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Our ref: HEM-13-101
Date: August 13, 2013

Subject: Westinghouse Hematite Decommissioning Project: Response to NRC Request for Additional Information dated July 10, 2013, on the May 28, 2013, HDP 20.2002 Alternate Disposal Request (License No. SNM-00033, Docket No. 070-00036)

Reference: 1) NRC Letter (Hayes) to Westinghouse (Richardson) dated July 10, 2013, "U.S. Nuclear Regulatory Commission Request for Additional Information from Westinghouse on the May 28, 2013, Hematite 20.2002 Alternate Disposal Request"

2) HEM-13-71 May 28, 2013, "Westinghouse Hematite Decommissioning Project: Request for Third Alternate Disposal Approval and Exemptions for Waste Transferred to US Ecology Idaho"

Dear Sirs:

In Reference 1, the U.S. Nuclear Regulatory Commission (NRC) identified areas where additional information is required in order to complete their review of the May 28, 2013, request made in Reference 2 for approval of an alternate disposal request and exemptions by Westinghouse Electric Company LLC (Westinghouse) for the Hematite Decommissioning Project (HDP). The purpose of this letter is to respond to the NRC requests for additional information (RAIs).

The RAIs from Reference 1 are reproduced in Enclosure 1 and the rightmost column is added with the Westinghouse response. While there were 10 numbered RAIs from Reference 1, an additional request arose during discussions and was added by Westinghouse as row number 11. Enclosure 2 contains the draft revision to HDP-TBD-WM-909 based on the responses in Enclosure 1. Enclosure 2 will be finalized following NRC identification of no further questions about the RAI responses.

Please contact me at 314-810-3376, or Kevin Davis at 314-810-3348, should you have questions or need additional information.

Sincerely,

Dennis Richardson

Dennis C. Richardson
Deputy Director
Hematite Decommissioning Project

Enclosure: 1) Response to NRC Requests for Additional Information on the 20.2002 Request Dated May 28, 2013
2) HDP-TBD-WM-909, "Safety Assessment for Third Alternative Disposal Request for Transfer of Hematite Project Waste to USEI," Draft Revision 1

cc: J. J. Hayes, NRC/FSME/DWMEP/DURLD
J. W. Smetanka, Westinghouse (w/o Enclosure)
M. M. LaFranzo, NRC Region III/DNMS/MCID (w/o Enclosure)
J. E. Tapp, NRC Region III/DNMS/MCID
Chad Hyslop, US Ecology Idaho, Inc.

Enclosure 1

Response to NRC Requests for Additional Information on the 20.2002 Request Dated May 28, 2013

Westinghouse Electric Company LLC
US Ecology Idaho, Inc.

Westinghouse Electric Company LLC, Hematite Decommissioning Project

Docket No. 070-00036

NRC RAIs						Westinghouse Response
RAI No.	Section No.	Issue	Regulatory Link	Discussion	Path Forward	
1	None	Physical security aspects of the waste to be shipped, handled, treated and disposed at USEI	10 CFR 73	This 20.2002 request involves special nuclear material (SNM). Yet, in support of this request there is no discussion of the physical security aspects associated with the transportation, handling, treatment and disposal of the material destined for USEI.	Provide a discussion of the physical security aspects associated with the waste to be transported, handled, treated and disposed at USEI.	Westinghouse has added new Section 10.0 to Revision 1 of HDP-TBD-WM-909, *Safety Assessment for Third Alternative Disposal Request for Transfer of Hematite Project Waste to USEI,* to address the physical security aspects of the waste to be shipped, handled, treated and disposed at USEI. This new Section 10.0 is consistent with the physical security analyses for Amendments 58 and 60 to SNM-33, t.
2	Executive Summary (1.0)	Dose to USEI workers from waste handling	10 CFR 20.2002(d)	In the first paragraph it is indicated that the estimated doses to USEI workers have been calculated for various functions. One function which is not included in this section is the treatment of the waste.	Indicate whether the doses to USEI operators will be calculated for waste treatment occurring at USEI.	The word “treatment” mentioned in the first sentence is added to the second sentence of the first paragraph of Section 1.0.
3	Material Description (5.1)	No reference to Table 1.		Table 1 is presented in the section but there is no reference in the text as to the purpose of the Table.	Incorporate Table 1 into the text if appropriate. Explain its relevance.	The sentence “Table 1 contains those concentrations from Reference 1” was added as the penultimate sentence in the paragraph preceding Table 1.
4	Material Description (5.1), Waste Characterization Plan (5.2)	(a) Volume estimates for Soil vs. Soil-Like Material not provided (b) Complete characterization of dewatered sludge was not provided	10 CFR 20.2002(a)	It was noted in Section 5.1 of HDP-TBD-WM-909 that 22,000 cubic meters of soil-and soil-like material (such as dewatered sanitary sludge) would be disposed. However, there are no specific volume estimates for each type of material, soil or soil-like. The original characterization associated with Amendment 58 was specific to soils, and did not include sanitary sludge. While a more conservative sampling frequency was ultimately chosen and approved by Amendment 58, the analysis used to determine the necessary soil sampling frequency did not include dewatered sludge. In order to complete its review, the staff needs information on the volume and characterization attributes of the soil-like materials in order to assess whether Westinghouse’s soil sampling strategies are appropriate. The staff is anticipating additional characterization information, based upon the statements in Section 5.2 of HDP-TBD-WM-909, “HDP will take additional samples of the sanitary system sludge for laboratory analysis for Tc-99, isotopic uranium, and gamma spectroscopy. These sample results will be submitted to NRC to augment this 20.2002 request.” However, Westinghouse has not indicated when such information will be provided.	Please provide information on the estimated volume of soil-like material and its density. and similar information for the soil. Please provide additional results on the characterization of sanitary system sludge, as noted in Section 5.2 of HDP-TBD-WM-909. Since the staff must evaluate the usage of a sampling plan, originally based only on soil characterization for use on soil-like materials, Westinghouse should provide a description of how the soil sampling frequency and methodology approved for Amendment 58 will be adequate to sample soil-like material (such as dewatered sludge).	Table 3 in HDP-TBD-WM-909 has been expanded to include the July 2013 sample results from the Sanitary Wastewater Treatment Plant (SWTP) sludge. For each of the nine density measurements, dewatering was simulated by passing a portion of the sample through a paint filter and taking the measurement on what remained of that sample on the filter. The average density of the dewatered SWTP sludge was 0.99 g/cm^3. This density variance from the soil applies to about 0.1 percent of the total waste volume in this 20.2002 request, so the potential impact of the density variance on the dose would be at the third significant digit and the dose is estimated at two significant digits. The potential volume of SWTP sludge is estimated to be 30 m^3, so the soil volume would be 21,970 m^3. Section 5.1 identifies that the soil density is 1.69 g/cm^3. The sampling plan for dewatered sanitary sludge in Section 5.2 of HDP-TBD-WM-909 has been revised based on the results from samples taken in July 2013. These results were used to calculate a unique sampling frequency for the dewatered sanitary sludge at 12 samples total for up to 30 m^3. The standard deviation of Tc-99 is less for this sludge than it was for waste associated with Amendment 58. The confidence interval of Tc-99 for this sludge is within the confidence interval for waste associated with Amendment 58.
5	Multiple Material Description (5.1),Waste Characterization Plan (5.2), Transport and Disposal Dose Assessments	Reference to NRC Amendments 58 & 60 as the source & bases for Hematite information	10 CFR 70.21(a)(3)	• Various portions of the text refer to References 1 & 2 as being the source and basis for information presented in the May 28, 2013 Hematite submittal. The NRC’s SERs associated with amendments 58 and 60 were not the source for such information. Rather the sources were the May 2009 and January 2012 Westinghouse 20.2002 submittals supplemented by additional submittals. Examples of information whose	Various portions of the text should be modified to clearly differentiate between information presented in the previous Westinghouse 20.2002 submittals and supporting information versus the NRC’s SERs. Reference section should be updated to incorporate the submittals and	Westinghouse’s intent in the formulation of the references was to follow NRC’s administrative practice of incorporation by reference in a license condition by citing the collection of references contained in an SER. Westinghouse attempted to accomplish this intent by including the following sentence in References 1 and 2 in revision 0 to HDP-TBD-WM-909, “This reference includes the referenced documents in the Safety Evaluation Report enclosed in this letter.” To provide clear and specific references that are incorporated by reference per 10 CFR 70.21(a)(3), Westinghouse has removed the quoted sentence and inserted the list of documents grouped together as Reference 1 and as Reference 2 in a revised Section 11.0 of HDP-TBD-WM-909.

NRC RAIs						Westinghouse Response
RAI No.	**Section No.**	**Issue**	**Regulatory Link**	**Discussion**	**Path Forward**	
	(6.0)			source was not the NRC's SERs includes: • expected concentrations of radionuclides; • information regarding the waste matrix. Information regarding average enrichments of waste; • average total activity concentration; • detailed characterization data and accompanying analyses; • methods and requirements associated with waste shipments; • dose assessment methodology for rail transport and USEI treatment and disposal activities; • updated Stabilization Operator data; • dose estimates for USEI workers while handling and treating the waste and to the public during transport of the waste;	various supporting documents associated with the May 2009 and January 2012 20.2002 requests.	
5a	Waste Characterization Plan (5.2), Table 2	Table 2 does not include soil-like material	10CFR20.2002(d)	Section 5.2 indicates that "the approach used to sample soil and soil-like material associated with this request will be identical to that approved by Reference 1, and "the sample results will be compared to the contingency plan limits shown in Table 2, above." However, Table 2 does not reference "soil-like" material, only soil.	Please clarify in Table 2 whether or not the same contingencies and limits for soil also apply to "soil-like" material.	Table 2 applies to dewatered sanitary sludge. No change is required to Table 2 because existing text makes Table 2 applicable to dewatered sanitary sludge. Specifically, the first paragraph of Section 5.1 describes for this third 20.2002 request that "The waste consists of soil and dewatered sanitary sludge…." The third paragraph of Section 5.1 in HDP-TBD-WM-909 states "The waste subject to Reference 1, Reference 2, and this request will be cumulatively counted against the limits in Table 2." This is the first reference to Table 2 and makes all waste subject to approved 20.2002 requests to be cumulatively counted against the limits in Table 2.
6	Waste Characterization Plan (5.2)	Sampling of soil and soil-like materials	10CFR20.2002(d)	In Section 5.2 it was noted that the same approach would be used to sample both soil and soil-like materials, but it was not clear whether or not populations of soil would be sampled separately from soil-like materials (or if Westinghouse intends to mix soil-like materials into soil prior to sampling). Currently, the NRC staff does not have sufficient characterization information to fully assess the similarity of soil and soil-like materials. As such, it would be prudent to sample soil and soil like materials separately (i.e., prior to any mixing.)	Please provide clarification that soil and soil-like materials will be sampled separately or provide justification for mixing the populations.	The third paragraph of Section 5.2 has been revised to identify that dewatered sanitary sludge will be sampled prior to commingling with soil or other waste. After the characterization results of dewatered sanitary sludge are obtained and evaluated to meet the Table 2 criteria, then it can be commingled with soil.
7	Transport and Disposal Dose Assessment (6.0)	External dose rates provided in Table	10 CFR 20.2002(d)	The NRC staff was not able to recreate these dose rate values for the Gondola Surveyor and the Excavator Operator using the Microshield outputs provided in the first two Hematite 20.2002 requests or their associated RAI responses.	Provide information on how the values of Table 4 for the Gondola Surveyor and the Excavator Operator were calculated, including the relevant Microshield files.	The external dose rate values for the Gondola Surveyor and the Excavator Operator in Table 4 of HDP-TBD-WM-909 are the same values discussed in the response to RAI CH-13 in Westinghouse letter HEM-12-67 (June 19, 2012, ML121740265). That RAI response (pdf page 5 in ML12173A428) stated in part "Dose factors for the gondola surveyor and excavator operator for the prior 20.2002 request were also recalculated (MicroShield (results attached). There is a slight increase in external dose to the gondola surveyor (1.2E-3 mrem to 2.5E-3 mrem) and a slight decrease in external dose to the excavator operator (8.4E-4 mrem to 4.2E-4)." While Westinghouse had intended to attach those Microshield® results, they were not in HEM-12-67, and have been included in a revised Appendix C to HDP-WM-TBD-909. The inputs to these Microshield calculations are the same as for the Amendment 60 request except that the soil density is 1.69 g/cm^3 and the radionuclide concentrations are from Table 1 of HDP-TBD-WM-909, which are the same density and concentrations for Amendment 58. ®MicroShield is a trademark of Grove Software, Inc., registered in the U.S. and other countries.

