40-8778

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April 3, 2000

Mr. Larry Camper, Chief
Decommissioning Branch
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 28052

Subject: **Response to NRC March 3, 2000 Request for Additional Information Related to the Molycorp Washington, PA Facility Decommissioning Plan, Part I, Revision.**

Dear Mr. Camper:

In a letter dated March 3, 2000, the NRC requested that Molycorp provide additional information pertaining to the Molycorp, Washington, PA Decommissioning Plan, Part I Revision. Enclosed you will find the requested information.

If you have any questions concerning this submittal please call me at the above number.

Sincerely,

George W Dawes

George W. Dawes
Project Manager

Docket No.: 040-8794
License No.: SMB 1393

Enclosed: Response to NRC comments

NMSS01 Public

Response to NRC March 3, 2000, Request for Additional Information
Molycorp Washington, PA, Facility Decommissioning Plan, Part 1 Revision

NRC Comment A.1

An NRC review of the (February 1993) site characterization plan (SCP) for the Washington facility identified additional buildings (buildings 34, 20, 25, 26, 28, 29, 30 and 33) not included in the SCP that Molycorp should list as being located in the "affected area" (e.g., as determined by the methodology in NUREG/CR-5849). The 1995 site characterization report does not include surveys for six (20, 25, 26, 28, 29 and 30) of these buildings recommended for affected area surveys. Molycorp must provide the technical basis (via scoping surveys and radiological history) and data to describe the location and extent of contamination on all building surfaces, structures and physical abutments to buildings on the Washington site. Molycorp should also provide information on which buildings are planned to be demolished during remediation. For any building remaining on site in affected areas, Molycorp should provide its plans for remediating the buildings including plans for characterizing and remediating building surface contamination.

Molycorp Response A.1

The NRC comment discussed both buildings and site soils. Therefore, Molycorp's response addresses the classification of onsite soil, both open land areas and under buildings, as well as the building classification.

Figure 2-2a in the Part 1 decommissioning plan shows the areas of the site where contamination may exceed 10 pCi/g total thorium. This includes surface and subsurface contamination. Land areas east of Buildings 25, 22, and 1 were classified as unaffected, with the exception of the land area in the vicinity of the old baghouse, which was classified as affected. Land areas west of Buildings 25, 22, and 1 were classified as affected.

Land under the existing buildings was classified as affected or unaffected based on the building history. The land under a building that was present before FeCb production began will be classified as unaffected since there is essentially zero probability that the land under an existing foundation could have become contaminated. In addition, the land under Buildings 2 and 2W are classified as unaffected since they were constructed on the foundation of buildings that were present before FeCb production began. All of the unaffected land under buildings will be combined into one unaffected survey unit. A total of 30 soil samples will be collected under the unaffected buildings.

The land under buildings and structures that were built after the beginning of FeCb production was classified as affected.

Enclosure

The buildings were classified based on the history of building use. Several buildings are classified as affected although the potential for significant contamination is low for all buildings. The fact that a building is constructed on land that is classified as affected does not require that the building also be classified as affected. The buildings classified as affected, and the reasons for their classification, are listed below.

- Building 26 is used to store drums of pond residues.
- Building 33 is used to store soil cuttings from the site characterization studies.
- Building 1 lab was used to store soil samples and radiological standards. The lab was also used to conduct a bench scale test to separate thorium from slag in 1993.
- Building 29 contained the ball mill operations during FeCb production.
- Building 19 was used to store soil samples.

The remaining buildings on the site are classified as unaffected since no operations involving FeCb production or storage were conducted in the buildings. Building 39 is currently used to store two nuclear density gauges among other items. However, these gauges have never been used and the building will be classified as unaffected. A scoping survey will be performed to verify the status of the unaffected buildings. The survey will consist of limited scan surveys and direct measurements in biased areas such as high traffic areas and selected horizontal surfaces. Any measurement exceeding the instrument MDA will be investigated and the extent of the scoping survey expanded. If the average activity level for all of the direct measurements exceeds 10% of the thorium surface contamination limit, i.e., 100 dpm/100 cm^2, or an individual measurement exceeds 25% of the thorium surface activity limit, i.e., 250 dpm/100 cm^2, the building will be classified as affected.

Table A.1 lists the classification of all open land areas, land under buildings and structures, and the buildings and structure surfaces on the Washington site.
All of the buildings identified in the NRC staff comment are included in Table 1 with two exceptions. Building 20 and 30 are not listed since they were renamed to Building 22 and 32, respectively, after the February 1993 site characterization plan was submitted to NRC.

It is not anticipated that building surfaces will require extensive remediation. Any remediation that is performed will be accomplished using standard techniques such as wiping, vacuuming, and scabbing. Building subsurface contamination will be addressed by either 1) demolishing the building, removing the foundation, and applying the soil remediation and survey methods described in the decommissioning plan, or 2) removing the foundation as necessary, with the building standing, to access, remediate, and survey the subsurface soil.

Molycorp's Response to NRC comment B.1.c addresses buildings to be demolished.

Table A.1 - Final Survey Classification of Land and Buildings on the Washington Site

	Affected Classification	**Unaffected Classification**
Open land areas	West of Buildings 25, 22, and 1 Area in the vicinity of the old baghouse	East of Buildings 25, 22, and 1
Land Under Buildings/Structures	Buildings 28, 32, 33, 34, 35, 36, 38, 39, and 42 Old ore unloading shed Ammonia storage tank Waste acid storage tanks Thickener filter press FeMo process baghouses and raw material storage bins 4 banks of transformers	2, 2W, 13,14, 19,21, 22, 23, 25, 26, 29, 31, 37, old guard house, acid plant and storage tanks, rail siding. Building 1 (additional characterization required to confirm classification)
Buildings	Buildings 19, 26, 29, and 33 Building 1 lab	Buildings 2, 2W, 13, 14, 22 23, 25, 28, 31, 34, 36, 37, 42 Old guard house Acid Plant (includes two acid storage tanks) Building 21 (includes compressor and oil storage rooms) Building 1 (except lab)

NRC Comment A.2

For the major work activities scheduled to take place during decommissioning of the Washington site, Molycorp must provide specific dose calculations to demonstrate that the activity will be conducted in accordance with NRC regulations and that any radiological exposure from the activity will be as low as reasonably achievable.

Molycorp Response A.2

Demonstration that decommissioning activities are conducted in accordance with NRC regulations is ultimately accomplished in the performance of the project. Active consideration of the regulatory requirements is included in the planning process. An initial step is to perform an assessment of potential radiological hazards for the project. This includes estimating the range of expected dose rates during conduct of basic decommissioning tasks. This provides a basis for determining the levels of protection needed.

Dose rates from direct radiation (gamma) from the thorium-bearing soil and slag mixture were calculated. Conservative assumptions were used to model source configurations. This is done to determine the range of dose rates that could be encountered in the absence of engineering or work controls. The results of the calculations are summarized in Table A.2.

Table A.2 - Calculated Dose Rates for Decommissioning Activities

Case Description	Source Model	Input Source Concentrations	Calculated Dose rate (mrem/hr)
Worker dose from excavation of contaminated material in Thorium Storage Pile	Finite slab – 232 ft x 39 ft base, 1 m thick with dose point **5 ft** from center of slab surface.	Uniform concentration of 1068 pCi/g total Th and 534 pCi/gm total U	1.50 (1.75 mR/hr)
General area dose rate in vicinity of excavated material.	Finite slab 10 x 1 m base and 10 ft high. Dose point **10 ft** from 10 x 10 m face & 1 m above ground.	Uniform concentration of 1068 pCi/g total Th and 534 pCi/gm total U	0.42 (0.49 mR/hr)
Average dose rate on site in areas with near-surface and subsurface contamination	Infinite slab, 1 m thick with dose point **1m** above source surface.	Uniform conc. of 72.8 pCi/g total Th and 36.4 pCi/gm total U	0.24 (0.29 mR/hr)

The principle assumptions used in the calculation of estimated dose rates from direct radiation are:

- Dose rates are calculated using the Microshield ™ computer code, version 5.05.
- The Thorium Pile is modeled as a finite slab source with dimensions approximating the longest dimensions of the irregularly shaped pile.
- The in-ground source is modeled as an infinite slab source.
- The source volumes are limited to 1 meter thickness as the dose does not increase with thickness beyond one meter.
- Average Th-232 concentration in Thorium Pile is 534 pCi/gm per response to NRC comment # B3.b. This is equivalent to total thorium concentration equal to 1068 pCi/gm as thorium series are assumed to be in equilibrium.
- For the purpose of this dose estimate, a U:Th ratio of 0.5 is assumed for all source volumes and the uranium series members are assumed to be in equilibrium. Note that the final U:Th ratio and equilibrium status is to be determined per Molycorp Responses B.1.a and B.2.b.
- Density of slag/soil is assumed to be 1.8 in all areas including the Thorium Pile
- Average Th-232 concentration in the in-ground contaminated soil is 36.4 pCi/gm per response to comment B.3.b

While the expected range of dose rates is relatively low, the calculated dose rates indicate the need for basic radiation protection procedures and work controls. As stated in the Decommissioning Plan Part 1 Revision, procedures will address: administrative dose limits, radiation surveys, ALARA evaluation, engineering controls, area posting and access controls, work permits to communicate hazards and protection requirements to workers, and worker training. Dose estimates for the major decommissioning work activities are:

- Excavation of contaminated soil. The estimated dose for excavation of the Thorium Pile represents a bounding estimate for a single task. The dose is estimated as follows: The dose rate is, as shown in Table A2-1,is 1.5 mrem/hr, 5 ft from the surface of the unshielded Thorium Pile (the operator's position in the loader cab. It is conservatively assumed that the operator will excavate and load 1000 cubic yards per day. Using a single operator, excavation of the Thorium pile (conservatively estimated to contain 10,000 cu. yd.) will require 10 days, or 80 operator-hours. This yields an estimated dose of 120 mrem for this task.

- General work activities. In the absence of a detailed work breakdown structure for a selected decommissioning alternative, a dose estimate is provided for general work activities. This is a class of activities encompassing typical tasks expected to be performed during the Washington site decommissioning. It assumes that workers including laborers, engineers, health physics technicians and others will

occupy locations adjacent to subsurface contaminated soil and adjacent to staged volumes of excavated material. The calculated average dose rate ranges from 0.24 to 0.42 mrem/hr. For this estimate, an average dose rate of 0.33 mrem/hr is assumed. The work duration is assumed to be 12 weeks with an average crew size of 10, for a total of about 5000 exposure-hours. This gives an estimated collective dose of 1.65 person-rem for the balance of decommissioning activities.

The potential exists for worker exposure to air borne radioactivity from suspension of contaminated soil during excavation and movement of contaminated soil. Due to the relatively low concentrations of thorium and uranium series members and controls to minimize dust generation, exposure to airborne radioactive materials is not expected to be significant. Experience with similar projects has shown that simple work controls such as wetting of soil during excavation and handling will maintain airborne radioactivity concentrations well below action levels for personnel respiratory protective measures. None-the-less a bounding estimate of the inhalation dose to a worker was performed. This is for the task described above. i.e., excavation of the Thorium Storage Pile. The principal assumptions used in the estimate are:

- A task duration of 80 hours exposure time (distributed over 10 work days) is assumed for the equipment operator.
- No personal respiratory protection measures, e.g., respirators, are applied.
- Inhalation dose factors are derived from 10CFR20 Appendix B (occupational DACs).
- Fugitive dust emission factors for soil excavation operations are derived from a U. S. EPA compilation of air pollutant emission factors [USEPA 1995].
- The dust emission rate calculation assumes soil excavation and handling of 1000 cubic yards of soil per day with a density of 90 lb. per cubic foot.
- The resultant calculated dust emission rate of respirable dust is 1.39 lb per day for uncontrolled emission [USEPA 1995].
- For the controlled emission case, i.e., water spray, a control efficiency of 50% is used per EPA technical guidance for control of industrial process fugitive particle emissions [USEPA 1997].
- Dust is emitted into a volume of air 30x30x30 meters.
- The average mass loading of dust in the air volume during each eight-hour shift is assumed to be equal to the hourly emission rate divided by the air volume and is uniformly distributed in the air volume.
- The average concentration of total thorium in the soil being excavated is 1068 pCi/g and total uranium is assumed to be 534 pCi/g for the purpose of this calculation (see Molycorp Response B.3.b).

The resulting bounding, worst case inhalation dose (CEDE, committed effective dose equivalent), assuming water spray dust suppression, is 470 mrem.

Note that the respirable dust loading derived in this estimate is 2.9E-3 gm/m^3. This is found to be conservative in comparison to the maximum value of respirable dust loading of 1.8E-3 gm/m^3 (surface coal mining) reported in the RESRAD Data Collection Handbook [Argonne 1993]. The RESRAD handbook provides an even lower estimated mass loading for construction activities, i.e., 6.0E-04 g/m^3.

Additional dust control and administrative control measures would be implemented as necessary to ensure that the bounding airborne concentrations calculated above were not encountered. If elevated airborne concentrations were encountered, respiratory protection measures would be employed reducing the inhalation exposure to much lower levels. However, even these worst case calculations for inhalation, combined with the worst case external dose calculations, result in exposures that are in compliance with NRC regulations.

References for Molycorp Response A.2:

Argonne 1993 Argonne National Laboratory, "Data Collection Handbook to Support Modeling the Impacts of Radioactive Material in Soil", ANL/EAIS-8, April 1993.

USEPA 1995 U. S. Environmental Protection Agency, "Compilation of Air Pollutant Emission Factors, Vol. 1: Stationary and Area Point Sources", 5th Edition, USEPA Publication No. EPA/AP-42, January 1995.

USEPA 1997 U. S. Environmental Protection Agency, "Technical Guidance for Control of Industrial Process Fugitive Particle emissions", USEPA Publication No. EPA-450/3-77-010, March, 1977.

NRC Comment B.1.a

Molycorp should provide NRC references for the information which supports the assumption that both thorium and uranium are in equilibrium with their daughter products. If this information is not available, then Molycorp should provide its plans for surveys which will determine the equilibrium or disequilibrium conditions for radionuclides on the site. This information should be supplied at least 30 days prior to the commencement of decommissioning activities.

Molycorp Response B.1.a

Molycorp historical records were reviewed to compile information on the equilibrium status of thorium and uranium series members at the site. Data prior to the 1994 Site Characterization study was not included due to the limited availability of supporting information. Reports were identified that contained information on thorium and uranium series equilibrium in FeCb slag and slag/soil mixtures from the Washington site [Felmy 1998, Foster Wheeler 1995, Radiation Surveillance Associates 1995, Raymo 1994]. To supplement the limited amount of historical data, five composite samples were prepared

in January 2000 from bore-hole samples archived from the 1994 Site Characterization sampling campaign [RSA Laboratories, Inc. 2000]. These core bores represent most areas of the site where thorium has been measured in concentrations above background. Preliminary results for the analyses of the five composite samples have been received by Molycorp and are under review. Based on the information compiled for this evaluation, the following preliminary conclusions are reached:

- Thorium series members are in secular equilibrium in slag and in the slag/soil mixture on the site.
- Principal uranium series members of interest; U-238, U-234, Th-230 and Ra-226 are in equilibrium in slag.
- In some of the soil samples results reviewed, Ra-226 appears to not be in equilibrium with its U-238 parent. On average, Ra-226 concentrations are in excess of U-238 by a factor of about 1.6 to 1.9.
- However, the results of numerous samples reported in the final survey report of the 1996 removal action on the northern boundary of the site, indicate that Ra-226 is in equilibrium with U-238 in the soil [Foster Wheeler 1996].
- Ra-226 progeny, as represented by Bi-214 and Pb-214 are depleted relative to Ra-226 in both slag and slag/soil mixture. This is not unexpected due to Radon emanation, and is conservative since lower concentrations of these radionuclides are present relative to equilibrium conditions.

