993 surveys.

4.4 SOIL SAMPLE RESULTS

During the 1993 survey, SEG took soil samples in areas that they judged were likely to exhibit residual activity. The sample locations were based on historical records and preliminary measurement results. These results are summarized in Appendix 4 of Reference 6.1, which contains the instrument readings and the maps showing the survey locations. Most of the samples were surface composite samples taken within a couple of inches of the surface from within the sample areas. Soil activity levels of greater than the preliminary criterion of ~2.5 pCi/g of thorium-232 were considered significant. Most (31 of 46) of the surface samples were collected from active areas that exceeded the 2.5 pCi/g level. Deep soil samples were taken in areas where the activity level was expected to be well over this criterion. Four out of nine of the subsurface samples did not exceed 2.5 pCi/g of thorium-232. Deep soil samples were not obtained from near Buildings 73 and 74, as the soil was mostly gravel to a depth greater than 6 inches. It is important to note that the high quantities of gravel in some of these areas would allow ore products to penetrate deeper than could occur in the clay soil found in other areas.

In January 2003, WESTON collected soil samples at intervals of 0 – 6 inches and 6 – 12 inches below the ground surface from about 50 locations in potentially contaminated areas of the site. Based on those data, the areas for excavation were delineated and an excavation depth of 12 inches was established. This cost estimate uses soil volumes for excavation and disposal determined using these data.

4.5 URANIUM AND THORIUM CHAIN EQUILIBRIUM DATA

The ore material that is processed by CSM is a physical concentrate of niobium and tantalum minerals. It generally has no prior history of metallurgical extraction or chemical processing, so there is no reason to expect the uranium and thorium decay chains in the ore material to be out of equilibrium to a significant degree. Unprocessed ore material is present in the ore storage areas and ore grinding areas.

There is a mass balance between presscake (fluoride waste solids) and filtercake because the amount of radioactivity in discharged wastewater is negligible. The presscake that is produced by the tantalum extraction process is expected to be slightly deficient in lead-210 and polonium-210 compared to the other uranium decay chain isotopes that are present. Otherwise, the decay chains in presscake should be approximately in equilibrium. The presscake solids are likely to be

Filtercake will not be present on-site to any appreciable degree because its routine disposal at local landfills is necessary for daily plant operations to continue. The quantity of filtercake generated each year is 18,000 tons, and the cost to analyze the radionuclide content, package, transport, and dispose of the filtercake is $57/ton. The average cost to dispose of filtercake each day is $4,104, assuming 50 operating weeks per year and 5 days per week for disposal. In the event of bankruptcy, the site would stop producing filtercake at the same time that it ceased transport and disposal, so a one-day accumulation might need to be disposed as part of the site decommissioning. This cost of $4,104 is less than 2% of the total overestimate of costs described in section 5 of this document, and was therefore not displayed in the tables or in the total.

Filtercake is only likely to be present as a soil contaminant in the immediate vicinity of the wastewater neutralization plant, and may not be present in concentrations that exceed cleanup levels. Radionuclide concentrations would be very low in soils contaminated with filtercake, as indicated by data from samples collected in January of 2003 and presented in Table 4-5. The low levels are reasonable because the filtercake itself has very low concentrations.

Table 4-5. Soil Concentrations Around The Waste Water Filtration Building

	Sample Location I.D. (pCi/g)					
	I26-06-061	**I26-12-062**	**I28-06-065**	**I28-12-066**	**I29-06-057**	**I29-12-058**
U-238	1.57 ±0.39	NR	0.95 ±0.30	NR	1.92 ±0.55	NR
U-234	1.40 ±0.36	NR	0.53 ±0.21	NR	1.88 ±0.54	NR
Th-232	1.20 ±0.37	NR	0.30 ±0.13	NR	0.46 ±0.23	NR
Th-230	1.37 ±0.40	NR	0.89 ±0.26	NR	1.54 ±0.47	NR
Th-228	1.11 ±0.35	NR	0.27 ±0.13	NR	0.45 ±0.22	NR
Pb-214	2.35 ±0.45	2.39 ±0.31	0.73 ±0.19	1.07 ±0.19	2.39 ±0.36	0.67 ±0.16
Pb-212	3.20 ±0.46	2.30 ±0.30	0.28 ±0.11	1.03 ±0.17	1.26 ±0.24	1.02 ±0.16
Pb-210	3.75 ±0.72	NR	1.73 ±0.55	NR	2.33 ±0.66	NR