NRC RAIs						Westinghouse Response
RAI No.	**Section No.**	**Issue**	**Regulatory Link**	**Discussion**	**Path Forward**	
8	Transport and Disposal Dose Assessment (6.0)	Table 4 value for the external dose to an individual for the Stabilization Worker	10 CFR 20.2002(d)	The value (3.9E-2), provided in the Table 4 does not match the value obtained by the NRC staff (3.2E-2).	Confirm if the value in Table 4 is correct.	The value in Table 4 for the external dose to an individual for the Stabilization Operator is now corrected to be 3.2E-02. The value of 3.9E-2 was from an early draft of Revision 0 that should have been changed based on internal reviews of Revision 0. Similarly, the value in Table 4 for the cumulative dose estimate for 2013 for the Stabilization Operator requires correction and is now revised to be 3.0E-01.
9	General and Post Closure Analysis (7.1)	Characterization of material that has been shipped to date and the shipping rate	10 CFR 20.2002(d)	As part of the sensitivity analysis associated with the post-closure dose analysis, Westinghouse estimated the combined impacts of a faster shipping rate. The cumulative dose was weighted assuming the amount of material shipped as of March 31, 2013 was shipped at a nominal shipping rate.	1) Please summarize the results of additional characterization data on the material associated with the approval of the May 2009 20.2002 that has already been shipped. 2) Please confirm the actual shipping rate as of March 31, 2013 for the material associated with the May 2009 20.2002 request (railcars/wk on average).	1) Attached is a summary table of shipment characterization data from the start of shipping under Amendment 58 through March 31, 2013. The 95% UCL for the Tc-99 shipped to USEI as of March 31, 2013, was 0.295 Ci. 2) The number of railcars shipped in this 62 week period since the start of shipping under Amendment 58 through March 31, 2013 was 227, for an average of 3.7 railcars/week.
10	Nuclear Criticality Safety (8.0)	Criticality safety with respect to soil-like material	10 CFR 70.24	Westinghouse submittal contains no discussion of how criticality safety is ensured for the soil-like material.	Please address criticality safety for the soil-like material.	Section 8.0 of HDP-TBD-WM-909 addressed criticality safety for sanitary sludge via reference to NSA-TR-HDP-11-11. Section 2.4.4.1 of NSA-TR-HDP-11-11 addresses the contents of sanitary equipment. However, NSA-TR-HDP-11-11 did not address the broader matter of soil-like material. HDP-TBD-WM-909 is now revised throughout to remove the term ‘soil-like material’ and only discuss the specific case addressed in NSA-TR-HDP-11-11, which is the sanitary sludge within the sanitary equipment.
Addition	Snake River Physa Snail	USFWS consultation	10 CFR 51.30	Consultation with USFWS identified that the Snake River Physa Snail has been found in the portion of the Snake River in the general vicinity of USEI.	It would be prudent to evaluate the potential for leaching of hazardous materials into the Snake River via a groundwater pathway or via overland flow (e.g., to Castle Creek) into the Snake River.	USEI’s operations would not impact the Snake River habitat of the Snake River Physa Snail via water pathways. With respect to surface waters, USEI is a zero-discharge facility. Attachment 1 to the Enclosure to Westinghouse letter HEM-09-52, dated May 21, 2009, (ML091480071) states: “The facility straddles the Castle Creek and Cloudburst Wash drainage basins. However, since the facility contains all runoff from active areas, it does not contribute runoff to either drainage.” In addition, identifiable surface water runoff within the facility is directed to surface impoundments within the USEI property boundary where it is managed in accordance with its RCRA permit. The USEI site exhibits rather large negative evapotranspiration characteristics (approximately -45” per year), so nearly all collected surface water eventually evaporates after collection. With respect to subsurface water (Upper and Lower Aquifers), the report “Summary of Hydrogeological Conditions and Groundwater Flow Model”, dated January 13, 2010, (ML100221416) states the following: “Liquid wastes are not accepted at the USEI facility as a condition of their operating permit with IDEQ. The liner and leachate collection systems for the waste cells at the USEI site are constructed to contain and remove any liquids that may accumulate as a result of an extreme rainfall event falling on the cells prior to closure. As part of previous permitting of the site, analyses were conducted to assess the fate of a release of water from a hypothetical liner failure. These studies have shown that water from such a failure would not reach the water table in the Upper Aquifer because it would be retained by capillarity in the thick vadose zone present at the site.” It also states, “This analysis concluded that the overall low moisture content and hydraulic contrast between the numerous discrete beds comprising the vadose zone at USEI Site B provide a high degree of protection against vertical movement of water from the surface to the Upper Aquifer. In addition the model results indicated that the vadose zone would retain more water than could reasonably be produced on the site if such water were to enter the vadose zone as a result of the failure of the disposal cell liner systems.”

Summary Table of Shipment Data from the Start of Shipping under Amendment 58 through March 31, 2013

Shipment Date	**Number of Containers (railcars)**	**Waste Weight** (lbs)	**Waste Volume†** (ft^3)	**U-235** (grams)	**Tc-99** (mCi)	**U-234** (mCi)	**U-235** (mCi)	**U-238** (mCi)	**Ra-226** (mCi)	**Th-232** (mCi)	**Total Activity*** (mCi)
1/19/2012	5	989700	9381	147	40.7	6.0	0.3	1.7	0.5	0.1	49.3
1/26/2012	5	1071550	10157	101	16.1	4.0	0.2	1.0	0.5	0.1	22.0
2/2/2012	5	1071400	10155	216	21.8	8.6	0.5	2.0	0.6	0.1	33.6
2/9/2012	5	1076600	10204	193	15.4	7.7	0.4	1.8	0.6	0.1	26.1
2/21/2012	2	431600	4091	289	3.2	11.5	0.6	1.8	0.2	0.1	17.3
5/3/2012	6	1304400	12364	206	3.7	8.4	0.5	2.0	0.6	0.5	15.6
5/15/2012	6	1299600	12318	205	3.8	8.4	0.5	2.1	0.6	0.5	15.7
5/22/2012	5	1064800	10093	281	2.1	12.1	0.6	8.1	0.5	0.5	23.9
6/19/2012	6	1302000	12341	541	2.3	21.6	1.2	2.8	0.7	0.7	29.2
7/10/2012	6	1307350	12392	617	2.0	24.8	1.4	3.4	1.4	0.6	31.1
7/24/2012	6	1295750	12282	553	1.3	22.3	1.2	2.9	0.7	0.7	29.1
7/31/2012	6	1301150	12333	441	1.8	17.5	1.0	2.8	0.7	0.7	24.6
8/7/2012	6	1300850	12330	676	1.7	27.0	1.5	4.3	0.8	0.7	35.9
8/21/2012	6	1302300	12344	584	2.5	23.3	1.3	3.4	0.7	0.6	31.9
8/28/2012	6	1303100	12351	705	1.5	28.1	1.6	4.1	0.7	0.7	36.7
9/13/2012	6	1320400	12515	671	1.6	26.8	1.5	5.8	0.8	0.7	37.1
9/20/2012	6	1248700	11836	821	1.1	32.7	1.8	4.6	0.7	0.6	39.9
9/27/2012	6	1297350	12297	722	3.8	28.9	1.6	4.2	0.7	0.7	39.9
10/9/2012	6	1297500	12298	1089	1.0	43.7	2.4	5.6	0.6	0.6	53.8
10/18/2012	5	1082300	10258	1292	1.2	51.0	2.8	7.7	0.6	0.6	64.0
11/1/2012	6	1295500	12279	1045	0.8	42.2	2.3	4.4	0.7	0.6	50.9
11/8/2012	6	1297400	12297	532	1.2	21.2	1.2	3.2	0.7	0.6	28.1
11/13/2012	6	1300750	12329	696	1.6	27.9	1.5	3.4	0.7	0.6	35.8
11/15/2012	6	1301200	12333	995	1.6	39.5	2.2	6.5	0.8	0.6	51.2
11/27/2012	6	1303150	12352	877	2.9	35.0	1.9	5.3	0.9	0.6	46.6
12/4/2012	6	1288950	12217	532	7.5	21.3	1.2	3.7	0.9	0.6	35.1

Shipment Date	**Number of Containers (railcars)**	**Waste Weight** (lbs)	**Waste Volume†** (ft^3)	**U-235** (grams)	**Tc-99** (mCi)	**U-234** (mCi)	**U-235** (mCi)	**U-238** (mCi)	**Ra-226** (mCi)	**Th-232** (mCi)	**Total Activity*** (mCi)
12/6/2012	6	1304050	12360	535	5.7	21.4	1.2	3.9	0.9	0.6	33.7
12/11/2012	6	1306500	12384	449	5.4	17.9	1.0	2.7	0.8	0.6	28.4
12/13/2012	6	1306200	12381	493	1.5	20.7	1.1	3.3	0.8	0.6	26.9
12/18/2012	3	652100	6181	360	0.8	14.4	0.8	2.2	0.4	0.3	18.9
1/3/2013	6	1307300	12391	657	3.0	26.5	1.4	3.0	0.7	0.6	34.1
1/8/2013	6	1296300	12287	332	2.1	13.2	0.7	2.8	0.7	0.6	20.2
1/10/2013	6	1300900	12330	342	10.6	13.4	0.8	2.8	0.7	0.4	28.7
1/15/2013	6	1289550	12223	473	14.5	18.9	1.0	3.0	0.7	0.4	38.5
2/5/2013	6	1302250	12343	413	21.6	16.4	0.9	2.6	0.7	0.4	42.5
2/7/2013	6	1305550	12374	878	11.5	34.9	1.9	6.8	0.7	0.5	56.4
2/14/2013	6	1304350	12363	924	2.9	36.9	2.0	5.1	0.7	0.6	48.2
2/26/2013	6	1279950	12132	600	0.9	24.1	1.3	3.3	0.7	0.6	30.9
3/5/2013	6	1296450	12288	1170	2.2	46.6	2.6	8.5	0.7	0.6	61.1
3/19/2013	6	1296700	12291	1211	0.7	48.3	2.7	7.2	0.7	0.6	60.2
Total*	**227**	**49003500**	**464474**	**23861**	**227**	**955**	**53**	**156**	**28**	**21**	**1433**

*Summary data is rounded and may result in slight difference in the totals, since the totals were based on the data before rounding.
†Since weight is measured and railcar fill volume is not measureable, volume is based on density correction of the weight using 1.69 g/cm^3.

Enclosure 2

HDP-TBD-WM-909

Safety Assessment for Additional Hematite Project Waste at USEI

Draft Revision 1

Westinghouse Electric Company LLC
US Ecology Idaho, Inc.

Westinghouse Electric Company LLC, Hematite Decommissioning Project

Docket No. 070-00036

Westinghouse

Hematite Decommissioning Project

Technical Basis Document

NUMBER: HDP-TBD-WM-909

TITLE: Safety Assessment for Third Alternative Disposal Request for Transfer of Hematite Project Waste to USEI

REVISION: Draft, proposed 1

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EFFECTIVE DATE: See Final Approved Date Below

Approvals:

Author: Joseph S. Guido*

Owner / Manager: Joseph S. Guido*

*Electronically approved records are authenticated in the electronic document management system

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REVISION LOG	
Revision No	**Change(s)**
0 05/28/2013	This document is needed to support a third 20.2002 alternate disposal request for transfer of HDP waste to USEI.
Draft, proposed 1 See Cover Page	This document was revised to resolve NRC requests for additional information dated 7/10/13. In addition, the fourth paragraph of Section 7.1 was revised to reflect that the post closure dose calculations for maximum shipping rates are based on a higher concentration of radioactivity being shipped in a shorter timeframe rather than being based solely on the number of railcars shipped per unit of time.

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1.0 EXECUTIVE SUMMARY

This radiological safety assessment was developed in support of an alternate disposal request pursuant to 10 CFR 20.2002 for transfer of specified low-activity radioactive materials from the Hematite Decommissioning Project (HDP), License No. SNM-0033, to US Ecology Idaho, Inc. (USEI) Resource Conservation and Recovery Act (RCRA) treatment and disposal facility near Grand View, Idaho. This safety assessment identifies the candidate waste material; the proposed manner and conditions of treatment for RCRA hazardous waste (including volatile organics [VOCs]); the estimated doses to members of the public during transport operations and to USEI workers during receipt, unloading, treatment, transport and disposal; and provides an assessment of the potential post-closure doses.

This Safety Assessment incorporates by reference the large body of safety assessment documents performed for two previous 20.2002 alternate disposal requests for the transfer of HDP waste to this same USEI facility. References 1 and 2 are the collection of documents that support the license amendments for these two previous 20.2002 requests. These documents are incorporated by reference into this third 20.2002 request.

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The additional volume of waste in this 20.2002 request is based on encountering more material during excavation that requires disposal than was accounted for by contingencies in the original estimates. The additional material is from areas that were previously characterized, but the volumetric extent of the contaminated material was underestimated. The additions of dewatered sanitary sludge and treatment of volatile organic (VOC) waste are due NRC letters dated February 26, 2013, and March 18, 2013 (References 3 and 4). In these letters NRC concluded that HDP is not authorized to transfer dewatered sanitary sludge or mixed VOC hazardous and radiological waste to USEI for treatment unless another 20.2002 request is submitted.

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This Safety Assessment demonstrates that this third 20.2002 request does not increase the cumulative limiting dose estimate from the two previous 20.2002 alternate disposal requests of 2.7 mrem. This dose is consistent with NUREG 1757's Vol.1, Rev.2, Consolidated Decommissioning Guidance - Decommissioning Guidance for Materials Licensees, Final Report, p. 15-31 criteria of a "few millirem/yr" to a member of the public.

This information and radiological safety assessment was developed in coordination with USEI.

This Safety Assessment also supports a request for NRC to exempt USEI from byproduct material and Special Nuclear Material (SNM) license requirements of 10 CFR 30.3 and 10 CFR 70.3, as allowed in 10 CFR 30.11 and 10 CFR 70.17. Such exemptions from regulation under the Atomic Energy Act for transfer (treatment and disposal purposes are consistent with the diffuse, low concentrations of contaminants in the waste and with such exemptions issued by NRC for managing equivalent or higher concentration wastes. Each railcar of waste shipped to USEI will meet the 10 CFR 40.13 requirements for unimportant quantities of source material.

2.0 USEI FACILITY OPERATING HISTORY

USEI's operating history is described extensively in the information associated with Reference 1, with supplemental information provided in the information associated with

Reference 2. There have been no significant changes to USEI's operating permit, radioactive materials acceptance limits, or regulatory status since the date of Reference 2.

Subsequent to the information associated with Reference 2, USEI has received approval to dispose of additional low-activity waste. This waste is from the Pacific Gas & Electric Humboldt Bay Nuclear Power Plant (HBNPP) near Eureka, California. USEI has not received any of this additional HBNPP waste to date. There are no pending 20.2002 requests for USEI at the time of this third HDP request. The additional HBNPP approvals (References 5 and 6) at USEI are:

- HBNPP Unit 3: 2,000,000 ft^3 of soil, debris, and miscellaneous waste from decommissioning, but does not include SNM.
- HBNPP Unit 3: 100,000 ft^3 of soil, debris, piping, and miscellaneous waste (or 1375 tons at 27.5 lb/ft^3), and 50,000 ft^3 of water (or 1,560 tons at 62.4 lb/ft^3 or 1 g/cc prior to solidification). This waste may include low levels of SNM at concentrations of 2 pCi/g for U-235, 4 pCi/g for Pu-239, and 150 pCi/g for Pu-241. SNM mass concentration of waste from HBNPP would be less than 1 g/m^3, or 0.001 g/L.

All of this other SNM material was below the average 0.1 $g^{235}U/L$ concentration limit for HDP waste consigned to USEI. The concentration is further reduced since these shipments were received between 2010 and 2012 and were combined with approximately 1.7 million tons of other non-SNM soils and debris in the USEI landfill. Therefore, no additional impact needs to be evaluated.

USEI remains in compliance with its operating permit and has maintained VPP "Star" status with the OSHA Voluntary Protection Program. Information on occupational illness and injuries for 2012 for both USEI and HDP are provided in Appendix A.

3.0 DISPOSAL FACILITY CHARACTERISTICS

A description of the USEI facility and waste placement practices is found in the information associated with Reference 1. The USEI disposal cell for this waste would continue to be Cell 15, consistent with the information associated with References 1 and 2. Cell 15 has additional capacity of approximately 700,000 tons, which represents about two years of burial space at current projections. Two years is beyond the scheduled duration of HDP disposal activities. As a contingency, USEI can establish controls to reserve space within Cell 15 while material from other sites is placed into Cell 16 once that cell is operational.

4.0 USEI WASTE ACCEPTANCE CRITERIA

USEI's waste acceptance criteria (WAC) associated with this 20.2002 request is included as Appendix B.