Supporting information is summarized in the following tables. Additional work is underway to complete the evaluation and to determine if additional sampling is needed to improve understanding of the equilibrium status of uranium series members in contaminated soil at the site. Molycorp will submit the final analysis of the equilibrium status of the natural uranium daughter products for NRC review and approval before beginning decommissioning activities, and no later than October 2000. This submittal will contain proposed values for the U-238 daughter products to be used for determining compliance with the unrestricted use limits. The radionuclide mixture will include the relative fractions of total uranium and total thorium (see Molycorp Response B.2.b), as well as the ratio of Th-230 and Ra-226 to U-238 if it is determined that disequilibrium exists.

Table B.1.a(1) - Summary of Information on Thorium Series Equilibrium

Radionuclide Pair	Average Ratio (± one SD)	Source and Method
Th-228:Th-232	1.03 ± 0.05	Radiation Surveillance Associates, Inc. 1995. Radiochemical analysis of six **slag** samples from Thorium Pile
	1.08 ± 0.11	Rayno 1994. Radiochemical analysis of 20 **soil/slag** samples from two bore-holes in 1994 site characterization survey.
	1.03 ± 0.07	RSA Laboratories, Inc.2000. Preliminary results from radiochemistry (alpha spec) of five composites collected from 1994 site characterization archived **soil/slag** samples.

Table B.1.a.(2) - Summary of Information on Uranium Series Equilibrium

Radionuclide Pair	Average Ratio (± one SD)	Source and Method
U-234:U-238	1.20 ± 0.40	RSA Laboratories, Inc. 2000. Preliminary results from radiochemistry analysis of five composites from 1994 site characterization archive **soil/slag** samples.
	1.04 ± 0.28	IEA 1994. Radiochemical analysis of 20 **soil/slag** split-spoon samples from two bore-holes in 1994 site characterization.
Th-230:U-238	1.3 ± 0.56	RSA Laboratories, Inc. 2000. Preliminary results from radiochemistry analysis of five composite samples of **soil/slag** from 1994 site characterization.
	0.96 ± 0.15	Rayno 1994. Radiochemistry analysis of 20 **soil/slag** split-spoon samples from two bore-holes in 1994 site characterization
Ra-226:U-238	1.08 ± 0.11	Felmy 1998. Radiological analysis (method unspecified) of four **slag** samples from thorium pile.
	1.89 ± 0.67	RSA Laboratories, Inc. 2000. Preliminary results from radiochemistry analysis of five composite samples of **soil/slag** from 1994 site characterization.
	1.65 ± 0.60	Rayno 1994. Radiochemistry analysis of 20 **soil/slag** split-spoon samples from two bore-holes in 1994 site characterization.
Bi-214:Ra-226	0.48 ± 0.09	Felmy 1998. Radiological analysis (method not specified) of four **slag** samples from the Thorium Pile.
	0.54 ± 0.18	RSA Laboratories, Inc. 2000. Preliminary results from gamma spectroscopy analysis of composite samples of **soil/slag** from 1994 site characterization.

References for Molycorp Response B.1.a:

Felmy 1998 Andrew R. Felmy et. al. "Solubility and Leaching Controls on Radionuclides in SDMP Wastes", Pacific Northwest National Laboratory, Draft ,January 1998.

Foster Wheeler 1995 "Site Characterization Report for License Termination of the Washington PA Facility", January 1995.

Foster Wheeler 1996 Foster Wheeler Environmental Corporation, "Final Radiological Status Report for the Removal Action Along the Northern Boundary of the Molycorp, Inc. Property Washington Pennsylvania", December 1996.

Radiation Surveillance Associates, Inc. 1995 "Support Documentation for the Site Characterization Plan for the Decommissioning of the Molycorp, Inc. Washington, PA Facility", Draft report January, 1995.

Rayno 1994 Don Rayno, IEA-North Carolina, letter report of radiological sample results to Tim Mulloy, Molycorp Inc. September 13, 1994

RSA Laboratories, Inc. 2000 "Data Reduction Sheet, Interim Report", March 14, 2000.

NRC Comment B.1.b

Section 3.3.2 of the DP indicates that draft implementing procedures for the Radiation Protection Plan will be finalized after approval of the DP and before decommissioning activities. NRC must evaluate the safety and environmental impacts of approving the DP prior to its approval. Therefore, Molycorp must provide full details of these implementing procedures prior to approval of the DP.

Molycorp Response B.1.b

The operating procedures for the decommissioning activities are in a final draft form and require minor review and revisions to complete. The procedures will be finalized, and available for NRC review, before June 1, 2000.

NRC Comment B.1.c

Molycorp should provide information on which buildings are planned to be demolished during remediation. For the buildings which will remain in affected areas, Molycorp should provide plans for characterization and remediation of subsurface contamination underneath building structures and in any conduits attached to the buildings.

Molycorp Response B.1.c

The buildings that have potential sub-slab soil contamination are identified in Table 1. At this time, it appears most cost-effective to demolish the buildings and remove the slab in order to remediate and final survey the sub-slab soil. However, if conditions change requiring that a building remain standing, the sub-slab soil will be remediated and surveyed with the building in place. In this case, a variety of methods may be employed including removing portions of the slab, sampling sub-slab soil through boreholes in the concrete, or selectively remediating under the slabs through excavation. If sub-slab soil sampling is required through boreholes in the concrete foundation, the methods for subsurface sampling referenced in Section 2.1.1 of the Decommissioning Plan will be employed (February 13, 1997, NRC letter to AAR Corporation).

Subsurface piping will be evaluated by surveying surface drains. If significant contamination potential exists based on operational history, or the drain survey indicates elevated contamination levels, a radiological pipe crawler will be used to measure the contamination levels on the internal surfaces of the pipes.

NRC Specific Comment B.1.d

Section 3.4 of the DP indicates that waste will be stockpiled in various areas, loaded into dump trucks and transported to an NRC approved location for permanent disposition. The use of dump trucks for the transport of radioactive material would be in violation of Department of Transportation regulations. Alternative trucks or transport vehicles should be considered. With regard to staging and transportation of waste, Molycorp should provide the following: (1) the estimated time stockpiled material will be stockpiled at the site prior to transport to an approved disposal location; (2) an estimate of the number of trucks shipments expected for transporting the waste; and (3) an estimate of radiological and non-radiological impacts to workers and public from planned transportation activities.

Molycorp Response B.1.d

The reference to dump trucks assumed that the load would be configured as a "strong, tight container" if required by DOT regulations. To accomplish this the truck beds would be lined with a polyethylene material such that it could be sealed to meet the strong tight container packaging criteria. Dump trucks would only be used for local hauling onsite, including to an on-site storage cell if it were an approved NRC location. Transportation to offsite disposal sites would use other types of transport vehicles.

The first part of the NRC comment asked about soil staging. As stated in Molycorp Response B.1.i, contaminated soil will be staged for about two weeks prior to being loaded into a transport vehicle. Clean soil, i.e., soil containing concentrations of uranium and thorium below the unrestricted use level, may requiring staging for 12-16 weeks.

The number of truck shipments is calculated as follows. The Part 1 Decommissioning Plan indicates that the volume of soil containing greater than 10 pCi/g total thorium is 91,000 yds. When the slag pile and roll-off boxes are included, the volume becomes 105,000 yds. Assuming 20 tons per truck and a density of 1.3 tons/yd, each truck would contain 16 yards of soil. Therefore, the number of individual truck shipments required would be about 6,600.

The estimated radiological impacts to workers and the public during shipment is calculated as follows based on methods provided in NUREG/CR-1757, "Technology, Safety, and Costs of Decommissioning a Reference Uranium Hexaflouride Conversion Plant," October 1981. This reference was the most applicable to the Molycorp material since it addresses bulk wastes from extraction ponds and lagoons. The fact that the source term material differs, i.e., thorium at relatively low concentrations as opposed to uranium at relatively high concentrations, is accounted for by modifying the exosure rates from the transport vehicle based on the results of Table A.2. Non-radiological impacts are assumed to be minimal.

The calculations were performed using the conversion factors provided in NUREG/CR-1757. The factors were scaled based on an assumed transportation distance for the Molycorp waste of 2000 miles, as opposed to the 500-mile distance in NUREG/CR-1757. The factors were also modified based on the exposure rates estimated from the Molycorp material in Table A.2. The weighted average exposure rate at 2m from the vehicle, as well as at the normally occupied position in the cab, is estimated to be 0.5 mR/hr for the Molycorp material.