4.6 ASSUMPTIONS AND INPUT FOR THE DOSE MODELING: SOIL CONTAMINATION

4.6.1 Future Land Use and Exposure Scenario

The Boyertown site is located on the fringes of suburban Boyertown. Assuming no significant changes from past trends, land use around the site will be industrial or suburban within in the next decade or two. To be conservative, CSM assumes that the future land use will be suburban-residential. Therefore the critical group is assumed to be suburban gardeners.

Suburban-residential land use implies a number of modifications to the standard scenario represented by D and D 2.1.0 (McFadden 2001). Suburban-residential land use typically does not involve raising poultry, livestock, or aquaculture. In addition, commodity crops such as wheat, rye or barley are not typically found in suburban-residential gardens.

4.6.1.1 Average Consumption Rate of Homegrown Produce for the Northeastern U.S.

The Exposure Factors Handbook (EPA 1998) (EFH), Table 13-33 provides regional consumption rates of fruits and vegetables for the northeastern United States. The average consumption rates, Figures 1 and 2 were calculated from the EFH data using Crystal Ball 2000.

5. COST ESTIMATE

The estimated cost for this project is $5,740,722 with the limitations and assumptions discussed previously. This estimate includes decontamination of equipment, concrete, and material (where feasible), radioactive waste disposal, radioactive waste volume reduction, health physics support, and final release survey. Details of the cost elements and methodologies are discussed below.

This cost estimate uses the latest disposal cost information from actual contract rates CSM has with their broker and the IUC disposal site in Utah. The contract with IUC is valid for one year with optional single-year extensions to the contract incorporating negotiable rate changes. These new cost parameters were applied to an initial cost estimate from 2002 that included costs to dispose of all materials at Envirocare of Utah. In the interest of simplicity, and to retain a conservative estimate of the total cost, several categories of costs were not reduced, as described below.

In Table 11.A of Attachment 4, the number of containers to be purchased to transport the presscake is shown as 268.7, but the container cost is based on 134.4 units because two trips to the disposal site are assumed and the containers would be reused, thus reducing the number of containers needed. A large number of containers remain in the estimate and the cost was reduced by only $52,404. The actual method of disposal incorporates container costs into the transportation cost, making about $58,000 of the container cost a conservative overestimate. The spreadsheet used to calculate the container costs was set to one decimal place, despite the fact that fractions of containers would be used. The minor cost impact from rounding up to the nearest number of whole containers is miniscule and adequately covered by the conservative overestimate.

In March 2004 the first presscake shipment to IUC was completed, making actual transportation rates available. The estimated transportation rates still used in this estimate are $640/ton; but actual rates now are $519/ton. This results in a total current overestimation of container and transportation fees equal to $491,392.

Additionally, the current contract rates with IUC do not require surcharges as apply at Envirocare. However, the surcharges have been left in Table 11.C resulting in an additional overestimation of the disposal fees equal to $239,448. Additional savings of a smaller scale (due to smaller quantities) would apply to the scabbling dust and soils. This leaves a current total of $730,840 that can be readily documented as an overestimate in the cost estimate. Increasing the contingency in Table 15 from 15% to 25% would add only $499,277 to the total, which would still leave an overage of about $231,000.

5.1 ESTIMATING APPROACH

This cost estimate is based on a detailed survey performed in 1993 by SEG (Reference 6.1), results of routine surveys performed at the site in the years since 1993, and supplemental measurements and laboratory analyses acquired in January 2003. This cost estimate reflects present day (2003) decommissioning standards and unit costs for labor, equipment rental, transportation, and disposal.