USEI's waste acceptance criteria are maintained on their website, nominally at:
usecology.com/idaho_documents_forms.htm

Idaho rules regulating radioactive materials (IDAPA 58.01.10) are maintained on their website, nominally at:
adminrules.idaho.gov/rules/current/58/index.html

In summary, USEI is authorized to accept low concentration SNM and byproduct material if:

- The NRC specifically exempts the material under 10 CFR 30.11 §70.17 and
- The sum of all activity within the material is less than 3,000 pCi/g, and
- IDEQ reviews and concurs with the NRC exemption and USEI Safety Assessment.

5.0 MATERIAL DESCRIPTION AND CHARACTERIZATION

5.1 Material Description

Westinghouse estimates the volume of the excavated waste that is a candidate for treatment and disposal at USEI to be up to 22,000 cubic meters at an average waste density of 1.69 g/cm^3 (e.g., approximately 41,000 tons). The waste consists of soil and dewatered sanitary sludge with low levels of SNM, source material, and byproduct material meeting the definition of diffuse material, as defined in the Fundamental Nuclear Material Control Plan, dated February 18, 2011, and approved by Amendment 59 to License SNM-33.

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The expected concentrations for the radionuclides are based on the information associated with Reference 1, with the following exceptions: 1) the total amount of Tc-99 will not exceed the numerical limits identified in Table 2, which are unchanged from Reference 2. The radionuclides concentrations from Reference 1 are appropriate for this request since those concentration were based on an assessment of soil from across the HDP Site, are higher and thus more conservative than the Reference 2 concentrations, and the Reference 1 waste matrix (soil with debris) is consistent with this third 20.2002 request for an additional volume of soil and dewatered sanitary sludge. Table 1 contains those concentrations from Reference 1. Consistent with the information provided in References 1 and 2, the overall uranium enrichment for this 22,000 m^3 of waste averages less than 10 percent.

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Table 1. Expected Radionuclide Concentrations in Westinghouse Hematite Waste

Shipped Volume (m^3)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Tc-99 (pCi/g)	Ra-226 (pCi/g)	Th-232 (pCi/g)
22,000	113	5.5	18	27*	1	1.2

* The total amount of Tc-99 will not exceed the limits identified in Table 2.

The waste subject to Reference 1, Reference 2, and this request will be cumulatively counted against the limits in Table 2. Cumulatively, the total Tc-99 inventory for all three requests will be maintained at or below 1.3 Ci, and the amount of Tc-99 at the 95 percent confidence interval on the mean will be maintained below 2.05 Ci. This will ensure that the cumulative dose to the public from all three requests is maintained below 2.7 mrem based on the mean inventory and below 4.2 mrem at the 95 percent upper confidence interval on the mean. Both of these values are within the ‘few millirem’ criterion in NUREG 1757 for 20.2002 requests.

Consistent with Reference 1, the average total activity concentration (sum of all nuclides and progeny) for this waste is approximately 226 pCi/g or approximately 8 percent of USEI’s 3,000 pCi/g total activity concentration limit.

Up to 22,000 m^3 of this waste may contain concentrations of hazardous constituents, such as metals and volatile organics, that exceed the levels identified in 40 CFR 261 for classification as hazardous waste and require treatment prior to disposal. This waste will require treatment at USEI.

Since the waste proposed for transfer to USEI will contain more than 1 gram of SNM, HDP will continue to meet 10 CFR 74.15 requirements to document the transfers of 1 gram or more of SNM to the disposal facility through use of DOE/NRC Form 741, and that USEI will report SNM receipts using its existing account with the Nuclear Material Management & Safeguards System (NMMSS).

Table 2, Contingency Plan Table

Prior to shipment, the following conditions will be evaluated, combining results for all three 20.2002 requests for HDP-USEI:

Parameter	Action Level	How Monitored	Actions
Total Quantity of Tc-99 shipped to USEI (mean)	>1.3 Ci	Running total activity (both shipped and pending shipment), based on laboratory sample results prior to shipment	• Reanalyze composite sample and/or analyze individual aliquots used to create the composite sample; • Resample stockpile and re-evaluate[a]; • Ship material to alternate facility.
95% Upper Confidence Level of the mean Tc-99 shipped to USEI (UCL(0.95)).	>2.05 Ci	Running confidence interval (both shipped and pending shipment) based on laboratory sample data prior to shipment	• Reanalyze composite sample and/or analyze individual aliquots used to create the composite sample; • Resample stockpile and re-evaluate[a]; • Ship material to alternate facility.
Total activity contribution from all radionuclides within individual railcar	>3000 pCi/g > 40 µR/hrb	Laboratory sample results for stockpile evaluated at 95% UCL prior to shipment Gamma radiation levels on railcars prior to shipment.	• Analyze additional aliquot of composite sample; • Unload railcar (at HDP) and re-load with material containing lower concentration (either blended or alternate material from onsite waste stream)a; • Ship material to alternate facility.
Unexpected Tc-99 results for stockpile samples (soil)	>99th percentile of the site wide dataset (573 pCi/g)c	Laboratory sample results for stockpile evaluated prior to shipment	• Analyze additional aliquot of composite sample; • Resample stockpile and re-evaluate[a]; • Blend with less contaminated material, resample stockpile and re-evaluate; • Ship material to alternate facility.
Unexpected Tc-99 results for concrete slab samples	>99th percentile of the dataset (1590 pCi/g)	Laboratory sample results for concrete slabs evaluated prior to shipment	• Analyze additional aliquot of sample; • Resample and re-evaluate[a]; • Blend with less contaminated material, resample and re-evaluate; • Ship material to alternate facility.
Unexpected Tc-99 results for stockpile samples (piping internal debris / residue)	>99th percentile of the dataset (162 pCi/g)	Laboratory sample results for stockpile evaluated prior to shipment	• Analyze additional aliquot of composite sample; • Resample stockpile and re-evaluate[a]; • Blend with less contaminated material, resample stockpile and re-evaluate; • Ship material to alternate facility.
Unexpected Tc-99 results for stockpile samples (piping average concentration)	>99th percentile of the dataset (125 pCi/g)	Laboratory sample results for stockpile evaluated prior to shipment	• Analyze additional aliquot of composite sample; • Resample stockpile and re-evaluate[a]; • Blend with less contaminated material, resample stockpile and re-evaluate; • Ship material to alternate facility.

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Table 2, Contingency Plan Table

Prior to shipment, the following conditions will be evaluated, combining results for all three 20.2002 requests for HDP-USEI:

Parameter	Action Level	How Monitored	Actions
Maximum average concentration of Ra-226 and Th-232 within individual railcar	Ra-226 >13 pCi/g Th-232 >16 pCi/g	Laboratory sample results for each railcar evaluated prior to shipment	• Analyze additional aliquot of composite sample; • Resample stockpile and re-evaluate[a]; Blend with less contaminated material, resample stockpile and re-evaluate; • Ship material to alternate facility.

[a] Re-sampling of material will generally occur after down blending of stockpile material. When such sampling is performed, the new sample dataset will replace the initial data for the purpose of subsequent calculations. If re-sampling is performed without down blending (which would be the case if the material was sampled in-situ railcars) then, the additional samples will be used to augment the initial dataset.

[b] Based on analysis previously transmitted in HEM-10-46, 5/24/10.

[c] Value shown is the 99th percentile of the pooled site wide Tc-99 dataset with EP-08-00-SL and EP-10-00-SL excluded using spreadsheet software.

5.2 Waste Characterization Plan

Detailed characterization data and accompanying analyses for soil are contained in Reference 1. This characterization information continues to apply to the waste subject to this request. The increase in volume is due to an underestimate in the volume of soil that require disposal due to contamination, but the nature of the contamination is consistent with the Reference 1 characterization.

Westinghouse will subject soils, which may include spent limestone used as backfill, associated with this request to the same sampling plan that was detailed in Reference 1, will compare the sample results to the combined contingency plan limits in Table 2, and will use the same radiological controls and programmatic elements detailed in Reference 1.

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The characterization of dewatered sanitary system sludge being readied for shipment will consist of 12 samples taken following dewatering. The 12 samples will be taken from random locations within the dewatering containers. Software will be used to randomly select each of the three coordinates that comprise the sampling location within the dewatering container. This characterization of dewatered sanitary sludge will occur prior to commingling with soil or other waste. After the characterization results of dewatered sanitary sludge are obtained and evaluated to meet the 20.2002 criteria, then it can be commingled with soil or other waste. The number of samples based on attaining a confidence interval of 35 pCi/g, based on analysis of the July 2013 characterization data using Visual Sample Plan©, as reported in Appendix D. The randomness of sample locations is also based on Appendix D. The sample results will be compared to the combined contingency plan limits in Table 2.

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Deleted: follow the same requirements associated with Reference 1 soils prior to their shipment for treatment and disposal

Available characterization data of sanitary system sludge is provided in Table 3. The upper half of the table is older data and the lower half of the table is July 2013 data. Figure 1 shows the locations within the Sanitary Wastewater Treatment Plant where the July 2013 sludge samples were taken. For each of the nine density measurements, dewatering was simulated by the passing a portion of the sample through a paint filter and taking the measurement on what remained of that sample on the filter. The July 2013 sludge samples

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were dried for inductively coupled plasma mass spectroscopy analysis for Tc-99. By drying the sludge samples, the Tc-99 results are conservatively high when compared to the dewatered state of the waste. The percent solid for the Tc-99 samples are included in Table 3.

Deleted: HDP will take additional samples of the sanitary system sludge for laboratory analysis for Tc-99, isotopic uranium, and gamma spectroscopy. These sample results will be submitted to NRC to augment this 20.2002 request.

The approach used to sample soil associated with this request will be identical to that approved by Reference 1. The sample results for both soil and dewatered sanitary sludge will be compared to the contingency plan limits shown in Table 2, above.

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Sample analysis for Tc-99 will follow the methodology currently employed, which is inductively coupled plasma mass spectrometry. Since this analysis is destructive, the sample aliquot is not returned; however, the excess portion of the sample is returned.

Table 3. Sample Results from the Sanitary Sludge

	ID	Bulk Density (g/ml)		Potassium-40 (pCi/g)			Radium-226 (pCi/g)			Technetium-99 (pCi/g)				Thorium-232 (pCi/g)			Uranium-235 (pCi/g)			Uranium-238 (pCi/g)		
		Result	MDC	Result	Error	MDC	Result	Error	MDC	Result	Error	MDC	% solid	Result	Error	MDC	Result	Error	MDC	Result	Error	MDC
4111-WM-130110-01-	01	-	-	14.11	2.08	1.31	1.37	0.18	0.32	-	-	-		ND	-	0.71	1.55	0.25	0.34	3.92	3.62	5.89
	02	-	-	12.10	1.79	1.12	1.09	0.14	0.25	-	-	-		ND	-	0.61	3.33	0.31	0.29	10.80	12.32	5.97
	03	-	-	13.90	2.08	1.38	1.32	0.16	0.12	-	-	-		ND	-	0.76	1.11	0.21	0.30	ND	-	7.28
	04	-	-	13.46	2.00	1.47	1.66	0.17	0.11	-	-	-		ND	-	0.81	44.36	1.90	0.29	183.47	19.78	9.25
	05	-	-	11.34	1.73	1.33	1.65	0.16	0.25	-	-	-		ND	-	0.66	48.16	1.99	0.45	184.70	18.72	8.72
	06	-	-	14.53	2.10	1.29	1.14	0.15	0.26	-	-	-		ND	-	0.75	3.07	0.30	0.34	9.95	3.66	6.28
	07	-	-	14.98	2.22	1.55	1.40	0.18	0.13	-	-	-		0.58	0.20	0.34	17.84	0.98	0.41	69.02	13.23	7.45
	08	-	-	14.10	1.98	0.81	1.02	0.15	0.22	-	-	-		ND	-	0.74	0.27	0.14	0.22	ND	-	6.61
	09	-	-	10.81	1.75	1.21	1.11	0.15	0.29	-	-	-		ND	-	0.71	0.23	0.15	0.24	ND	-	6.40
	10	-	-	14.52	2.04	1.01	1.16	0.14	0.25	-	-	-		ND	-	0.76	3.07	0.29	0.27	10.13	3.46	6.41
	11	-	-	14.85	2.18	1.33	1.14	0.15	0.27	-	-	-		ND	-	0.78	1.87	0.27	0.35	5.36	3.69	5.88
	12	-	-	10.02	1.64	1.23	1.05	0.14	0.24	-	-	-		0.47	0.19	0.31	2.29	0.25	0.28	16.37	17.23	5.33
See Figure 1 for Location	S1	0.88	0.10	8.29	1.99	2.14	1.03	0.32	0.33	7.01	1.07	0.25	3.2	0.59	0.32	0.62	43.2	4.66	1.4	129	14.7	5.29
	S2	-	-	5.92	2.35	3.59	0.96	0.31	0.35	16.4	2.17	0.22	0.8	0.98	0.33	0.17	17.6	2.09	0.86	62	7	3.76
	S3	0.87	0.10	5.39	1.57	1.92	1.20	0.31	0.39	27.5	3.53	0.22	3.8	0.95	0.39	0.64	25.8	2.94	1.26	90	9.91	4.36
	S4	-	-	5.36	2.35	3.27	2.37	0.76	0.76	192	29.5	0.27	0.8	1.01	0.78	1.22	137	13.9	2.87	429	43.4	9.33
	S5	0.93	0.10	3.28	1.44	2.17	-0.54	2.84	3.77	86.3	13.5	0.26	0.4	1.37	1.97	4.27	29.6	6.48	5.81	89.5	15	15.1
	S6	0.84	0.10	9.03	2.39	2.49	2.50	0.53	0.43	24.8	3.6	0.26	1.8	1.42	0.51	0.50	131	13	1.8	413	41.2	6.91
	S7	1.20	0.10	4	1.94	3.28	1.86	0.50	0.45	37.6	8	0.36	0.9	0.59	0.40	0.66	167	16.6	3.24	520	52.4	11.6
	S8	1.30	0.10	-0.79	12	25.7	0.99	0.97	1.26	93.9	11.9	0.23	0.6	0.98	1.01	2.01	174	17.7	4.28	599	61.7	15.9
	S9	0.95	0.10	5.23	1.91	2.17	1.10	1.22	1.96	95	13.8	0.26	0.8	-0.97	58-	5.23	16.6	4.6	4.59	66.6	13.5	12.4
	S10	1.00	0.10	5.54	2.06	2.42	1.07	0.44	0.55	85.4	14.4	0.25	1.9	0.64	0.46	0.83	77.4	7.95	1.89	257	26.4	6.97
	S11	-	-	14.5	5.11	6.35	0.96	0.43	0.44	115	15.4	0.23	2.8	0.85	0.31	0.36	41	4.36	1.86	162	17.7	5.64
	S12	0.93	0.10	0.36	7.6	17.9	1.06	0.44	0.53	64.2	9.65	0.25	2.3	1.47	0.62	0.64	23.2	2.83	1.46	82.3	8.69	4.8