Assumptions:

- All shipments are assumed to be in compliance with DOT regulations. The exposure rates from the transport vehicle are estimated based on Table A.2.
- 0.5 mR/hr – at any point 2 m from the vehicle.
- 0.5 mR/hr – at any normally occupied position in the vehicle by transport workers.
- Onlooker dose is 1.0E-03 person-rem/shipment
- General public dose is 3.6E-04 person-rem/shipment
- Total public dose is 1.4E-03 person-rem/shipment.
- Truck driver dose is 6.8E-02 person-rem/shipment

Based on the above conservative conversion factors, the total public dose from the shipment of material is calculated as follows:

(6600 truck shipments)(1.4E-03 person-rem/shipment) = 10 person-rem to public

The truck driver dose is calculated as follows:

(6600 shipments)(6.8E-02 person-rem/shipment) = 450 person-rem to truck drivers

NRC Comment B.1.d

The DP should commit to follow survey procedures and analysis methods found in NUREG/CR-5849 for building surfaces and structures.

Molycorp Response B.1.d

The Final Status Survey methods proposed in the decommissioning plan are consistent with NUREG/CR-5849 with two exceptions. First, the direct measurement survey coverage is proposed to be 1 measurement per 4 m^2 as opposed to 1 measurement per 1 m^2. Verbatim compliance with NUREG/CR-5849 may require a direct measurement frequency of 1 per m^2 since the scan MDA is likely to be greater than 25% of the 1000 dpm/100 cm^2 surface contamination limit for total thorium. Molycorp proposes to use 1000 dpm/100 cm^2 as the scan sensitivity level for requiring 1 measurement per 1 m^2, i.e., if the scan sensitivity is maintained below 1000 dpm/100 cm^2, the direct measurement frequency will be 1 per 4 m^2.

Verbatim compliance with the NUREG/CR-5849 guidance regarding direct measurement frequency is considered overly burdensome for the Molycorp buildings since the potential for significant building surface contamination is very low in all of the buildings. If contamination above the limit were present, the 100% coverage by scan surveys would identify the contamination and an investigation would be conducted. The exposure rate measurements provide additional confidence that any significant contamination would be identified.

The second exception to NUREG/CR-5849 is described in Molycorp's response to NRC comment A.1, which proposes specific criteria for designating buildings as affected based on the results of the scoping surveys requested by NRC. NUREG/CR-5849 does not contain specific criteria for building surface affected area designation.

NRC Comment B.1.e

Molycorp should revise the DP to incorporate by reference or correctly state the language of the cleanup limits. The limits for both total thorium and uranium (section 4.1 of the DP) should state, "if all daughters are present in equilibrium" rather than "assuming all daughters are in equilibrium." Molycorp must clarify that daughters are in equilibrium with parent radionuclides or otherwise demonstrate that compliance with limits will not underestimate the actual concentration of parents and/or daughters.

Molycorp Response B.1.e

Molycorp intended that the definition of the uranium and thorium limits be interpreted as described in the NRC comment. The definition of the limits for total thorium and total uranium will be as follows.

- 10 pCi/g average Total thorium (Th-232 + Th-228), if all daughters are in equilibrium
- 10 pCi/g average total uranium (U-238 + U-234), if all daughters are in equilibrium

The question as to the equilibrium of the uranium and thorium daughter products is addressed in Molycorp's response to NRC Question B.1.a. Molycorp proposes to submit for NRC review, by October 2000, detailed data and statistical analyses to define the equilibrium status of the uranium daughters.

However, Molycorp believes that the methods for demonstrating compliance with the natural uranium limit, assuming that a condition of disequilibrium exists, should be reviewed and approved as a part of the Part 1 Decommissioning Plan. The proposed methods for demonstrating compliance if disequilibrium exists are presented below. The methods for applying the unity rule to the sum of natural uranium and natural thorium are also provided.

Methods for Demonstrating Compliance with the Natural Uranium Limit if the U-238 Daughters are in Disequilibrium

The unrestricted use limit for natural uranium is based on the cleanup criteria listed in NRC's SDMP Action Plan and assumes that U-238, U-234, and associated daughter products are in equilibrium at a concentration of 5 pCi/g each. As described in the 1981 BTP on disposal of uranium and thorium, the 10 pCi/g natural uranium limit was selected to ensure that the concentration of Ra-226 is equal to the Environmental Protection Agency limit of 5 pCi/g.

If it is determined that there is a statistically significant disequilibrium between U-238 and Th-230 or Ra-226, compliance with the natural uranium limits of 10 pCi/g will be demonstrated as described below. The four equilibrium conditions described below assume that U-238 is in equilibrium with U-234.

- **Equilibrium Condition # 1** – U-238 and Ra-226 in equilibrium, U-238 and Th-230 not in equilibrium with Th-230 levels statistically greater than U-238

  Compliance will be based on the following equation. No assessment of uranium is required since compliance with the equation below ensures that the total uranium concentration is below 10 pCi/g

  $$(\text{Th-230 pCi/g})\ (0.35) + (\text{Ra-226 pCi/g})(0.65) < 5\ \text{pCi/g}$$

- **Equilibrium Condition #2** – U-238 and Th-230 in equilibrium, U-238 and Ra-226 not in equilibrium with Ra-226 levels statistically greater than U-238.

Compliance with the 10 pCi/g total uranium limit will be demonstrated by ensuring that Ra-226 concentrations are below 5 pCi/g. No assessment of uranium is required.

Ra-226 < 5 pCi/g

- **Equilibrium Condition # 3** – U-238 not in equilibrium with Th-230 or Ra-226. Both Th-230 and Ra-226 levels are statistically greater than U-238.

  Compliance will be based on the following equation. No assessment of uranium is required since compliance with the equation below ensures that the total uranium concentration is below 10 pCi/g.

  (Th-230 pCi/g) (0.35) + (Ra-226 pCi/g)(0.65) < 5 pCi/g

- **Equilibrium Condition #4** - U-238 not in equilibrium with Th-230 and/or Ra-226. Th-230 and/or Ra-226 levels are statistically less than U-238.

  Compliance will be based on 10 pCi/g total uranium (U-238 + U-234)

  U-238 + U-234 < 10 pCi/g

Regarding natural thorium, Molycorp assumes that the Th-232 daughter products are in equilibrium because of the relatively rapid ingrowth of daughters. This assumption is verified by the data presented in Molycorp Response B.2.b.

The unity rule will be used to demonstrate that the site is suitable for unrestricted use. The unity rule will apply to total thorium and total uranium, where the total uranium limit is defined by Equilibrium Condition 1, 2, 3, or 4, depending on the equilibrium status of the uranium daughters.

Compliance with the unity rule will be demonstrated using a surrogate calculation based on gamma spectroscopy analysis of Th-232 and Equation 4-1 in MARRSIM. The surrogate calculation will consider the U-238/Th-232 ratio, as well as the equilibrium status of the U-238 daughters. The ratio and equilibrium status used in the surrogate calculation will be approved by NRC (see Molycorp's responses to NRC comments B.1.b and B.2.b).

NRC Comment B.1.f

Molycorp must provide additional information to clarify what the content of section 3.5 of the DP was intended to comprise. Section 4.72 states that section 3.5 details the extent of the soil contamination and proposed method of removal, however no such section exists.

Molycorp Response B.1.f

There is no Section 3.5 in the Decommissioning Plan and the reference to this section is incorrect. The information that was stated as being found in Section 3.5 is provided in other sections. The extent of soil contamination is provided in Table 2.1 and Figures 2-1 through 2-7. The proposed methods for removal of soil are summarized in Section 2.1.