The Radiation Safety Officer at CSM indicated in 2002 that the licensed activities are continuing in essentially the same locations at the CSM facility as they were in 1993, with minor changes as noted in this report. In addition, no major spills or releases of radioactive materials have occurred since 1993. Therefore contamination levels in plant areas are considered to be unchanged from 1993. However, the depth of contamination in soils around the site is considered now to require excavation to a depth of 12 inches rather than the 6 inches used in the 1993 cost estimate.

The release criteria for standing structures and soil have changed from numerical concentrations to a dose-based standard of 25 mrem/y. This made it necessary for WESTON to modify certain assumptions that SEG made concerning the extent of contamination that would have to be removed from standing structures and soil. Those assumptions were that more extensive decontamination would be required for standing structures and additional contaminated soil would require off-site disposal.

5.1.1 Procedures used to estimate the areas requiring cleanup

Surface contamination estimates were based on physical dimensions for the CSM plant and information provided in the 1993 survey performed by the Scientific Ecology Group (SEG). The building surface contamination areas that required cleanup were updated to include new areas where licensed activities, such as thorium doping are taking place.

Soil contamination volumes requiring cleanup were based on the 1993 SEG decommissioning funding plan as well as a supplemental radiological characterization that was performed by WESTON in January 2003. The goals of the WESTON supplemental characterization were to define background, to better define depths of contamination, to characterize the extent of contamination around the bulk storage bins, and to provide data for the revised DCGL calculations.

Estimates of surface contamination in plant areas were similarly based on the 1993 SEG report and verified by a review of contamination data from routine surveys performed in the past several years by CSM.

Current labor rates, transportation fees, and disposal charges were applied to the activities, and volumes and quantities of materials associated with the decommissioning effort. Rates, fees, and charges came from three sources, as listed below.

- Current quotes or existing contract rates of transportations and disposal charges from the licensed disposal sites that are currently acceptable to CSM,
- Labor rates that would be quoted by Weston Solutions in a competitive bid for similar work, as taken from proposals completed in the past year, or
- Regional rates for construction labor and equipment rental quoted in industry references, such as "RS Means Labor Rates for Construction Industry, 2003" for the Reading. PA region.

5.2 ESTIMATING METHODOLOGY

WESTON developed tables that correlate closely with the guidance provided in NUREG 1757, Volume 3, Appendix A to provide the buildup to the total cost estimate. WESTON's cost estimate tables are provided in Attachment 4. The rationale for the values in those tables is explained in the following sections. Unit costs and explanations are provided for each of the major categories of work that would need to be performed. Contracted labor and health physics personnel were assumed to provide support for all decommissioning activities. Time estimating factors, hours by labor category, labor rates, labor costs by major decommissioning task, equipment rental rates, and laboratory charges are provided in Tables 4, 8, 9, 10, 12, and 13 of 4. Table 15 in Attachment 4 provides a summary roll-up and total of all costs. Attachment 5 provides an ALARA analysis of this methodology as required by NUREG-1757, Volume 2, Appendix N.

5.2.1 Equipment and Tank Decontamination

In 1993 SEG assumed that equipment decontamination would generate a compacted waste volume equivalent to 5% of the volume of the equipment being decontaminated. That value is applied for the new cost estimate for the following reasons:

- The NRC accepted that volume reduction ratio for the CSM site in the last cost estimate and has not provided more stringent values.
- SEG had extensive experience with such activities and based their estimate on that experience.
- Methods for compacting structural materials and equipment have continued to improve since 1993 and would, if anything, make the assumed volume reduction ratio easier to attain than in 1993.
- The volume estimate for equipment and tank decontamination includes both protective clothing and cleaning materials.

The numbers and dimensions of facility components are provided in Table 1 of Attachment 4. Unit labor factors for handling the equipment are provide in Table 4 of Attachment 4.

5.2.2 Concrete and Surface Decontamination

Concrete processing costs were estimated from WESTON construction experience with scabbling and pressure washing concrete surfaces, which correlated well with SEG's decommissioning experience described in the 1993 cost estimate. Labor costs and equipment rental rates are taken from WESTON proposal efforts developed in the past year for similar activities and from accepted construction pricing references such as "RS Means Labor Rates for Construction Industry, 2003" for the Reading, PA region. The percentage of the areas in the structures that will have to be decontaminated was increased beyond those previously defined by SEG to meet the current decommissioning criteria. Dimensions and calculations for the facility structures are provided in Table 2 of Attachment 4.