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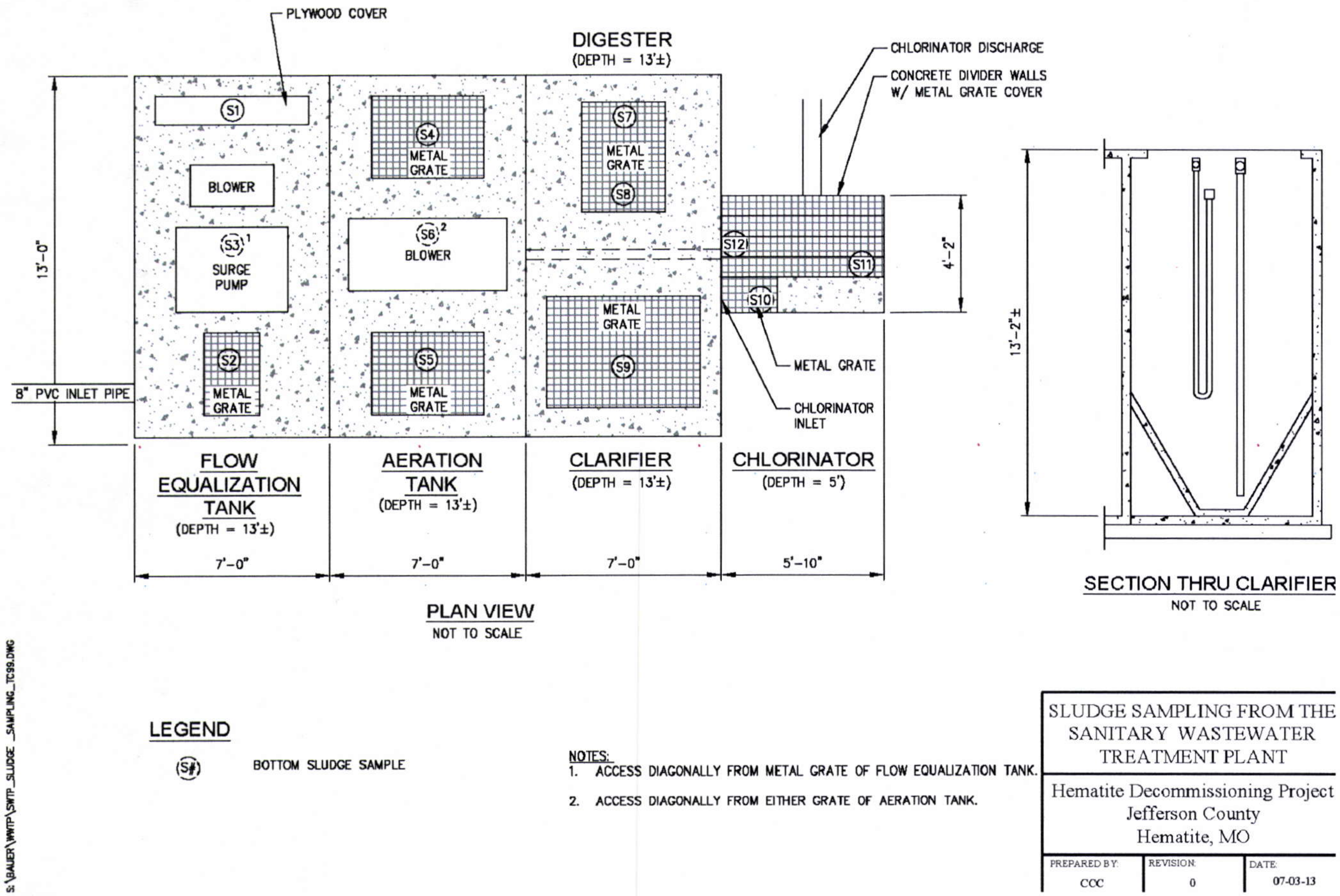
Figure 1. Sludge Sample Locations in the Sanitary Wastewater Treatment Plant



LEGEND

(S#) BOTTOM SLUDGE SAMPLE

NOTES:
1. ACCESS DIAGONALLY FROM METAL GRATE OF FLOW EQUALIZATION TANK.
2. ACCESS DIAGONALLY FROM EITHER GRATE OF AERATION TANK.

SLUDGE SAMPLING FROM THE SANITARY WASTEWATER TREATMENT PLANT		
Hematite Decommissioning Project Jefferson County Hematite, MO		
PREPARED BY: CCC	REVISION: 0	DATE: 07-03-13

6.0 TRANSPORT AND DISPOSAL DOSE ASSESSMENTS

The waste in this third 20.2002 request will be shipped by rail using the same methods and requirements as described in the information associated with Reference 2. The dose assessment methodology for rail transport and USEI treatment and disposal activities associated with Reference 2 is unchanged in this request. The information for the Stabilization Operator is updated from Reference 2 to provide additional information on the treatment activities. This information on treatment activities was initially provided to NRC in Westinghouse letter HEM-12-77 (Reference 7). The dose estimates associated with transport and USEI workers are evaluated for impacts by the increase in the volume of the waste and the treatment of the waste by USEI.

For the public along the transport route, the dose would be less than the more restrictive dose calculated below for the USEI work, as discussed in the information supporting Reference 2. In order for the dose to a bystander during rail transport to exceed that of the site worker and therefore be bounding, the individual would have to spend more than 1000 hrs at 1 meter from the gondola railcar or 790 hrs at 1 foot, which are not credible external exposure scenarios during transportation. Since the waste within the gondola railcars is contained during transport, no internal dose would be assigned to a by-stander.

The dose estimate for USEI workers is based on the dose estimates associated with References 1 and 2. These estimates were then modified for the volume and density of waste being transported and treated in this 20.2002 request. More specifically, the dose estimates for USEI workers in Reference 1 are carried forward in the development of this assessment, with the exception of the gondola surveyor and stabilization operator. Reference 2 identified revised dose estimates for gondola surveyor and stabilization operator from Reference 1, so those Reference 2 estimates are carried forward in the development of this assessment. Appendix C contains the Microshield®[1] calculations for the stabilization operator, gondola surveyor, and excavator operator (called 'gondop' in Appendix C). From those baseline estimates, the number of railcars is adjusted from 400 in Reference 1 to 372 (372 is based on 110 tons per railcar). The number of cubes for the Stabilization Operator is increased to 372 to reflect up to 100 percent of the waste in this 20.2002 request being treated, as compared to 5 percent in Reference 1. Section 6.1, provides a detailed summary of the waste stabilization process. Table 4 contains the exposure estimates for the USEI workers.

The potential cumulative USEI worker doses are estimated by the following equation, and the results are in the right column of Table 4. This equation is based on the 58 percent of Reference 1 waste that was not shipped as of December 31, 2012, 100 percent of the waste associated with Reference 2, 100 percent of the waste associated this 20.2002 request are conservatively assumed to be disposed at USEI in 2013.

$$\text{Cum. Dose 2013} = 0.58(\text{Dose Reference 1}) + (\text{Dose Reference 2}) + (\text{Dose Reference 3})$$

The highest cumulative dose is 0.86 mrem/year, which is less than the bounding post-closure dose of 2.7 mrem/year.

[1] MicroShield is a trademark of Grove Software, Inc., registered in the U.S. and other countries.

6.1 Stabilization Operator

Up to 22,000 m^3 of the HDP waste may contain chemical constituents at concentrations identified in 40 CFR 261 to be hazardous waste. Such constituents are Tetrachloroethylene (D039), Trichloroethylene (D040), Vinyl Chloride (D043), Arsenic (D004), Mercury (D009), and Lead (D008). USEI's RCRA Part B permit allows the facility to accept this waste, treat it to meet USEPA Land Disposal Restrictions and dispose it in the facility's disposal cell.

All treatment activities will be conducted inside a containment building, with 50,000 cfm of negative airflow. The waste will be treated by a stabilization operator. Six stabilization operators share this task. It normally takes the stabilization operator up to 45 minutes to perform this operation. The operator occupies a position approximately 2.8 meters from the material. The estimated radiation field, internal and external dose rates per gondola railcar and per operator are provided in Table 4 (based on up to 372 gondola cars containing waste with constituents requiring stabilization).

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Stabilization treatments applicable to waste shipped from the Hematite site to the USEI site are as follows:

1. Stabilization is a proven treatment process that irreversibly bonds target molecules into an environmentally inert material that reduces the leachability of the contaminants of concern. Stabilization uses limebearing material such as Portland cement, kiln dust, or other lime sources. Stabilization results from the chemical reaction of the lime, waste and water (supplied or in the waste). All of these reactions contribute to the reduced leachability of the constituents of concern.
2. Chemical Reduction involves reagents which, when used in conjunction with stabilization, reduce the leachability of inorganic and organic constituents. Reducing reactions, oxidation reactions, and competing reactions may all occur during the use of these reagents. These processes allow the formation of compounds, which are insoluble or have significantly reduced solubility.
3. Macro-encapsulation is a confining or immobilization process used to treat all types of hazardous debris independent of the hazardous constituents involved. The macro-encapsulation process encases the debris to provide a physical barrier that prevents/minimizes potential leaching of hazardous constituents from the debris.
4. Micro-encapsulation is a confining or immobilization process that requires the stabilization of the debris with the following types of reagents (or waste reagents) such that the leachability of the hazardous contaminants is reduced: (1) Portland cement; or (2) lime/pozzolans (e.g., fly ash and cement kiln dust). Additional reagents (e.g., iron salts, silicates, carbon, polymers or clays) may be used as appropriate.

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Table 4. Summary of Doses to USEI Workers during Transport, Treatment and Disposal of Westinghouse Hematite Waste

	Input Parameters				External dose rate (mrem/hr)	Dose (mrem/conveyance)		Individual Dose (mrem/worker)			Cumula-tive Dose Estimate for 2013 (mrem/ worker)
	No. of Workers	Minutes to perform task[1]	Distance from object (meters)	Type of conveyance modeled (count)[2]		Internal[3]	External[4]	Internal[5]	External[6]	Total[7]	
Gondola surveyor	8	20	1	Gondola (372)	2.5E-03	1.8E-03	8.5E-04	NA[8]	4.0E-02	4.0E-02	1.2E-01
Excavator operator	4	45	2	Gondola (372)	4.2E-04	4.1E-03	3.2E-04	3.8E-01	3.0E-02	4.1E-01	8.6E-01
Gondola Cleanout	8	10	1	Gondola (372)	1.6E-03	9.0E-04	2.7E-04	4.2E-02	1.3E-02	5.4E-02	1.1E-01
Truck Surveyor	8	5	1	Truck (1117)	2.0E-03	4.5E-04	1.7E-04	NA[8]	2.4E-02	2.4E-02	8.0E-02
Truck Driver	14	45	0.6	Truck (1117)	2.3E-03	4.1E-03	1.7E-03	NA[8]	1.4E-01	1.4E-01	4.3E-01
Stabilization Operator	6	45	2.8	Cube (372)	6.9E-04	4.1E-03	5.2E-04	2.5E-01	3.2E-02	2.9E-01	3.0E-01
Cell Operator	2	15	1	Gondola (372)	2.3E-03	1.4E-03	5.7E-04	2.6E-01	1.1E-01	3.7E-01	7.2E-01

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1 The minutes assigned for each job function listed in Table 4 are the times estimated by knowledgeable and experienced site personnel for one person to perform each function one time.
2 Calculations based on volume of material in a gondola railcar.
3. Internal dose per conveyance calculated based on the product of the intake quantity of 0.23 mg/m3 of respirable dust, 1.2 m3/hr inhalation rate, individual radionuclide concentrations based on Table 1, dose conversion factors from FGR 11, and the handling times shown.
4 External dose per conveyance calculated based on the product of the external dose rate and handling time indicated.
5 Internal dose per individual worker calculated based on the internal dose per conveyance times the number of conveyances per year and divided by the total number of workers.
6 External dose per individual worker calculated based on the external dose per conveyance times the number of conveyances per year and divided by the total number of workers.
7 Total dose per individual worker is the sum of the internal dose per individual and external dose per individual.
8 Internal dose is not applicable for this job function because waste remains in the conveyance and is covered.

7.0 POST-CLOSURE AND INTRUDER DOSE ASSESSMENTS

The dose assessment methodology for post-closure (1000 years) and intruder dose associated with Reference 2 is unchanged in this request. The results for post-closure and intruder dose are evaluated for impacts by the increase in the volume of the waste and the additional amount of radioactivity, except for Tc-99, which is capped at the Reference 2 limits in Table 2 of this request.

7.1 Post-Closure Analysis

As a conservative parameter, the waste material referenced in this submittal is estimated to be removed and disposed of at USEI within calendar year 2013. If the work extends into 2014, that will reduce the estimated post-closure exposure because the additional time will allow more material from other waste streams to comingle and dilute this HDP waste.

The post-closure analysis associated with References 1 and 2 determined that Tc-99 was the only nuclide contributing to the post-closure dose. Since the cumulative amount of Tc-99 is not being increased with this third 20.2002 request, there will be no increase in the post-closure dose from Tc-99 in this waste. In essence, the additional volume of waste associated with this third 20.2002 request amounts to diluting HDP waste with respect to Tc-99.

The dose contributions from the other radionuclides are on the order of 10^{-4} to 10^{-30} mrem/yr from the information associated with References 1 and 2. The volume of HDP waste is being increased by 50 percent over the combined volume associated with References 1 and 2. A 50 percent increase in a dose on the order of 10^{-4} mrem/yr will be on the order of 10^{-3} mrem/yr. The effect of less non-HDP waste for commingling and dilution should also be considered. Assuming the amount of non-HDP waste is reduced by 50 percent, the resulting dose would double, but still be less than 10^{-2} mrem/yr from radionuclides other than Tc-99. The post closure dose contribution from Tc-99 remains the controlling (highest) dose.

A shipping schedule where more of the radioactivity is received at USEI in a shorter time and smaller volume results in a higher dose. The combined effect of such a maximum shipping rate for all three requests is calculated as follows, considering the 14,210 m^3 (62 percent) of waste shipped through March 31, 2013, associated with Reference 1. The dose contribution from Reference 1 waste is weighted according to the shipping schedule. From Reference 1 the dose associated with the nominal shipping rate is 1.9 mrem and the dose associated with the maximum shipping rate is 4.1 mrem; these doses are from Tc-99. From Reference 2, the dose from the maximum shipping rate is 1.6 mrem (this dose is from Tc-99). Since this 20.2002 request does not increase the amount of Tc-99 from the combined amounts from References 1 and 2, there is no contribution in the following equation.