The statement in Section 4.7.2 regarding soil samples pertains only to remedial action support, not final status surveys. Soil samples collected for remedial support will be used to help guide the soil excavation and to help ensure that the area has been successfully remediated before beginning the final status surveys. However, soil sampling will not be the primary method for guiding the soil excavation process. In field measurement methods such as in-situ gamma spec or scan surveys with NaI detectors will be the primary methods used for this purpose. Soil samples will likely be used on a limited basis for remedial action support. There is no need for a statistical basis for remedial action support surveys. The final status survey provides the statistically based soil samples analyses, as well as 100% scan survey in affected areas, to ensure that the unrestricted use criteria are met with high confidence

NRC Comment B.1.g

Additional clarification is needed regarding the statement (DP section 4.11) that soil samples will be analyzed for thorium by gamma spectroscopy. This section does not differentiate between surface and subsurface sampling. Therefore, NRC interprets the statement to mean that all surface and subsurface soil samples will be analyzed by gamma spectroscopy. If this interpretation is incorrect, then Molycorp should provide more specific information to clarify how all soil samples will be analyzed. Molycorp should also clarify whether gamma spectroscopy analysis, if used will be done on site or at a lab, the type of instrumentation, that will be used, whether the lab will be certified and by whom, and whether quality control samples will be sent to alternate labs for analysis. The DP should also describe the analyses to be conducted to determine the uranium concentration in soils.

Molycorp Response B.1.g

The NRC interpretation of Section 4.11, i.e., that all surface and subsurface samples will be analyzed by gamma spectroscopy, is correct.

A decision regarding the use of an onsite versus offsite laboratory for the gamma spectroscopy analysis of soil samples has not been made. The final determination will be based on cost/benefit analyses during the detailed project planning phase after approval of the decommissioning plan. Regardless of whether an onsite or offsite laboratory is used, a detailed QA/QC program will be implemented to ensure that the analytical results are defensible and properly documented. The QA/QC program will include the use of NIST traceable sources, at least 5% blank and spiked samples, control charts, crosscheck

with an independent qualified laboratory, detailed operating procedures, a qualification program for the system operators, and periodic program audits.

The uranium concentration in soils will be determined through the use of a surrogate calculation using Equation 4-1 in MARSSIM. The gamma spectroscopy results for total thorium will be used as the surrogate for the more difficult to detect uranium isotopes. As described in Molycorp's response to NRC comment B.1.e, the surrogate calculation will be based on an NRC approved uranium to thorium ratio.

NRC Comment B.1.i

Molycorp should provide additional detailed plans for soil remediation and survey activities. As presently described, all soil contaminated above the NRC limits will be excavated along with clean overburden that will be set aside. During the excavation process, Molycorp states that it intends to comply with action limits that will require periodic sampling of soils to determine concentrations. DP section 3.3.6 indicates that excavation activities will be stopped if specific action levels are observed, such as contamination above 10 pCi/g average total thorium. Molycorp should state when, during decommissioning activities, it intends to conduct the sampling and the extent and frequency that will apply to this sampling. Molycorp should make clear that it intends to conduct the final surveys for surface and subsurface soils before reintroduction of clean fill material into the excavations. Molycorp should also clearly define the sequence of events that will occur during excavation)e.g., sampling during backfilling of excavations) so that the NRC can understand the proposed approach and be able to evaluate any potential radiological safety concern.

Molycorp Response B.1.i

The soil remediation and survey activities planned for the Washington site include standard industry practices. The excavation activities are expected to take up to 12 weeks. The first step is to mobilize required equipment, setup decontamination facilities, and setup erosion control measures for excavation activities. The locations for stockpiling overburden material and other excavated material containing less than unrestricted use limits for uranium and thorium will be identified. The "clean" stockpile could be present as long as 12-16 weeks. The contaminated stockpiles are not expected to be present for longer than two weeks since we anticipate loading transport vehicles as the material is excavated. All stockpiles will be outside of the 100-year flood plain limits and as far from the site boundary as practical. Regardless of where the stockpiles are located, controls will be maintained to ensure that the concentrations of source material in air and water at site boundaries will be maintained well below the 10 CFR 20, Appendix B, Table 2, effluent limits. These controls include the following:

- Temporary erosion control measures
- HDPE or VLDPE liners for stockpiles of material expected to exceed the unrestricted use limits

- Fugitive dust emission control through water spray or other dust suppressants
- Covering stockpiles expected to remain for extended periods of time (greater than about two weeks)
- Temporary air monitoring stations in areas where material is stockpiled
- Routine air and surface water samples in the vicinity of stockpiles

Prior to beginning the soil excavation, an engineering survey will be performed to assist in locating contaminated areas identified by site characterization and to provide a more accurate baseline for excavation activities. The excavation will be guided by the information provided through site characterization, supported in the field by remedial support surveys during excavation. As discussed in Molycorp's response to NRC Comment B.1.f, the remedial support survey will be primarily scan surveys using NaI detectors or in-situ gamma spectroscopy. Soil samples will also be used periodically to augment the field survey methods.

Material determined to exceed the unrestricted use criteria will be staged for loading into an appropriate transport vehicle for movement to an NRC approved location. The material to be transported will be sampled to the extent required by the acceptance criteria for the designated NRC approved location. Excavated material that appears to be below the unrestricted use limits based on characterization data and field surveys will be stockpiled onsite for use as backfill after final surveys are completed in excavated areas. Before stockpiled material is used as backfill it will undergo a final status survey at a frequency of 1 soil sample per 25 m^2.

After all excavation and final surveys are completed in a given area, and NRC has had an opportunity to perform inspections and confirmatory surveys as necessary, the area will be backfilled. It is likely that the final survey and backfill will be performed in one area when excavation is continuing in another area. Areas where a final survey has been completed will be closely controlled through procedures to ensure that no cross-contamination occurs. The stockpiled soil that has been verified to contain less than the unrestricted use limits and clean fill from offsite will be used for backfill. After backfill, site grading, and site reclamation is completed, all equipment will undergo a final decontamination as necessary. Final demobilization will complete the excavation activities.

As described in detail in Section 3.0 of the Decommissioning Plan, a comprehensive radiation protection program will be in place to ensure compliance with NRC regulations in 10 CFR part 20 during excavation. In addition, administrative action levels have been established at levels below the 10 CFR Part 20 limits to ensure that the excavation activities are conducted in a manner consistent with the ALARA principle.

NRC requested clarification of the statement in Section 3.6 regarding the 10 pCi/g action level. This action level is intended to be ensure that the excavation activities are maintained in areas posted and controlled through an RWP and to control the inadvertent spread of contamination. The samples will be collected on a routine basis to be

determined during decommissioning operations as a part of the radiation protection program.

Molycorp will conduct final surveys prior to backfilling an area.

NRC Comment B.1.j

Molycorp should briefly describe the potential for radiological or non-radiological accidents occurring during decommissioning activities. Radiological accident concerns include any credible occurrence that could provide sufficient energy to disperse radioactive material and significantly increase worker or public exposure or result in offsite contamination. Such events might include fire, explosions of fuel or other chemicals, and natural disasters such as earthquakes, floods and tornadoes. Non-radiological accidents might also include the aforementioned events that could lead to dispersal of hazardous material.

Molycorp Response B.1.j

A review was conducted to identify accidents that could present significant risks to workers or to members of the public from decommissioning activities. Flooding is considered a minor concern since all staging excavated soil staging areas will be outside the 100-year flood plain. The probability of earthquakes and tornadoes during decommissioning is considered negligible because the project will take only 12-20 weeks. There are no major sources of combustible materials on the site. There is a 200-gallon fuel oil tank and a 200-gallon gasoline tank on the site which are not considered major potential sources.

The bounding potential accident on the site, with a non-negligible chance of occurrence is the accident that involves the upset of a haul truck carrying 20 cubic yards of contaminated soil excavated from the Thorium Pile. The load is spilled and a fuel tank is ruptured such that the entire load is soaked with diesel fuel. Ignition occurs causing the entire load of soil to burn for eight hours. The maximum dose to a member of the public is incurred by a firefighter who spends eight hours in the immediate vicinity of the spill attempting to control the fire. The following additional assumptions and calculations are used in the evaluation:

- No personal respiratory protection measures, e.g., respirators, are applied.
- Control measures for suppression of emissions during the accident are not assumed.
- Inhalation dose factors are derived from 10CFR20 Appendix B (occupational DACs).
- The respirable dust and emissions resulting from the accident are a combination of the fugitive dust from dumping the soil in the spill and emissions resulting from burning of the soil.