5.2.3 Soil Decontamination and Determination of Volumes

Soil decontamination includes the removal of three categories of material: residual ores, presscake, and contaminated soils around the operations buildings. The volume of ores was taken as the average quantity of ore held on-site to ensure continued operations of the site. Realistically, the ore feedstock should not be included in the cost estimate for decontamination because it is a valuable commodity and common sense dictates that CSM would use up all ores on-site prior to terminating its license. In addition, if ores were left at the site when CSM ceased operating, they would transfer them to another licensee who would pay for transportation, or they would sell them to another licensed operator to regain the price that had been paid for them. .

The volume of contaminated soil to be excavated was estimated by establishing contours around the process buildings based on the soil sample results and the DCGLs calculated in this document. This evaluation assumes that soils under the process building floors are not contaminated because the most common method of spreading contamination beneath concrete is by spills of liquids, and the liquids in the CSM process contain very limited amounts of the radionuclides. The presscake (fluoride residues that are disposed at the bulk storage bins) volumes were assumed to be the current amount of about 4,000 tons, which will diminish over the near future, as material is disposed at the Utah uranium mill site. Volumes of these materials are listed in Table 2 of Attachment 4.

5.2.4 Radioactive Waste Transportation and Disposal Cost

Contaminated piping, equipment, and objects that cannot be properly decontaminated or surveyed for surface contamination are assumed to be radioactive waste. These materials would be disposed of at a licensed disposal facility. Rates are provided in Table 11 that were acquired from WESTON proposals that had been completed since January 2001 for disposal of similar materials at Envirocare in Utah. Presscake, ores, and soils and concrete chips that exceeded release criteria would be transported to a licensed uranium mill in the western United States. CSM signed a contract with IUC in February 2004 and is listed on the IUC license as a source material supplier. Unlimited quantities of material may be transferred under this contract. The contract terms are valid for one year with options to extend the contract annually.

Site control and maintenance costs during decommissioning activities are expected to be negligible because existing perimeter fences are adequate to prevent access by the general public and they are kept in good repair. They should require no maintenance and repair because the schedule for decommissioning activities is short, less than one year, due to the relatively small size of the site. In addition, the specific areas where excavation and decontamination activities will be performed are a small fraction of the overall site, and will require limited amounts of temporary fencing, in the worst case. There will be no costs associated with long-term site maintenance and control because this estimate assumes the site will be cleaned to unrestricted release levels. Work area and site control monitoring will require minor effort and are included in the time allotted for health physics support.

6. REFERENCES

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6.3 NRC, Consolidated NMSS Decommissioning Guidance, NUREG-1757, Volumes 1, 2, and 3, September 2003.

6.4 NRC, Residual Radioactive Contamination From Decommissioning, User's Manual D and D Version 2.1, NUREG/CR-5512, Vol. 2, 2001.

6.5 EPA 1998. Exposure Factors Handbook, Volume 2, PB98-124233, Chapter 13. Washington, DC.

6.6 K McFadden, et al. 2001. Residual Radioactive Contamination From Decommissioning: User's Manual D and D Version 2.1. NUREG/CR-5512, Vol. 2, SAND2001-0822P. Sandia National Laboratories, Albuquerque, NM.

6.7 NCRP 1999. Recommended Screening Limits for Contaminated Surface Soil and Review of Factors Relevant to Site-Specific Studies. NCRP Report No. 129. National Council on Radiation Protection and Measurements, Bethesda, MD, Page 104.

6.8 NRC 2002. Re-evaluation of the Indoor Resuspension Factor for the Screening Analysis of the Building Occupancy Scenario for License Termination, Draft NUREG-1720, Nuclear Regulatory Commission.

6.9 Weston Solutions 2003. Dose Assessment for Recycling of Wastewater Treatment Sludge from the Cabot Supermetals Facility in Boyertown, Pennsylvania. Submittal to NRC by Weston Solutions, Inc.