Deleted: The maximum shipping schedule was established in References 1 and 2 at 20 railcars per week.
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$$\text{Cumulative Dose} = 0.62(1.9\text{ mrem})+0.38(4.1\text{ mrem})+(1.6\text{ mrem})$$

The cumulative dose from the maximum shipping rate is 4.3 mrem.

7.2 Intruder Scenario

The intruder construction scenario performed for this request is based on the same methodology associated with Reference 1. The lack of an agricultural pathway for the intruder scenario precludes pathways for the Tc-99 to significantly contribute to the dose when compared to uranium. Accordingly, only uranium is considered for the intruder scenario. Since the volume of waste for this third 20.2002 request is slightly less than the volume of waste associated with Reference 1, the doses from the three intruder scenarios in Reference 1 are bounding for this third request.

The highest concentration of the isotopic mixture considered in Reference 1 is the disposal of waste at the USEI WAC within a 1 ft layer. This concentration is Ra-226 at 1.3E+01, Pb-210 at 1.3E+01, Tc-99 at 3.6E+02, Th-232 at 1.6E+01, Ra-228 at 1.6E+01, Th-228 at 1.6E+01, U-234 at 1.5E+03, U-235 at 7.3E+01, and U-238 at 2.4E+02.

Table 5. Post-Closure Intruder Scenarios and Estimated Dose for This 20.2002 Request

Intruder Scenario	**Description**	**Estimated Dose** (mrem/yr)
Acute Well-Driller	Intruder digs a well by drilling through the waste disposal cell to reach the underlying aquifer at a depth of 93.1 m. The total period of exposure is 40 hours, 8 of which occur during the drilling through the contaminated layer.	2.9
Chronic Well-Driller	Intruder spreads the exhumed drill cuttings around the residence and grows a garden in soil containing the drill cuttings over the course of one year. His time for the year is spent either gardening (100 hours), outdoors (1,800 hours) or indoors (4,380 hours).	2
Construction Intruder	Intruder is assumed to excavate or construct a building on a disposal site following a breakdown in institutional controls. The intruder is exposed to dust particles through the inhalation pathway, and may also be exposed to direct gamma radiation resulting from airborne particulates and by working directly in the waste-soil mixture. The dose from the inhalation and from external gamma exposure is evaluated for duration of 500 working hours, or a construction period of 3 months.	10

Table 6. Cumulative Estimated Post-Closure Intruder Doses from HDP 20.2002 Requests

Scenario	**Maximum Dose Reference 1** (mrem/yr)	**Maximum Dose Reference 2** (mrem/yr)	**Maximum Dose this Request** (mrem/yr)	**Cumulative Maximum Dose** (mrem/yr)
Intruder Construction	10	16	10	36
Intruder Acute Well Drilling	2.9	2.9	2.9	8.7
Intruder Chronic Well Drilling	2	3	2	7

This conservative analysis of cumulative intruder dose yields a dose less than the Part 20 dose limit of 100 mrem/yr to members of the public. This cumulative dose is unrealistic since it assumes the radioactivity from all three maximum scenarios is lined up in proximity together at the time of intrusion.

7.3 Sensitivity Analysis

The sensitivity analyses associated with References 1 and 2 demonstrated that the dose estimates are not highly sensitive to small changes in parameters. Since the methods of calculating dose are the same as Reference 1 and 2, these sensitivity analyses remain valid for this third 20.2002 request.

8.0 NUCLEAR CRITICALITY SAFETY

Nuclear criticality safety assessments, NSA-TR-09-14 and NSA-TR-HDP-11-11 (References 8 and 9), demonstrate that the treatment and disposal of Hematite decommissioning waste at the USEI site can be safely performed. The assessments have determined that there are very large margins of safety under normal (i.e., expected) conditions and that there is considerable tolerance to abnormal conditions. Under all foreseen abnormal conditions a criticality event is considered either not credible or is precluded by controls in place at the Hematite site.

NSA-TR-HDP-11-11 includes assessment of the sanitary sludge being considered under this request.

Deleted: as part of soil-like material

This analysis applies to disposal of Hematite decommissioning wastes with a maximum average fissile nuclide concentration of 0.1g ^{235}U/L at the USEI site. This average fissile nuclide concentration is assessed on a per railcar basis. The conservative average of 0.1g^{235}U/L is derived based on the following analysis.

- NUREG/CR-6505 Vol. 1 derives a minimum critical infinite sea concentration of 1.4 g^{235}U/L (39.6 g^{235}U/ft^3) for a fictitious bounding medium consisting of only SiO_2 and ^{235}U.
- Section 10 of NUREG/CR-6505 (Ref. 15, pg. 45) concludes that a concentration factor of greater than ten is not considered credible for migration of 235U based on the hydrogeochemical modeling.

The treatment methods will not result in the waste exceeding an average of 0.1 g^{235}U/L, as described and analyzed in Nuclear Criticality Safety Assessments, NSA-TR-09-14 or NSA-TR-HDP-11-11. While these two documents discuss five percent of the waste requiring treatment, the amount being treated is not a limitation to ensuring nuclear criticality safety, which is achieved on a concentration basis. The estimate of waste, approximately 22,000 m^3, requiring stabilization prior to disposal, will exceed the five percent estimate mentioned in the NCSAs.

As discussed in Section 1 above, non-HDP SNM material shipped to USEI has been below the average 0.1 g^{235}U/L concentration limit for HDP waste consigned to USEI. USEI disposal cell 15 includes not only HDP and non-HDP SNM waste, but approximately 1.7 million tons of other non-SNM soils and debris disposed between 2010 and 2012. Therefore, no additional impact needs to be evaluated.

9.0 RECORDS OF TRANSFER

10 CFR 70.42 (d)(2) requires a written certification by the transferee that the recipient is authorized by license or registration certificate to receive the type, form, and quantity of SNM to be transferred, specifying the license or registration certificate number, issuing

agency, and expiration date. Since USEI would be exempted from the 10 CFR 70.3 requirement of an NRC licensee to possess SNM, the §70.42 requirement would not apply. However, Westinghouse will maintain as an alternative written registration certificate a copy of the permit issued to USEI by the State of Idaho and NRC approval of this alternate disposal request for specific HDP wastes. DOE/NRC Form 741, *Nuclear Material Transaction Report*, would be used by Westinghouse to document transfers of SNM to the disposal facility. USEI will report SNM receipts using its existing account with the Nuclear Materials Management & Safeguards System.

10.0 PHYSICAL SECURITY ASPECTS OF THE WASTE TO BE SHIPPED, HANDLED, TREATED AND DISPOSED AT USEI

Physical security aspects of this 20.2002 alternate disposal request are no different than the physical security aspects of the preceding 20.2002 requests (References 1 and 2). From a physical security standpoint, this assessment considers the concentration and the enrichment of the SNM being shipped to USEI and handled there, the attractiveness of the form of the SNM being disposed, and the ability of an adversary to efficiently and timely segregate such material after acquisition. The activities considered in this assessment are: (1) shipment of the waste material via gondola cars to USEI; (2) unloading of the waste from the gondola cars on to trucks for treatment and disposal at the USEI burial cell, and (3) treatment and disposal of the waste material in the burial cells.

10.1 Concentration, Amount, and Enrichment

Each shipment (railcar) of waste to USEI will meet the transportation security requirements in 10 CFR §73.67(g), *In-Transit Requirements for Special Nuclear Material of Low Strategic Significance*, when quantities meeting those requirements are present in the shipment. A Formula Quantity of SNM or SNM of Moderate Strategic Significance will not be transferred to USEI. The 10 CFR 73 definition of SNM of Low Strategic Significance for U-235 is summarized below (‘percent’ is percent by weight):

(1) 15 to 999 grams of uranium-235 where enrichment is 20 percent or more; or

(2) 1,000 to 9,999 grams of uranium-235 where enrichment is 10 up to 20 percent; or

(3) 10,000 grams or more of uranium-235 where enrichment exceeds 0.72 up to 10 percent.

In addition to ensuring that the waste transferred to USEI does not exceed the criteria SNM of Low Strategic Significance, any waste containing highly enriched SNM will be Diffuse Material as defined in the Physical Security and Fundamental Nuclear Material Control Plans for HDP. No discrete material, which is material not meeting the definition of Diffuse Material, will be transferred to USEI.

Based on the average estimated amount of U-235 in the waste of 5.5 pCi/g (from Table 1) and a maximum railcar load weight of 225,000 lbs (102,058,283 g), the average railcar is expected to be less than 260 g ^{235}U. The waste proposed in this 20.2002 request is limited to a maximum average fissile nuclide concentration of 0.1g ^{235}U/L. This average fissile nuclide concentration is assessed on a per railcar basis. The maximum shipping volume of the gondola car is 2700 ft^3 or 76,455 L. Thus, a single railcar could contain 7,646 g ^{235}U, provided the amount of U-235 in waste with enrichment of 20 percent or more does not exceed 1000 g.

All shipments to USEI containing fissile material will meet the fissile exempt requirements as described in 49 CFR 173.453, *Fissile Material – Exceptions.*

10.2 Rail Transport and Tracking

For all shipments to USEI, the contents of each gondola railcar will be entirely enclosed in form-fitting, sift-proof, and closable wrappers meeting U.S. Department of Transportation (DOT) Industrial Type-I Package (IP-1) requirements. The IP-1 package precludes dispersal of waste to the air or loss of material during transport. A tamper indicating device will be placed on the closure(s) for the wrappers.

When the quantity of fissile material in a shipment meets the criteria of SNM of Low Strategic Significance, security measures for transport of this SNM will be implemented as discussed in the HDP Physical Security Plan (Reference 10) and the Waste Management and Transportation Plan (Reference 11).

Westinghouse is responsible for the safe and secure transport of the material in accordance with the provisions of the Decommissioning, Physical Security and Fundamental Nuclear Material Control Plans until it is accepted by USEI for treatment and disposal.

Prior to the shipment leaving the facility, HDP will receive confirmation from USEI that they will be ready to accept the railcar shipment at the planned time and location. This confirmation may be in the form of an email.

The Hematite Decommissioning Project (HDP) receives via email from the Railroad a railcar status report each day following departure of shipments. In addition, HDP personnel can log into a Railroad website to obtain the most recent status of railcars in shipment. Thus, HDP is aware of the location of the shipments and the reasons for any delays. Requests can be made of the Railroad in furtherance of the railcar reaching its destination as soon as possible. A trace investigation will be completed if receipt acknowledgment is not received within 20 days after the shipment departs HDP. The results of the trace investigation will be reported to the NRC within 2 weeks of completion of the investigation as required by 10 CFR 20, Appendix G.III.E. A search will be conducted for any shipment that is determined to be lost or unaccounted for. The NRC Operations Center will be notified within one hour after discovery of the loss of the shipment and within one hour after recovery or accounting for such lost shipment in accordance with the provisions of 10 CFR 73.71, Reporting of Safeguards Events (Reference 5.3).

Pursuant to 49 CFR 172.800 et seq., USEI maintains security at its waste handling, treatment and disposal facilities for hazardous materials. Such areas are enclosed in a 6-foot chain link fence, topped with barb-wire, posted with warning signs. Security personnel are continuously on duty monitoring access, including after hours patrols and inspections. Potential employees are subject to a background check. Upon hire, employees are trained on USEI's security policy, including the requirements to report suspicious behavior or objects and to restrict unauthorized entry to waste handling and management areas. All visitors are required to sign in before entering the facility.

10.3 Attractiveness

Due to the difficulty, time, and necessary equipment required to separate 7.6 kg of SNM from 110 tons of waste and due to the additional processing that would be required to make the SNM useful in either an improvised nuclear device or a radiological dispersal device, this waste is considered to be highly unattractive to adversaries. The SNM present in the waste is not in a useful form because it is mixed with dirt and sanitary sludge. Thus, the timely and efficient removal of the SNM during transport or during USEI handling/treatment by an adversary for unauthorized purposes is improbable. The combination of the existing railroad security, physical security at the USEI site, and the effort to identify SNM under such conditions effectively prevent any opportunities for extracting SNM prior to burial.

The difficulty of recovering SNM from the waste would increase considerably after burial compared to the recovering the material prior to burial. The increased difficulty is because of having to find and extract the waste from the burial cell, with dimensions of 30 acres of area by 49-foot depth. This waste will be intermixed with waste from other sources, further diluting the SNM concentration. Potential adversaries would have to excavate the burial cell, identify SNM-bearing materials, and then separate these SNM materials. The timely and efficient removal of the SNM from the disposal site by an adversary for unauthorized purposes is improbable.

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11.0 REFERENCES

Note: The "ML#" is the accession number for the NRC ADAMS document database that is accessible via the internet.

1. Documents associated with SNM-33 License Amendment 58, specifically:

   NRC (McConnell) letter to Westinghouse (Hackmann), dated October 27, 2011, Issuance of Hematite Amendment No. 58 Approving Westinghouse Hematite Request for Alternate Disposal of Soil and Debris and Granting Exemptions to 10 CFR 30.3 and 10 CFR 70.3, (ML112560105).

   Westinghouse (Hackmann) letter to NRC (Document Control Desk), HEM-11-16, dated February 18, 2011, Revised Technical Basis for Characterization of Decommissioning Soils Waste That is Subject to the Alternate Disposal Request for U.S. Ecology Idaho, Inc. (ML110530153)

   Westinghouse (Hackmann) letter to NRC (Document Control Desk), HEM-10-135, dated December 21, 2010, "Waste Characterization for Alternate Disposal Request for Decommissioning Soils" (ML103570023)

   Westinghouse and NRC Teleconferences on June 21, 2010, and June 25, 2010, Regarding 20.2002 Exemption Request (ML110560334)

   Westinghouse (Hackmann) letter to NRC (Document Control Desk), HEM-10-46, dated May 24, 2010, "Additional Information and Clarifications Concerning l0 CFR 20.2002 Alternate Waste Disposal Authorization and Exemption for Specific Hematite Decommissioning Project Waste" (ML101450240)

   Westinghouse (Hackmann) letter to NRC (Document Control Desk), HEM-10-38, dated March 31, 2010, "Additional Information for Alternate Waste Disposal Authorization and Exemption" (ML100950386)

   Westinghouse (Hackmann) letter to NRC (Document Control Desk), HEM-10-9, dated January 21, 2010, "Corrected Compact Disks Concerning Alternate Waste Disposal" (No ML number)

   Westinghouse (Hackmann) letter to NRC (Document Control Desk), HEM-10-6, dated January 20, 2010, "Additional Information Concerning Alternate Waste Disposal" (ML100221416)

   NRC (Hayes) letter to Westinghouse (Hackmann), dated December, 3, 2009, "Westinghouse Hematite 10CFR20.2002 Alternate Disposal Requests for Additional Information" (ML093360222)

   Westinghouse (Hackmann) letter to NRC (Document Control Desk), HEM-09-146, dated December 29, 2009, "Response to Request for Additional Information - Alternate Waste Disposal" (ML100320540)

   Westinghouse (Hackmann) letter to NRC (Document Control Desk), HEM-09-52, dated May 21, 2009, "Request for Alternate Disposal Approval and Exemptions for Specific Hematite Decommissioning Project Waste" (ML091480071)

Deleted: This reference includes the referenced documents in the Safety Evaluation Report enclosed in this letter.