- Fugitive dust emission factors are derived from U. S. EPA compilation of air pollutant emission factors [USEPA 1995]. The value of 1.14 E-3 lb per ton for the spilling of 20 cu. yd (24.3 tons) of soil yields 0.03 lb of fugitive respirable dust released in the accident.
- An emission factor of 1.8 lb. per cubic yard of material burned is assumed for the accident. This is a factor for open burning of coal refuse piles which is conservatively assumed to simulate the burning soil. The value is obtained from the EPA "Factor Information Retrieval (FIRE) System, Version 6.21"
- The estimate assumes that the entire 20 cubic yards of soil is effectively consumed in the fire. This yields a total of 3.6 lb emission from the burning.
- The total mass of respirable dust emitted in the accident is 3.63 lb.
- The dust and emissions from burning are emitted into a volume of air 30x30x30 meters.
- The mass loading in the air volume during the eight-hour event is assumed to reach equilibrium instantaneously at a concentration of one eighth of the total mass emitted divided by the air volume. The resultant mass loading of 7.6E-03 gm/m^3 remains constant for the eight-hour duration.
- For this estimate, the average concentration of total thorium in the soil in the accident is 1068 pCi/g and total uranium is 534 pCi/g (see response to NRC comment B.3.b).
- The calculated airborne radioactivity concentrations are 8.15E-12 $\mu Ci/cm^3$ total thorium and 4.07E-12 $\mu Ci/cm^3$ total uranium.

The resulting inhalation committed effective dose equivalent (CEDE) is 243 mrem. This is well below the EPA Protective Action Guideline of one rem for members of the public in the event of an accident involving release of radioactive materials.

Reference for Molycorp Response B1.j:

USEPA 1995 U. S. Environmental Protection Agency, "Compilation of Air Pollutant Emission Factors, Vol. 1: Stationary and Area Point Sources", 5th Edition, USEPA Publication No. EPA/AP-42, January 1995.

NRC Comment B.2.a

Molycorp should provide the nature and duration of remediation activities, including the types and frequencies of all environmental monitoring conducted to comply with the Commonwealth of Pennsylvania and the U. S. Environmental Protection Agency regulatory requirements. The data collected during the past five years should be provided. The results of chemical analyses and other data for monitoring of groundwater, surface water, surface water and air should be provided. This information is required in order to assess potential pathways of radionuclide transport and evaluate any risks created by hazardous materials during remediation of outdoor areas and dismantlement of affected structures. The measures to be taken to prevent re-contamination of remediated areas should be identified.

Molycorp Response B.2.a

Molycorp currently performs the following environmental monitoring for Commonwealth of Pennsylvania. No monitoring is performed for the EPA.

- Quarterly groundwater monitoring for metals, conductivity, TOC, TOX, sulfates, chlorides, and alkalinity
- Weekly NPDES monitoring for molybdenum, arsenic, pH, and temperature.

Per the NRC request, Attachment 1 contains groundwater monitoring results for the last five years. In addition, 1 year of monthly surface water sampling was conducted between 10/95 and 9/96. These results are also included in the attachment.

The nature and duration of remediation activities is provided in Molycorp's response B.1.i.

NRC Comment B.2.b

The DP should provide a discussion of uranium contamination at the Washington site. Based on previous data submitted by Molycorp, U may constitute a significant portion of the total inventory of radioisotopes at the site. For example, a January 28, 1997 letter from Molycorp responding to NRC questions on the radiological status of the Findlay property, noted a uranium/thorium ratio of 0.2 to 6.1 in rolloffs. In addition, the January 18, 1997 letter indicated uranium/thorium ratios ranging from 0.16 to 1.59 for slag samples from the impoundment area. Molycorp should provide additional clarifying information on uranium in soils in order that the true level of contamination can be determined.

Molycorp Response B.2.b

A review of Molycorp historical records was conducted to compile information on uranium concentrations and U:Th ratios. It was decided to not include information reported prior to the 1994 Site Characterization study due to the limited availability of supporting information. Reports were identified that contained information on uranium in FeCb slag and slag/soil mixtures from the Washington site [Felmy 1998, Foster Wheeler 1995, Raymo 1994]. To supplement the limited amount of historical data, five composite samples were prepared in January 2000 from bore-hole samples archived from the 1994 Site Characterization sampling campaign. These core bores represent most areas of the site where thorium has been measured in concentrations above background. Preliminary results for the analyses of the five composite samples have been received by Molycorp and are under review [RSA Laboratories 2000]. General conclusions reached from a review of the identified data are:

- Measurements of slag consistently indicate that the ratio of uranium to thorium is low (on the order of a few percent).

- The ratio of uranium to thorium in slag/soil mixtures on the site is variable, exhibiting a range from about 0.018 to 1.60 in the samples reviewed.

The results on U:Th ratios from the referenced data sources are summarized in Table B.2.b. Note that the results are based on an initial review of the information from the sources identified. Additional work is underway to complete the compilation and evaluation of post-1994 information and to determine if additional sampling is needed to characterize uranium concentrations and the U:Th ratio(s) for the site, including the sub-surface soil, the Thorium Pile and the roll-off boxes. Molycorp will submit the final analysis of the U:Th ratio for NRC review and approval before beginning decommissioning activities, and no later than October 2000. This submittal will contain proposed values for the radionuclide mixture to be used for determining compliance with the unrestricted use limits. The radionuclide mixture will include the relative fractions of total uranium and total thorium, as well as the ratio of Th-230 and Ra-226 to U-238 if it is determined that disequilibrium exists.

Table B.2.b - Uranium:Thorium Ratios in Slag and Soil

Material	U:Th Ratio ± 1 SD (range)	Source and Method
FeCb slag	0.05 (no range)	Foster Wheeler 1995. Analysis of single **slag** sample by Department of Metallurgical Engineering, South Dakota School of Mines and Technology (analytical method not specified).
FeCb slag	0.018 ± 0.002 (0.016 to 0.019)	Felmy 1998. Average of five **slag** samples analyzed by X- ray Fluorescence by Pacific Northwest National Laboratories for NRC
Slag/soil mixture	1.12 ± 0.43 (0.60 to 1.60)	Raymo 1994. Radiochemistry analysis of split-spoon **soil/slag** samples from two boreholes from 1994 site characterization. U:Th ratios calculated as (U-234+U-238)/(Th-228+Th-232). Results from samples with Th-232 concentrations below 4 pCi/gm were not included since these results are strongly effected by added uncertainty due to being near the range of natural Th & U background.
Slag/soil mixture	0.46 ± 0.41 (0.18 to 1.16)	RSA Laboratories, Inc. 2000. Preliminary results from radiochemistry analysis of five composite samples of **soil/slag** from 1994 site characterization.

References for Molycorp Response B.2.b:

Felmy 1998 Andrew R. Felmy et. al. "Solubility and Leaching Controls on Radionuclides in SDMP Wastes", Pacific Northwest National Laboratory, Draft ,January 1998.

Foster Wheeler 1995 "Site Characterization Report for License Termination of the Washington PA Facility", January 1995.

Rayno 1994 Don Rayno, IEA-North Carolina, letter report of radiological sample results to Tim Mulloy, Molycorp Inc. September 13, 1994

RSA Laboratories, Inc. 2000 "Data Reduction Sheet, Interim Report", March 14, 2000.

NRC Comment B.2.c

Concentration data reported in Molycorp's June 30, 1999, Decommissioning Plan, Part 1 Revision is not consistent with concentration data from Molycorp's 1995 Site Characterization Report (SCR). Multiple data sets from the same location, but with different numbers, invalidate assumptions about the amount, concentration, and location of contaminated material. Molycorp should submit an explanation for these various discrepancies and provide a revised Table 2-1 reflecting a best estimate of maximum total thorium for each borehole.

Molycorp Response B.2.c

It is assumed that the comment refers to concentration data from the 1995 Site Characterization Report in Appendix N, "Gamma Logging Data". The information in Table 2-1 of the 1999 Decommissioning Plan, Part 1 Revision is based on the data files that were used by the Site Characterization contractor to prepare Appendix N. In response to the comment, a review of the entire Table 2-1 was conducted to identify duplicate borehole data entries. In addition, a detailed comparison was made between Appendix N and Table 2-1. A large sample comprising 172 of the total of 307 records (rows) in Table 2-1 was selected for review. The following discrepancies were identified:

- A total of six cases were identified where Table 2-1 contained double entries for boreholes, i.e., where the borehole measurements were re-logged.
- 27 discrepancies in the maximum total thorium concentration in a bore-hole were identified between Table 2-1 and Appendix N (Table 2-1 values were compared to Appendix N value adjusted for total Thorium by multiplying times 2).