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2. Documents associated with SNM-33 License Amendment 60, specifically:

   NRC (Camper) letter to Westinghouse (Richardson), dated April 11, 2013, Issuance of Hematite Amendment No. 60 Approving Westinghouse Hematite Request for Alternate Disposal of Specified Low-Activity Radioactive Material and Granting Exemptions to 10 CFR 30.3 and 10 CFR 70.3 (ML12158A372).

   USEI (Weismann) letter to NRC (Document Control Office), dated October 4, 2012, Request for Exemptions under 10CFR30.11 and 10CFR70.17 for Alternate Disposal of Wastes from Hematite Decommissioning Project under 10CFR20.2002" (ML12313A014).

   Westinghouse (Copp) letter to NRC (Document Control Desk), HEM-12-121, October 17, 2012, Further Information for the Final Responses Dated July 24, 2012, to NRC Requests for Additional Information Dated May 1, 2012, on the January 16, 2012, Hematite 20.2002 Alternate Disposal Request" (ML12293A029).

   Westinghouse (Copp) letter to NRC (Document Control Desk), HEM-12-88, dated July 24, 2012 "Final Responses to NRC Requests for Additional Information Dated May 1, 2012, on the January 16, 2012, Hematite 20.2002 Alternate Disposal Request" (ML122090321)

   Westinghouse (Copp) letter HEM-12-67 to NRC (Document Control Desk), dated June 19, 2012, "Partial Response to NRC Requests for Additional Information dated May 1, 2012, on the January 16, 2012, Hematite 20.2002 Alternate Disposal Request" (ML121740265)

   NRC (Hayes) letter to Westinghouse (Copp), dated May 1, 2012, "NRC Request for Additional Information from Westinghouse on the January 16, 2012, Hematite 20.2002 Alternate Disposal Request" (ML120890557).

   Westinghouse (Copp) letter to NRC (Document Control Desk), HEM-12-41, dated March 28, 2012, Additional Information Concerning Scaling Factors for Radioactive Waste Associated with a Request for Additional Alternative Disposal Approval and Exemptions" (ML12090A191)

   Westinghouse (Copp) letter to NRC (Document Control Desk), HEM-12-2, dated January 16, 2012, "Request for Additional Alternate Disposal Approval and Exemptions for Specific Hematite Decommissioning Project Waste at US Ecology Idaho" (ML12017A188, ML12017A189, and ML12017A190)

   Deleted: This reference includes the referenced documents in the Safety Evaluation Report enclosed in this letter.

3. NRC (Hayes) letter to Westinghouse (Copp), dated February 26, 2013, "Disposal of Sanitary Waste Solids and Water Treatment Materials at U.S. Ecology Idaho" (ML13036A331)
4. NRC (Hayes) letter to Westinghouse (Copp), dated March 18, 2013, "The U.S. Nuclear Regulatory Commission's Assessment of Westinghouse Hematite Unreviewed Safety Question Involving the Shipment of Radiologically Contaminated Waste Containing Volatile Organic Compounds for the Treatment of the Organics at U.S. Ecology" (ML13038A141)
5. NRC (McConnell) letter to Humboldt Bay (Conway) dated April 25, 2012, "Humboldt Bay Power Plant Unit 3 – Request for 10 CFR 20.2002 Alternate Disposal Approval

and 10 CFR 30.11 Exemption for Plant Waste Disposal at US Ecology Idaho" (ML120620454)

6. NRC (Camper) letter to USEI (Weismann) dated December 19, 2012, "Request for 10 CFR 20.2002 Alternate Disposal Approval and Exemptions from 10 CFR 30.11 and 10 CFR 70.17 for Humboldt Bay Plant Waste Disposal at US Ecology Idaho" (ML12299A056)
7. Westinghouse (Copp) letter to NRC (Document Control Desk), HEM-12-77, dated July 30, 2012, "Additional Information on the Hematite Nuclear Criticality Safety Assessment of the US Ecology Idaho (USEI) Site for the Land Fill Disposal of Decommissioning Waste from the Hematite Site, Revision 6, July 2012" (ML12215A351)
8. NSA-TR-09-14, "Nuclear Criticality Safety Assessment of the US Ecology Idaho (USEI) Site for the Land Fill Disposal of Decommissioning Waste from the Hematite Site"
9. NSA-TR-HDP-11-11, "Nuclear Criticality Safety Assessment of the US Ecology Idaho (USEI) Site for the Land Fill Disposal of Additional Decommissioning Waste from the Hematite Site
10. Physical Security Plan (ML11214A106)
11. Waste Management and Transportation Plan (ML110330370), and Resolution of NRC Request for Additional Information on the Waste Management and Transportation Plan (ML111880290)

Appendix A
HDP and USEI Occupational Injury and Illness Data

Work-related injuries at the HDP

Year	Work Hours	Injuries	OSHA Recordable Injury/Illness	Fatalities	Injuries per 10,000 hours
2001	438,404	67	50	0	1.5
2002	115,832	11	5	0	1.0
2003	86,736	1	0	0	0.1
2004	52,208	0	0	0	0
2005	169,739	18	3	0	1.1
2006	144,480	26	1	0	1.8
2007	57,760	0	0	0	0
2008	114,000	0	0	0	0
2009	120,623	0	0	0	0
2010	111,015	1	1	0	0.2
2011	146,727	5	0	0	0.3
2012	161,813	15	6	0	0.9
TOTAL	**1,719,337**	**144**	**66**	**0**	**N/A**

Work-related injuries at the USEI

Year	Work Hours	Injuries	OSHA Recordable Injury/Illness	Fatalities	Injuries per 10,000 hours
2001	87,362	9	5	0	1.0
2002	81,707	8	3	0	1.0
2003	93,490	18	2	0	1.9
2004	94,872	16	3	0	1.7
2005	121,048	20	4	0	1.6
2006	158,800	22	5	0	1.4
2007	180,683	40	7	0	2.2
2008	179,072	30	3	0	1.7
2009	149,929	16	3	0	1.1
2010	117,151	14	2	0	1.2
2011	133,366	5	2	0	0.4
2012	120,251	12	3	0	1.0
TOTAL	**1,517,731**	**210**	**42**	**0**	**N/A**

Appendix B
USEI Waste Acceptance Criteria

USEI Part B Permit
EPA ID. No.: IDD073114654
Revision Date: September 25, 2008

C.3 WASTE ACCEPTANCE CRITERIA

C.3.1 Pre-acceptance Review

The preacceptance protocol has been designed to ensure that only hazardous and radioactive material that can be properly and safely stored, treated and/or disposed of by USEI are approved for receipt at the facility. A two-step approach is taken by USEI. The first step is the chemical and/or radiological and physical characterization of the candidate waste stream by the generator. The second step is the preacceptance evaluation performed by USEI to determine the acceptability of the waste for receipt at the facility. Figure C-2 presents a logic diagram of the preacceptance protocol that is utilized at the facility.

C.3.2 Radioactive Material Waste Acceptance Criteria

The following waste acceptance criteria are established for accepting radiological contaminated waste material that is generally or specifically exempted from regulation by the Nuclear Regulatory Commission (NRC) or an Agreement State under the Atomic Energy Act of 1954 (“AEA”), as amended. Material may also be accepted if it is not regulated or licensed by the NRC or has been authorized for disposal by the IDEQ and is within the numeric waste acceptance criteria. Waste acceptance criteria are consistent with these restrictions.

The following five tables establish types and concentrations of radioactive materials that may be accepted. These tables are based on categories and types of radioactive material not regulated by the NRC based on statute or regulation or specifically approved by the NRC or an Agreement State for alternate disposal. The criteria are consistent with these restrictions and detailed analyses set forth in *Waste Acceptance Criteria and Justification for FUSRAP Material*, prepared by Radiation Safety Associates, Inc. (RSA) as subsequently refined, expanded and updated in *Waste Acceptance Criteria and Justification for Radioactive Material*, prepared by USEI.

Material may be accepted if the material has been specifically exempted from regulation by rule, order, license, license condition, letter of interpretation, or specific authorization under the following conditions: Thirty (30) days prior to intended shipment of such materials to the facility, USEI shall notify IDEQ of its intent to accept such material and submit information describing the material’s physical, radiological, and/or chemical properties, impact on the facility radioactive materials performance assessment, and the basis for determining that the material does not require disposal at a facility licensed under the AEA. The IDEQ will have 30 days from receipt of this notification to reject USEI’s determination or require further information and review. No response by IDEQ within thirty (30) days following receipt of such notice shall constitute concurrence. IDEQ concurrence is not required for generally exempted material as set forth in Table C.4a.

Based on categories of waste described in the waste acceptance criteria, the concentration of the various radionuclides in the conveyance (e.g., rail car gondola, other container etc.) shall not exceed the concentration limits established in the WAC without the specific written approval of the IDEQ unless generally exempted as set forth in Table C.4a. Radiological surveys will be performed as outlined in ERMP-01 to verify compliance with the WAC. If individual “pockets” of activity are detected indicating the limits may be exceeded, the RSO or RPS shall investigate the discrepancy and estimate the extent or volume of the material with the potentially elevated radiation levels. The RPS or RSO shall then make a determination on the compliance of the entire conveyance load with the appropriate WAC limits. If the conveyance is determined not to meet the limits, USEI will notify IDEQ's RCRA Program Manager within 24 hours of a concentration based exceedance of the facility WAC to evaluate and discuss management options. The findings and resolution actions shall then be documented and submitted to the IDEQ.

The radioactive material waste acceptance criteria, when used in conjunction with an effective radiation monitoring and protection program as defined in the USEI *Radioactive Material Health and Safety Plan* and *Exempt Radioactive Materials Procedures* provides adequate protection of human health and the environment. Included within this manual are requirements for USEI to submit a written summary report of Table C.1 through C.2 radioactive material waste receipts showing volumes and radionuclide concentrations disposed at the USEI site on a quarterly basis. USEI will also submit a Table C.3 through C.4b annual report of exempted products devices, materials or items within 60 (sixty) days of year end (December 31st). The annual report will provide total volumes or mass of isotopes and total activity by isotope listing the activity of each radionuclide disposed during the preceding year, and the cumulative total of activity for each radionuclide disposed at the facility. The report will include an updated analysis of the impact on the facility performance assessment.

These criteria and procedures are designed to assure that the highest potential dose to a worker handling radioactive material at USEI shall not exceed 400 mrem/year TEDE dose, and that no member of the public is calculated to receive a potential post closure dose exceeding 15 mrem/year TEDE dose, from the USEI program. TEDE is defined as the "Total Effective Dose Equivalent", which equals the sum of external and internal exposures. The public dose limit during operation activities is limited to 100 mrem/yr TEDE dose. An annual summary report of environmental monitoring results will be submitted to IDEQ by June 1st for the preceding year.

Materials that have a radioactive component that meets the criteria described in Tables C.1 through C.4b and are RCRA regulated material will be managed as described within this WAP for the RCRA regulated constituents.

USEI Part B Permit
EPA ID. No.: IDD073114654
Revision Date: February 26, 2013

Table C.1: Unimportant Quantities of Source Material Uniformly Dispersed* in Soil or Other Media**

	Status of Equilibrium	Maximum Concentration of Source Material	Sum of Concentrations Parent(s) and all progeny present
a	Natural uranium in equilibrium with progeny	<500 ppm / 167 pCi/g (^{238}U activity)	≤ 3000 pCi/g
	Refined natural uranium	<500 ppm / 167 pCi/g (^{238}U activity)	≤ 2000 pCi/g
	Depleted Uranium	<500 ppm / 169 pCi/g	≤ 2000 pCi/g
b	Natural thorium	<500 ppm / 55 pCi/g (^{232}Th activity)	≤ 2000 pCi/g
	^{230}Th (with no progeny)	0.1 ppm / ≤2000 pCi/g	
	Any mixture of Thorium and Uranium	Sum of ratios ≤ 1****	≤2000 pCi/g

*Refined Uranium includes ^{238}U, ^{235}U, ^{234}U; ^{234}Th, ^{234m}Pa, ^{231}Th

Table C.2: Naturally Occurring Radioactive Material Other Than Uranium and Thorium Uniformly Dispersed* in Soil or Other Media**

	Status of Equilibrium	Maximum Concentration of Parent Nuclide	Sum of Concentrations of Parent and All Progeny Present
a	^{226}Ra or ^{228}Ra with progeny in bulk form [1]	500 pCi/g	≤ 4500 pCi/g
b	^{226}Ra or ^{228}Ra with progeny in reinforced IP-1 containers [1]	1500 pCi/g	13,500 pCi/g
c	^{210}Pb with progeny(Bi & ^{210}Po)	1500 pCi/g	4500 pCi/g
	^{40}K	818 pCi/g	N/A
	Any other NORM		≤3000 pCi/g

[1] Any material containing ^{226}Ra greater than 222 pCi/g shall be disposed at least 6 meters from the external point on the completed cell.

Table C.3: Particle Accelerator Produced Radioactive Material

Acceptable Material	Activity or Concentration
Any particle accelerator produced radionuclide.	All materials shall be packaged in accordance with USDOT packaging requirements. Any packages containing iodine or volatile radionuclides will have lids or covers sealed to the container with gaskets. Contamination levels on the surface of the packages shall not exceed those allowed at point of receipt by USDOT rules. Gamma or x-ray radiation levels may not exceed 10 millirem per hour anywhere on the surface of the package. All packages received shall be directly disposed in the active cell. All containers shall be certified to be 90% full.

*Average over conveyance or container. The use of the phrase "over the conveyance or container" is meant to reflect the variability on the generator side. The concentration limit is the primary acceptance criteria.

**Unless otherwise authorized by IDEQ, other Media does not include radioactively contaminated liquid (except for incidental liquids in materials). See radioactive contaminated liquid definition (definition section of Part B permit).

*** $\frac{\text{Conc. of U in sample}}{\text{Allowable conc. of U}} + \frac{\text{Conc. of Th in Sample}}{\text{Allowable conc. of Th}} \leq 1$

Table C.4a: NRC Exempted Products, Devices or Items

Exemption 10 CFR Part*	Product, Device or Item	Isotope, Activity or Concentration
30.15	As listed in the regulation	Various isotopes and activities as set forth in 30.15
30.14, 30.18	Other materials, products or devices specifically exempted from regulation by rule, order, license, license condition, concurrence, or letter of interpretation	Radionuclides in concentrations consistent with the exemption
30.19	Self-luminous products containing tritium, ^{85}Kr, ^{3}H or ^{147}Pm	Activity by Manufacturing license
30.20	Gas and aerosol detectors for protection of life and property from fire	Isotope and activity by Manufacturing license
30.21	Capsules containing ^{14}C urea for *in vivo* diagnosis of humans	^{14}C, one µCi per capsule
40.13(a)	Unimportant quantity of source material: see Table C.1	≤0.05% by weight source material
40.13(b)	Unrefined and unprocessed ore containing source material	As set forth in rule
40.13(c)(1)	Source material in incandescent gas mantles, vacuum tubes, welding rods, electric lamps for illumination	Thorium and uranium, various amounts or concentrations, see rules
40.13(c)(2)	(i)Source material in glazed ceramic tableware (ii)Piezoelectric ceramic (iii) Glassware not including glass brick, pane glass, ceramic tile, or other glass or ceramic used in construction	≤20% by weight ≤2% by weight ≤10% by weight
40.13(c)(3)	Photographic film, negatives or prints	Uranium or Thorium
40.13(c)(4)	Finished product or part fabricated of or containing tungsten or magnesium-thorium alloys. Cannot treat or process chemically, metallurgically, or physically.	≤4% by weight thorium content.
40.13(c)(5)	Uranium contained in counterweights installed in aircraft, rockets, projectiles and missiles or stored or handled in connection with installation or removal of such counterweights.	Per stated conditions in rule.
40.13(c)(6)	Uranium used as shielding in shipping containers if conspicuously and legibly impressed with legend "CAUTION RADIOACTIVE SHIELDING – URANIUM" and uranium incased in at least 1/8 inch thick steel or fire resistant metal.	Depleted Uranium
40.13(c)(7)	Thorium contained in finished optical lenses	≤30% by weight thorium, per conditions in rule.
40.13(c)(8)	Thorium contained in any finished aircraft engine part containing nickel-thoria alloy.	≤4% by weight thorium, per conditions in rule.

USEI Part B Permit
EPA ID. No.: IDD073114654
Revision Date: February 26, 2013

Table C.4b: Materials Specifically Exempted by the NRC or NRC Agreement State

Exemption	Materials	Isotope, Activity or Concentration*
10 CFR 30.11**	Byproduct material including production particle accelerator material exempted from NRC or Agreement State regulation by rule, order, license, license condition or letter of interpretation may be accepted as determined by specific NRC or Agreement State exemption.***	Byproduct material at concentrations consistent with the exemption
10 CFR 40.14**	Source material exempted from NRC or Agreement State regulation by rule, order, license, license condition or letter of interpretation may be accepted as determined by specific NRC or Agreement State exemption.***	Source material at concentrations consistent with the exemption.
10 CFR 70.17	Special Nuclear Material (SNM) exempted from NRC regulation by rule, order, license, license condition or letter of interpretation may be accepted as determined by specific NRC or Agreement State exemption.***	SNM at concentrations consistent with the exemption.

*Sum of all isotopes up to a maximum concentration of 3,000 pCi/gm.

** Alternate disposals authorized by Agreement States also require an NRC exemption for the purposes of disposal in the State of Idaho.

*** Similar material not regulated or licensed by the NRC may also be accepted. Sum of all isotopes up to a maximum concentration of 3,000 pCi/gm. IDEQ shall be notified prior to the receipt of Special Nuclear Material not regulated or licensed by the NRC.

Additional Information for USEI's Waste Analysis Plan

1. US Ecology Idaho, Inc. (USEI) may receive contaminated materials or other materials as described in Tables C.1 - C.4b above. USEI may not accept for disposal any material that by its possession would require USEI to have a radioactive material license from the Nuclear Regulatory Commission (NRC).

2. Unless approved in advance by USEI and IDEQ, average activity concentrations may not exceed those concentrations enumerated in Tables C.1 and C.2. Additionally, for Tables C.1 and C.2, individual pockets of material may exceed the WAC for the radionuclides present as long as the average concentration of all radionuclides within the package or conveyance remains at or below the WAC and the highest dose rate measured on the outside of the unshielded package or conveyance does not exceed those action levels enumerated in ERMP-01.

3. Other items, devices or materials listed in Table C.4a, which are exempted in accordance with 10 CFR Parts 30, 40 or equivalent Agreement State regulations or 10 CFR Part 70 may be accepted at or below the activities (per device or item) or concentrations specified in those exemptions.

4. 10CFR20.2008 authorizes disposal of certain byproduct material as defined in Section 11.e(3) and 11.e(4) of the Atomic Energy Act, as amended, at disposal facilities authorized to dispose of such material in accordance with any Federal or State solid or hazardous waste law, as authorized under the Energy Policy Act of 2005.

5. The generator of particle accelerator produced waste must specify that the waste meets applicable acceptance criteria.

6. In accordance with permit requirements, notification of any exceedance of the WAC will be provided to the RCRA Program Manager within 24 hours, in accordance with the permit.

Appendix C
Microshield Calculations

Deleted: for Stabilization

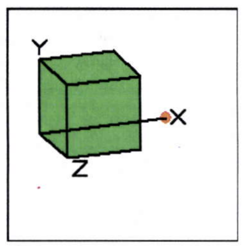
MicroShield 7.02 Westinghouse Electric Company (08-MSD-7.02-1424)

Date	By	Checked

Filename	Run Date	Run Time	Duration
HDP Stabilization Operator.ms7	May 21, 2013	6:15:57 PM	00:00:01

Project Info	
Case Title	USEI Stab. Worker-
Description	USEI SSPA, Density=1.69 g/cc
Geometry	13 - Rectangular Volume

Source Dimensions	
Length	385.572 cm (12 ft 7.8 in)
Width	385.572 cm (12 ft 7.8 in)
Height	385.572 cm (12 ft 7.8 in)



Dose Points			
A	X	Y	Z
#1	665.988 cm (21 ft 10.2 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	5.73e+07 cm³	Concrete	1.69
Air Gap		Air	0.00122

Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Included
Library: Grove

Nuclide	Ci	Bq	μCi/cm³	Bq/cm³
Ac-227	1.9593e-007	7.2496e+003	3.4182e-009	1.2647e-004
Ac-228	1.1372e-004	4.2076e+006	1.9839e-006	7.3404e-002
Bi-210	6.8637e-005	2.5396e+006	1.1974e-006	4.4304e-002
Bi-211	1.9498e-007	7.2141e+003	3.4015e-009	1.2585e-004
Bi-212	1.1326e-004	4.1905e+006	1.9758e-006	7.3105e-002
Bi-214	9.5787e-005	3.5441e+006	1.6711e-006	6.1829e-002
Fr-223	2.7039e-009	1.0004e+002	4.7171e-011	1.7453e-006
Pa-231	4.5093e-007	1.6685e+004	7.8667e-009	2.9107e-004
Pa-234	2.7514e-006	1.0180e+005	4.8000e-008	1.7760e-003
Pa-234m	1.7196e-003	6.3627e+007	3.0000e-005	1.1100e+000
Pb-210	6.8654e-005	2.5402e+006	1.1977e-006	4.4315e-002
Pb-211	1.9498e-007	7.2141e+003	3.4015e-009	1.2585e-004
Pb-212	1.1326e-004	4.1905e+006	1.9758e-006	7.3105e-002
Pb-214	9.5787e-005	3.5441e+006	1.6711e-006	6.1829e-002
Po-210	6.8167e-005	2.5222e+006	1.1892e-006	4.4001e-002

Po-211	5.3228e-010	1.9695e+001	9.2860e-012	3.4358e-007
Po-212	7.2563e-005	2.6848e+006	1.2659e-006	4.6839e-002
Po-214	9.5767e-005	3.5434e+006	1.6707e-006	6.1816e-002
Po-215	1.9498e-007	7.2142e+003	3.4015e-009	1.2585e-004
Po-216	1.1326e-004	4.1905e+006	1.9758e-006	7.3105e-002
Po-218	9.5807e-005	3.5448e+006	1.6714e-006	6.1842e-002
Ra-223	1.9498e-007	7.2142e+003	3.4015e-009	1.2585e-004
Ra-224	1.1326e-004	4.1905e+006	1.9758e-006	7.3105e-002
Ra-226	9.5806e-005	3.5448e+006	1.6714e-006	6.1841e-002
Ra-228	1.1372e-004	4.2076e+006	1.9839e-006	7.3404e-002
Rn-219	1.9498e-007	7.2142e+003	3.4015e-009	1.2585e-004
Rn-220	1.1326e-004	4.1905e+006	1.9758e-006	7.3105e-002
Rn-222	9.5807e-005	3.5448e+006	1.6714e-006	6.1842e-002
Tc-99	2.6364e-003	9.7548e+007	4.5994e-005	1.7018e+000
Th-227	1.9264e-007	7.1277e+003	3.3607e-009	1.2435e-004
Th-228	1.1326e-004	4.1906e+006	1.9759e-006	7.3107e-002
Th-230	3.9207e-006	1.4507e+005	6.8399e-008	2.5308e-003
Th-231	5.3309e-004	1.9724e+007	9.3000e-006	3.4410e-001
Th-232	1.1464e-004	4.2418e+006	2.0000e-006	7.4000e-002
Th-234	1.7196e-003	6.3627e+007	3.0000e-005	1.1100e+000
Tl-207	1.9444e-007	7.1944e+003	3.3922e-009	1.2551e-004
Tl-208	4.0693e-005	1.5056e+006	7.0991e-007	2.6267e-002
U-234	1.0890e-002	4.0293e+008	1.8998e-004	7.0293e+000
U-235	5.3309e-004	1.9724e+007	9.3000e-006	3.4410e-001
U-238	1.7196e-003	6.3627e+007	3.0000e-005	1.1100e+000

Buildup: The material reference is Source **Integration Parameters**	
X Direction	20
Y Direction	20
Z Direction	20

Results

Energy (MeV)	**Activity (Photons/sec)**	**Fluence Rate MeV/cm²/sec No Buildup**	**Fluence Rate MeV/cm²/sec With Buildup**	**Exposure Rate mR/hr No Buildup**	**Exposure Rate mR/hr With Buildup**
0.015	7.916e+07	3.760e-12	4.132e-12	3.225e-13	3.544e-13
0.02	7.341e+01	3.641e-13	4.281e-13	1.261e-14	1.483e-14
0.03	2.892e+06	1.194e-05	1.657e-05	1.184e-07	1.642e-07
0.04	4.301e+04	1.263e-06	2.076e-06	5.587e-09	9.181e-09
0.05	6.182e+05	4.306e-05	8.113e-05	1.147e-07	2.161e-07
0.06	2.614e+06	3.032e-04	6.735e-04	6.022e-07	1.338e-06
0.08	5.034e+06	1.088e-03	2.886e-03	1.721e-06	4.566e-06
0.1	6.433e+06	2.053e-03	6.049e-03	3.141e-06	9.254e-06
0.15	3.282e+06	1.927e-03	6.083e-03	3.174e-06	1.002e-05
0.2	1.485e+07	1.307e-02	4.067e-02	2.307e-05	7.178e-05

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0.3	1.840e+06	2.846e-03	8.234e-03	5.399e-06	1.562e-05
0.4	1.464e+06	3.395e-03	9.155e-03	6.616e-06	1.784e-05
0.5	6.548e+05	2.088e-03	5.313e-03	4.099e-06	1.043e-05
0.6	3.079e+06	1.277e-02	3.085e-02	2.493e-05	6.022e-05
0.8	1.884e+06	1.190e-02	2.660e-02	2.263e-05	5.060e-05
1.0	4.235e+06	3.726e-02	7.872e-02	6.868e-05	1.451e-04
1.5	1.253e+06	2.033e-02	3.895e-02	3.421e-05	6.554e-05
2.0	9.630e+05	2.418e-02	4.373e-02	3.739e-05	6.763e-05
3.0	1.503e+06	6.933e-02	1.160e-01	9.406e-05	1.574e-04
Totals	**1.318e+08**	**2.026e-01**	**4.141e-01**	**3.300e-04**	**6.877e-04**

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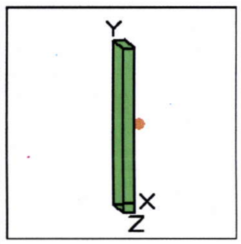
MicroShield 7.02
Westinghouse Electric Company (08-MSD-7.02-1424)

Date	By	Checked

Filename	Run Date	Run Time	Duration
SoilApGondSurveyorRev1.ms7	May 20, 2012	12:53:51 PM	00:00:01

Project Info	
Case Title	Case 1
Description	Case 1
Geometry	13 - Rectangular Volume

Source Dimensions	
Length	121.92 cm (4 ft)
Width	274.32 cm (9 ft)
Height	1.8e+3 cm (60 ft)



A	X	Y	Z
#1	222.714 cm (7 ft 3.7 in)	914.4 cm (30 ft)	137.16 cm (4 ft 6.0 in)

Shields

Shield N	Dimension	Material	Density
Source	6.12e+07 cm³	Concrete	1.69
Shield 1	.794 cm	Iron	7.86
Air Gap		Air	0.00122

Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Excluded
Library: Grove

Nuclide	Ci	Bq	μCi/cm³	Bq/cm³
Ac-227	1.8358e-007	6.7925e+003	3.0015e-009	1.1105e-004
Ac-228	1.2091e-004	4.4738e+006	1.9769e-006	7.3144e-002
Bi-210	7.0398e-005	2.6047e+006	1.1510e-006	4.2586e-002
Bi-211	1.8260e-007	6.7562e+003	2.9854e-009	1.1046e-004
Bi-212	1.2021e-004	4.4476e+006	1.9653e-006	7.2715e-002
Bi-214	1.0234e-004	3.7865e+006	1.6731e-006	6.1906e-002
Fr-223	2.5334e-009	9.3737e+001	4.1420e-011	1.5325e-006
Pa-231	4.4509e-007	1.6468e+004	7.2769e-009	2.6925e-004
Pa-234	2.9359e-006	1.0863e+005	4.8000e-008	1.7760e-003
Pa-234m	1.8349e-003	6.7892e+007	3.0000e-005	1.1100e+000
Pb-210	7.0418e-005	2.6055e+006	1.1513e-006	4.2598e-002
Pb-211	1.8260e-007	6.7562e+003	2.9854e-009	1.1046e-004
Pb-212	1.2021e-004	4.4476e+006	1.9653e-006	7.2715e-002
Pb-214	1.0234e-004	3.7865e+006	1.6731e-006	6.1906e-002