To evaluate the source of the 27 discrepancies, the electronic files used to produce Appendix N and Table 2-1 were also reviewed. In all 27 cases, it was found that the Appendix N entry for the maximum Th-232 concentration was not in agreement with the source electronic data file, whereas the Table 2-1 entry was in agreement with the electronic data file. The supporting documentation for the electronic files and Appendix N does not allow the origin of the discrepancies to be identified. Regardless, the magnitude of the discrepancies in the maximum borehole concentrations is small, typically on the order of ± 10% of the stated Table 2-1 values. This level of variability

will have an insignificant effect on the estimated volumes and concentrations of contaminated soil in view of the other uncertainties in the concentration measurements and in the estimating process itself.

The corrections to Table 2-1 for the cases of double entry are given. Based on a review of the electronic source files, none of the following were used in the soil volume estimates:

- SB-053 relog-94
- SB-056c-94 2nd trial
- SB-085-relog-94
- SB-140 relog-94
- SB-267a-94
- Sb-284a-94

NRC Comment B.2.d

Distribution figures from the SCR are different from those in the DP which utilize the same data set. Molycorp should revise the figures from the DP to reflect the proper concentrations and provide an electronic copy of the modeling software input data and also provide the name and version of the software they used. Volume and inventory considerations should also include data points from the slag pile.

Molycorp Response B.2.d

Distribution figures from the SCR differ from those in the DP because of:

- differences in the means of presenting the physical site model (as explained below)
- change in resolution of the model gridding and
- doubling the input concentrations to account for total thorium.

Figures in the DP do reflect the "proper" input concentrations. The same basic data set was used to prepare the SCR and DP figures with an adjustment made for total thorium concentrations in the input file for the DP figures. An electronic copy of the input data will be made available to the NRC Staff.

The SCR presents lateral thorium distribution by depicting surface distribution (Figure 5-7) and then distribution at discrete elevations using plan views and horizontal slicing (Figures 5-8 through 5-16). The SCR also depicts vertical thorium distribution using cross sectional views at four east-west locations (Figures 5-17 through 5-21). The DP depicts lateral thorium distribution by level of thorium contamination with all elevations depicted together and lesser levels of thorium stripped away (Figures 2-2a through 2-7a—"a" series). This DP depiction allows the viewer to see lateral distribution at all depths rather than rely on select horizontal slices to reveal discrete depths. The DP also

depicts vertical thorium distribution using side-view, orthographic projections, similar to cross sections but with all depth (into page) visible since lesser concentrations of thorium are stripped away (Figures 2-2b through 2-7b—"b" series). However, the SCR cross sections are oriented west-east and are viewed to the north while the DP projections are oriented south-north and are viewed to the west to enable alignment to the plan view depictions.

Another significant difference is that the SCR uses a model with much lower resolution that the model used in the DP. The cell size for the SCR model was 56'x85'x2' in the x-y-z directions, resulting in a model with relatively planar facets and a "chunky" appearance. The DP model uses a cell size of 10'x10'x0.5' resulting in smoother contouring and greater agreement with the input data. The DP model was also calculated using a method that better accounts for non-detect data. Greater computer capacity and enhancements in the software over the 4.5 years between the SCR and the DP reports enabled these improvements.

Regarding the surface depictions, SCR Figure 5-7 and DP Figure 2-1, slight additional differences exist because of refinements in the surface topography that was used to slice the top of the model. Vertical differences of fractions of a foot are capable of revealing different levels of contamination when the thorium is shallow, as is the case here. This can cause dramatic changes in surface appearance.

The software used to develop both models was EarthVision, by Dynamic Graphics, Inc. Versions 2.0 and 5.0.1 were used to create the SCR and DP models, respectively.

The NRC comment reads "Volume and inventory considerations should also include data points from the slag pile." The volume and thorium concentrations of the thorium slag pile are taken into consideration in the site inventory of contaminated soils. However, the data points from the slag pile should not be, and were not, included in the site-wide model of thorium distribution. This is because these few elevated data are isolated from the general distribution (i.e., the pile has a bottom) and including them in the model would inappropriately amplify thorium modeling results in the vicinity of the pile.

NRC Comment B.3.a

Molycorp should provide additional information in the DP to clarify why a subset of the reported gamma logging results contained in the SCR (Appendix H) was used for the regression analysis rather than all of the reported data (the regression analysis done to compare gamma log based exposure rates with measured soil concentrations to provide a supporting basis for the conversion of count rates to thorium soil concentration). The regression analysis for subsurface measurements is based on data reported in tables H-2 through H-4 (22 data points) but values from table H-1 (8 data points) were apparently excluded. Molycorp should conduct the regression analysis using all the collected data to obtain the most precise results from the statistical analysis. Also, Molycorp should justify

the inclusion of the 2 values from the barrel experimental conditions (logging a barrel full of soil vs logging site soil). Molycorp should determine if results of the regression analysis would be different without the 2 barrel numbers. In addition, overall experimental results indicate that the regression analysis is for data from one hole in a limited area. Molycorp should determine if there would be differences in slag or soils across the sites and whether the differences might not be representative and invalidate application of the results to other locations (i.e., in areas that have slag vs slag chunks).

Molycorp Response B.3.a

Appendix H of the 1995 SCR [Foster Wheeler 1995] was reviewed. The discussion that follows is based primarily on the information contained in Appendix H. Measurement results from four bore-holes are included in Table H-1 (bore-hole SB-056), Table H-2 (bore-hole SB-056a), Table H-3 (bore-hole SB056b) and Table H-4 (bore-hole SB-056c). As stated in the NRC comment, Table H-5 reports the results of a regression analysis of down-hole logger response vs the measured Th-232 concentration. The data included in this regression analysis are from three of the four bore-holes. Data from SB-056 is apparently not included. In addition, two data points from a "barrel experiment" are included in the analysis.

A review of the Appendix H text reveals no direct explanation of why the SB-056 data was excluded from the analysis. The text does indicate that two-foot averages of measurements were used in the regression analysis. This is confirmed by comparison of the data entries in tables H-1 through H-3 with the regression data set in table H-5. It is noted that the Sb-056 data set includes only one data pair (measurement point SB-056-14.0) that meets this condition. This is apparently due to poor sample recovery from the bore-hole. It is noted that the measured Th-232 concentrations from SB-056 measurement depths 14.0 to 16.0 ft. (included in measurement point SB-056-14.0) are at natural Th-232 background levels. For these reasons, it seems reasonable to not include SB-056 measurements in the regression analysis.

Molycorp agrees that inclusion of the two data points from the barrel measurements in the regression data is not warranted, as they do not conform to the conditions being tested by the in-ground measurement data set. As requested, Molycorp has performed a regression analysis to determine the effect of removing the barrel data from analysis. It is concluded that removal of the barrel data has no statistically significant effect on the principal results, i.e., the slope and intercept of the regression line. Table B.3.a summarizes the results. The table also includes a run of the regression analysis to confirm the original Table H-5 results.

Table B.3.a - Confirmatory Analysis of SCR Correlation Study for Down-Hole Logger Measurements

Case Description	Results				
	Slope (μR/hr per pCi/gm)	Slope Standard error	Intercept (μR/hr)	Intercept standard error	R^2 coefficient
Original Table H-5 results	5.35	0.493	10.7	5.0	0.85
Reproduction of Table H-5 results	5.45	0.39	10.2	4.5	0.89
Table H-5 data with two barrel measurements removed	5.51	0.73	10.0	5.4	0.74

The regression runs summarized in the table were performed using a standard commercial statistical analysis software package, SYSTAT version 9 ™. The basic – simple linear regression module was used. The intercept was not fixed (or "forced to zero) in the analysis.

The NRC Staff raises a final point regarding the use of a small set of measurements representing a limited portion of the site for exploring the relation between in-situ down-hole logger measurements and measurements of Th-232 concentration by analysis of physical samples withdrawn from the ground. It is agreed that the Appendix H study represents only a small "sample" of the Washington PA site in this regard. A larger data set is available for this purpose. This is the set of measurements reported in Appendix J of the SCR. As part of the 1994 site characterization survey, physical samples were collected from 6 inch depth increments in 30 bore-holes and analyzed for Th-232 concentration by gamma spectroscopy. These boreholes are in the set of 400+ bore-holes in the site characterization survey. The location of these 30 bore-holes is depicted in Figure 5-4 of the SCR. As can be seen from the figure, these bore-holes represent most areas of the site where elevated concentrations of Th-232 have been measured. Molycorp has recently completed an independent statistical analysis of a larger data set which includes both the Appendix J and Appendix H data (excluding the Appendix H barrel measurements). This study concludes that Th-232 concentrations measured by the down-hole logging technique, as described in Appendix H, is in good agreement (at the 95% confidence level) with the Th-232 concentrations measured by gamma spectroscopy of samples withdrawn from the same bore-holes.

NRC Comment B.3.b

Molycorp estimates of the total quantity of thorium on the site (page 10 of Molycorp's December 14, 1999, response to NRC comments) to be 11 curies. The assumption that the 10,000 cubic yards slag pile (see Environmental Report, 1997) has the same concentration profile (i.e., less than 1 percent of the volume has a concentration > 1000 pCi/g - see page 10 of December 14, 1999 correspondence) contradicts previous reports that the average concentration of thorium-232 in the slag pile (see SCR) is1250 pCi/g 0r 2500 pCi/g total thorium. Molycorp should recalculate the total inventory of the site taking into consideration realistic "concentration profiles" for the roll-off boxes and the slag pile.

Molycorp Response B.3.b

The SCR (page 5-5) reports that the average Th-232 concentration measured in 20 samples from the Thorium Pile was 1242.6 pCi/gm [Foster Wheeler 1995]. From this result, the inference is made that this value represents the average Th-232 concentration in the entire Thorium Pile. This value, 1243 pCi/gm or 1.1 % Th-232 on a mass basis, is typical of the slag product, not of the heterogeneous mixture of slag and soil contained in the Thorium Storage Pile. For example, the recent report by Battelle Pacific Northwest Laboratories [Felmy 1998] reports the average Th-232 concentration of four slag samples as 1.3% Th-232 (1417 pCi/gm). Unfortunately, the source document for the SCR result [Applied Health Physics 1975] provides no explanation of the rationale and method for selection of the 20 samples from the Pile.

Additional measurements of Th-232 concentrations in the Thorium Pile are available that are believed to be more representative. During the 1994 site characterization survey, seven boreholes were drilled in the Thorium Pile and Th-232 concentrations measured by gamma logging. These results indicate that the Thorium Pile is indeed a heterogeneous mixture of thorium-bearing slag and soil. The average concentration of Th-232 from 56 measurements made in the seven bore-holes is 534 pCi/gm, with a range of concentrations from 4.1 to 1530 pCi/gm. Six of the 56 measurements exceed 1000 pCi/gm and five are less than 100 pCi/gm.

Based on the above, a more realistic average concentration for estimating Thorium Pile inventory appears to be 1064 pCi/g total thorium. As requested, the simplified estimate of the site inventory in the December 14, 1999, correspondence has been recalculated. The revised estimate also considers information available on thorium and uranium concentrations in the roll-off boxes. The estimated site inventory is 35.8 Ci of thorium plus uranium; 23.9 Ci of thorium (total thorium) and 11.9 Ci of uranium (total uranium). The following tables give a summary of the inventory calculation for the site.

Table B.3.b(1) - Estimated In-ground Inventory of Thorium and Uranium (total Th and total U above background)

Concentration Interval (pCi/gm)	Mid-interval concentration (pCi/gm)	In-ground volume (ft^3) (from Fig 2-7a)	Fraction of total in-ground volume	Mass of contaminated soil (gm)	Inventory (Ci)
10 – 30	20	1.23E+06	4.99E-01	6.27E+10	1.25E+00
30 –100	65	8.29E+05	3.36E-01	4.22E+10	2.74E+00
100 – 200	150	2.48E+05	1.01E-01	1.26E+10	1.89E+00
200 – 500	350	1.42E+05	5.76E-02	7.23E+09	2.53E+00
500 – 1000	750	1.77E+04	7.17E-03	9.02E+08	6.76E-01
1000 – 2070	1535	5.80E+02	2.35E-04	2.95E+07	4.54E-02
	Totals	2.47E+06	1.00E+00	1.26E+11	
Total thorium in-ground inventory (Ci) =>					9.15E+00
Total uranium in-ground inventory (Ci) =>					4.57E+00
Average total thorium in-ground concentration. (pCi/gm) =>					7.28E+01
Average total uranium in-ground concentration. (pCi/gm) =>					3.64E+01

Table B.3.b(2) - Estimated Site Thorium and Uranium Inventory

	Volume (cu yd)	Volume (ft^3)	Average Concentration (pCi/gm)	Inventory (Ci)
In-ground	91400	2.47E+06		
Total Th			72.8	9.15
Total U			36.4	4.47
Thorium Pile	10000	270000		
Total Th			1068	14.7
Total U			534	7.34
Roll-off boxes	3840	103680		
Total Th			13	0.07
Total U			11	0.06

Principle assumptions used in the estimates are:

- the slag pile volume is conservatively assumed to be10,000 yd^3
- In-ground volume estimates are from D Plan Part 1 Revision 1999, Figure 2-7a [Molycorp 1999].
- The average density of the soil/slag mixture in the in-ground volume, the roll-off boxes and the Thorium Pile is assumed to be 1.8 gm/cm^3
- For the purposes of this inventory estimate, the U:Th ratio in in-ground soil and Thorium Pile is assumed to be 0.5 based on an average ratio of 0.46 derived from results reported by RSA in 3/2000 for five composite samples from major site areas including the Thorium Pile.
- Average total thorium and uranium concentrations in the roll-off boxes are based on results reported in the 1996 Final Radiological Status Report for Removal Action along the Northern Boundary of the site [Foster Wheeler 1996].

NRC Comment B.3.c

The 1985 Oak Ridge Associated Universities report, "Radiological Measurements at the Molybdenum Corporation of America Plant, Washington,Pennsylvania," indicates that contamination extends past the site boundaries to the north, south, east and west. In addition, information from the same report indicates that sediments below the storm drain exiting the active plant site, north of the Caldwell Street Bridge, have concentrations exceeding 10 pCi/g. Molycorp should conduct further analysis to assure that the extent of off-site contamination is understood. In addition, Molycorp needs to describe the excavation and procedures that will be used to remediate any contamination off site that exceeds the cleanup criteria.

Molycorp Response B.3.c

The surveys documented in the 1985 Oak Ridge Associated Universities Report appear to be on Molycorp property with the exception of the area north of the plant (Findlay property) and possible the stream sediment. The figures indicate that some samples and surveys may have been performed outside of fences in place at the time but still within Molycorp's boundaries. We believe that it is because these surveys were outside of the fenceline that ORAU designated them as past the site boundaries. Regarding the area north of the plant, remediation has been completed in off-site areas and the excavated material stored in roll-off boxes on the site.

Notwithstanding the fact that the ORAU surveys were likely on Molycorp property, Molycorp intends to continue excavation and remediation until all material exceeding NRC criteria for unrestricted use are removed, including material that may extend beyond the site boundary. The procedures used to remediate off-site contamination, if present, will be the same as those used for onsite remediation.

Based on the data provided in the 1995 Site Characterization Report (Appendix K), the concentrations of Th-232 in Chartiers Creek appear to be at background levels, ranging from 0.23 to 0.89 pCi/g. These results are more recent than the ORAU results and are likely to be more representative of existing conditions. To ensure that the concentration in the Chartiers Creek sediment remains below the unrestricted use levels at the end of the site decommissioning, a minimum of 10 sediment samples will be collected and analyzed after excavation activities are completed.

ATTACHMENT

Groundwater Monitoring Results
and
Surface Water Monitoring Results

Non-Radiological Constituents