Po-210	6.9845e-005	2.5843e+006	1.1419e-006	4.2251e-002
Po-211	4.9849e-010	1.8444e+001	8.1501e-012	3.0155e-007
Po-212	7.7016e-005	2.8496e+006	1.2592e-006	4.6589e-002
Po-214	1.0232e-004	3.7857e+006	1.6728e-006	6.1893e-002
Po-215	1.8260e-007	6.7562e+003	2.9854e-009	1.1046e-004
Po-216	1.2021e-004	4.4476e+006	1.9653e-006	7.2716e-002
Po-218	1.0236e-004	3.7872e+006	1.6735e-006	6.1919e-002
Ra-223	1.8260e-007	6.7562e+003	2.9854e-009	1.1046e-004
Ra-224	1.2021e-004	4.4476e+006	1.9653e-006	7.2716e-002
Ra-226	1.0236e-004	3.7872e+006	1.6735e-006	6.1918e-002
Ra-228	1.2091e-004	4.4738e+006	1.9769e-006	7.3145e-002
Rn-219	1.8260e-007	6.7562e+003	2.9854e-009	1.1046e-004
Rn-220	1.2021e-004	4.4476e+006	1.9653e-006	7.2716e-002
Rn-222	1.0236e-004	3.7872e+006	1.6735e-006	6.1919e-002
Tc-99	2.8744e-003	1.0635e+008	4.6994e-005	1.7388e+000
Th-227	1.8044e-007	6.6764e+003	2.9501e-009	1.0915e-004
Th-228	1.2021e-004	4.4477e+006	1.9654e-006	7.2718e-002
Th-230	3.8699e-006	1.4319e+005	6.3270e-008	2.3410e-003
Th-231	5.6883e-004	2.1047e+007	9.3000e-006	3.4410e-001
Th-232	1.2233e-004	4.5262e+006	2.0000e-006	7.4000e-002
Th-234	1.8349e-003	6.7892e+007	3.0000e-005	1.1100e+000
Tl-207	1.8210e-007	6.7377e+003	2.9772e-009	1.1016e-004
Tl-208	4.3190e-005	1.5980e+006	7.0613e-007	2.6127e-002
U-234	1.1620e-002	4.2995e+008	1.8998e-004	7.0294e+000
U-235	5.6883e-004	2.1047e+007	9.3000e-006	3.4410e-001
U-238	1.8349e-003	6.7892e+007	3.0000e-005	1.1100e+000

Buildup: The material reference is Source Integration Parameters	
X Direction	20
Y Direction	20
Z Direction	20

Results					
Energy (MeV)	**Activity (Photons/sec)**	**Fluence Rate MeV/cm²/sec No Buildup**	**Fluence Rate MeV/cm²/sec With Buildup**	**Exposure Rate mR/hr No Buildup**	**Exposure Rate mR/hr With Buildup**
0.015	3.959e+04	1.902e-164	4.032e-30	1.632e-165	3.459e-31
0.02	7.170e+01	2.631e-80	1.149e-32	9.113e-82	3.981e-34
0.03	3.085e+06	2.798e-27	6.708e-27	2.773e-29	6.648e-29
0.04	4.565e+04	2.448e-16	8.421e-16	1.083e-18	3.724e-18
0.05	6.554e+05	2.899e-10	1.523e-09	7.723e-13	4.058e-12
0.06	2.789e+06	2.750e-07	1.907e-06	5.462e-10	3.788e-09
0.08	5.362e+06	6.234e-05	5.175e-04	9.865e-08	8.189e-07
0.1	6.863e+06	5.757e-04	4.742e-03	8.807e-07	7.255e-06
0.15	3.501e+06	1.949e-03	1.341e-02	3.209e-06	2.209e-05

0.2	1.584e+07	1.921e-02	1.146e-01	3.391e-05	2.022e-04
0.3	1.959e+06	5.493e-03	2.682e-02	1.042e-05	5.087e-05
0.4	1.563e+06	7.446e-03	3.155e-02	1.451e-05	6.147e-05
0.5	6.960e+05	4.938e-03	1.875e-02	9.692e-06	3.681e-05
0.6	3.281e+06	3.211e-02	1.114e-01	6.267e-05	2.175e-04
0.8	2.004e+06	3.253e-02	9.871e-02	6.188e-05	1.878e-04
1.0	4.511e+06	1.085e-01	2.986e-01	2.000e-04	5.505e-04
1.5	1.335e+06	6.537e-02	1.531e-01	1.100e-04	2.577e-04
2.0	1.029e+06	8.233e-02	1.758e-01	1.273e-04	2.718e-04
3.0	1.595e+06	2.483e-01	4.719e-01	3.369e-04	6.403e-04
Totals	**5.615e+07**	**6.088e-01**	**1.520e+00**	**9.714e-04**	**2.507e-03**

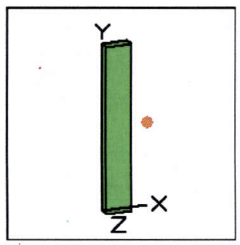
MicroShield 7.02
Westinghouse Electric Company (08-MSD-7.02-1424)

Date	By	Checked

Filename	Run Date	Run Time	Duration
SoilApGondOpRev1.ms7	May 20, 2012	12:54:33 PM	00:00:01

Project Info	
Case Title	Case 1
Description	Case 1
Geometry	13 - Rectangular Volume

Source Dimensions	
Length	274.32 cm (9 ft)
Width	121.92 cm (4 ft)
Height	1.8e+3 cm (60 ft)



Dose Points			
A	X	Y	Z
#1	476.86 cm (15 ft 7.7 in)	914.4 cm (30 ft)	60.96 cm (2 ft)

Shields			
Shield N	Dimension	Material	Density
Source	6.12e+07 cm³	Concrete	1.69
Shield 1	2.54 cm	Iron	7.86
Air Gap		Air	0.00122

Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Excluded
Library: Grove

Nuclide	Ci	Bq	µCi/cm³	Bq/cm³
Ac-227	1.8358e-007	6.7925e+003	3.0015e-009	1.1105e-004
Ac-228	1.2091e-004	4.4738e+006	1.9769e-006	7.3144e-002
Bi-210	7.0398e-005	2.6047e+006	1.1510e-006	4.2586e-002
Bi-211	1.8260e-007	6.7562e+003	2.9854e-009	1.1046e-004
Bi-212	1.2021e-004	4.4476e+006	1.9653e-006	7.2715e-002
Bi-214	1.0234e-004	3.7865e+006	1.6731e-006	6.1906e-002
Fr-223	2.5334e-009	9.3737e+001	4.1420e-011	1.5325e-006
Pa-231	4.4509e-007	1.6468e+004	7.2769e-009	2.6925e-004
Pa-234	2.9359e-006	1.0863e+005	4.8000e-008	1.7760e-003
Pa-234m	1.8349e-003	6.7892e+007	3.0000e-005	1.1100e+000
Pb-210	7.0418e-005	2.6055e+006	1.1513e-006	4.2598e-002
Pb-211	1.8260e-007	6.7562e+003	2.9854e-009	1.1046e-004
Pb-212	1.2021e-004	4.4476e+006	1.9653e-006	7.2715e-002
Pb-214	1.0234e-004	3.7865e+006	1.6731e-006	6.1906e-002

Po-210	6.9845e-005	2.5843e+006	1.1419e-006	4.2251e-002
Po-211	4.9849e-010	1.8444e+001	8.1501e-012	3.0155e-007
Po-212	7.7016e-005	2.8496e+006	1.2592e-006	4.6589e-002
Po-214	1.0232e-004	3.7857e+006	1.6728e-006	6.1893e-002
Po-215	1.8260e-007	6.7562e+003	2.9854e-009	1.1046e-004
Po-216	1.2021e-004	4.4476e+006	1.9653e-006	7.2716e-002
Po-218	1.0236e-004	3.7872e+006	1.6735e-006	6.1919e-002
Ra-223	1.8260e-007	6.7562e+003	2.9854e-009	1.1046e-004
Ra-224	1.2021e-004	4.4476e+006	1.9653e-006	7.2716e-002
Ra-226	1.0236e-004	3.7872e+006	1.6735e-006	6.1918e-002
Ra-228	1.2091e-004	4.4738e+006	1.9769e-006	7.3145e-002
Rn-219	1.8260e-007	6.7562e+003	2.9854e-009	1.1046e-004
Rn-220	1.2021e-004	4.4476e+006	1.9653e-006	7.2716e-002
Rn-222	1.0236e-004	3.7872e+006	1.6735e-006	6.1919e-002
Tc-99	2.8744e-003	1.0635e+008	4.6994e-005	1.7388e+000
Th-227	1.8044e-007	6.6764e+003	2.9501e-009	1.0915e-004
Th-228	1.2021e-004	4.4477e+006	1.9654e-006	7.2718e-002
Th-230	3.8699e-006	1.4319e+005	6.3270e-008	2.3410e-003
Th-231	5.6883e-004	2.1047e+007	9.3000e-006	3.4410e-001
Th-232	1.2233e-004	4.5262e+006	2.0000e-006	7.4000e-002
Th-234	1.8349e-003	6.7892e+007	3.0000e-005	1.1100e+000
Tl-207	1.8210e-007	6.7377e+003	2.9772e-009	1.1016e-004
Tl-208	4.3190e-005	1.5980e+006	7.0613e-007	2.6127e-002
U-234	1.1620e-002	4.2995e+008	1.8998e-004	7.0294e+000
U-235	5.6883e-004	2.1047e+007	9.3000e-006	3.4410e-001
U-238	1.8349e-003	6.7892e+007	3.0000e-005	1.1100e+000

Buildup: The material reference is Source

Integration Parameters	
X Direction	20
Y Direction	20
Z Direction	20

Results

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	3.959e+04	0.000e+00	1.921e-30	0.000e+00	1.647e-31
0.02	7.170e+01	4.188e-232	5.474e-33	1.451e-233	1.896e-34
0.03	3.085e+06	3.429e-75	5.208e-28	3.398e-77	5.162e-30
0.04	4.565e+04	1.368e-37	2.044e-29	6.050e-40	9.038e-32
0.05	6.554e+05	8.155e-22	7.599e-21	2.172e-24	2.024e-23
0.06	2.789e+06	1.531e-14	2.277e-13	3.041e-17	4.522e-16
0.08	5.362e+06	9.083e-09	1.825e-07	1.437e-11	2.888e-10
0.1	6.863e+06	1.403e-06	2.857e-05	2.146e-09	4.371e-08
0.15	3.501e+06	4.149e-05	6.453e-04	6.832e-08	1.063e-06

Deleted: 0

0.2	1.584e+07	7.556e-04	9.451e-03	1.334e-06	1.668e-05
0.3	1.959e+06	3.368e-04	3.115e-03	6.389e-07	5.909e-06
0.4	1.563e+06	5.592e-04	4.190e-03	1.090e-06	8.164e-06
0.5	6.960e+05	4.224e-04	2.685e-03	8.290e-07	5.271e-06
0.6	3.281e+06	3.022e-03	1.682e-02	5.899e-06	3.284e-05
0.8	2.004e+06	3.518e-03	1.603e-02	6.691e-06	3.049e-05
1.0	4.511e+06	1.295e-02	5.097e-02	2.388e-05	9.395e-05
1.5	1.335e+06	9.158e-03	2.834e-02	1.541e-05	4.769e-05
2.0	1.029e+06	1.262e-02	3.402e-02	1.952e-05	5.261e-05
3.0	1.595e+06	4.185e-02	9.559e-02	5.678e-05	1.297e-04
Totals	**5.615e+07**	**8.524e-02**	**2.619e-01**	**1.321e-04**	**4.244e-04**

VSP Sample Design Report for Calculating a Two-Sided Confidence Interval for the Population Mean Using Simple Random Sampling

Summary

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Construct a Confidence Interval on the True Mean
Type of Sampling Design	Parametric
Sample Placement (Location) in the Field	Simple random sampling
Formula for calculating number of sampling locations	Confidence Limits using Student's t-distribution
Calculated total number of samples	11

Primary Sampling Objective

The primary purpose of sampling at this site is to construct a confidence interval on the true population mean value. After the samples are collected and analyzed, the resulting sample values can be used to construct a two-sided confidence interval. Once the confidence interval is computed (which will be an upper and a lower threshold), you can have the specified confidence that the true population mean is between the upper and lower thresholds.

Selected Sampling Approach

A parametric random sampling approach was used to determine the number of samples and to specify sampling locations. A parametric formula was chosen because the conceptual model and historical information (e.g., historical data from this site or a very similar site) indicate that parametric assumptions are true. These assumptions will be examined in post-sampling data analysis.

Both parametric and non-parametric equations rely on assumptions about the population. Typically, however, non-parametric equations require fewer assumptions and allow for more uncertainty about the statistical distribution of values at the site. The trade-off is that if the parametric assumptions are valid, the required number of samples is usually less than if a non-parametric equation was used.

Locating the sample points randomly provides data that are separated by many distances, whereas systematic samples are all equidistant apart. Therefore, random sampling provides more information about the spatial structure of the potential contamination than systematic sampling does. As with systematic sampling, random sampling also provides information regarding the mean value, but there is the possibility that areas of the site will not be represented with the same frequency as if uniform grid sampling were performed.

Number of Total Samples: Calculation Equation and Inputs

The equation used to calculate the number of samples is based on a confidence interval calculation using the Student's t-distribution. The formula used to calculate the number of samples is:

$$n = \left[\frac{t_{1-\alpha/2,df}\, S_{total}}{d} \right]^2$$

where

n is the recommended minimum sample size for the study area,

S_{total} is the estimated standard deviation due to both sampling and analytical variability,

α is the maximum acceptable probability that the true mean will not lie in the confidence interval (the confidence level is 1-α),

d is the half-width of the confidence interval,

$t_{1-\alpha/2,df}$ is the value of the Student's t-distribution with $df=n-1$ degrees of freedom such that the proportion of the distribution less than $t_{1-\alpha/2}$ is $1-\alpha/2$.

Because n appears on both sides of the equation (on the right side it appears in the degrees of freedom of the t-statistic), the equation must be solved iteratively. VSP does this automatically using the iteration scheme in Gilbert (1987, pg. 32).

The values of these inputs that result in the calculated number of sampling locations are:

Analyte	n	Parameter			
		S	d	α	$t_{1-\alpha/2,df}$
Tc-99	11	52.6	35.2	5%	2.22814 [a]

[a] This value is automatically calculated by VSP based upon the user defined value of α

Statistical Assumptions

The assumptions associated with the formulas for computing the number of samples are:

1. The sample mean is normally distributed,
2. The population values are not spatially or temporally correlated, and
3. The sampling locations will be selected randomly.

The first two assumptions will be assessed in a post data collection analysis. The last assumption is valid because the sample locations were selected using a random process.

This report was automatically produced* by Visual Sample Plan (VSP) software version 6.3.
Software and documentation available at http://vsp.pnnl.gov

* Text not essential to the objective was modified by the end-user of the software.