# SAFETY EVALUATION REPORT

# REQUEST FOR ALTERNATE DISPOSAL APPROVAL AND EXEMPTIONS FOR SPECIFIC HEMATITE DECOMMISIONING PROJECT WASTE AT US ECOLOGY'S IDAHO FACILITY

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# 1. INTRODUCTION

## 1.1. Westinghouse Request

The U.S. Nuclear Regulatory Commission (NRC) received a request, by letter dated July 11, 2014 (ADAMS Accession No. ML14193A008), from Westinghouse Electric Company, LLC (WEC), a NRC licensee. The July 11, 2014 WEC letter requested that the NRC approve an amendment to WEC's license for its former Hematite fuel cycle facility located in Festus, Missouri (NRC license number SNM-33). Specifically, WEC requested an increase in the amount of licensed material[1] permitted to be disposed in accordance with Title 10 of the Code of Federal Regulations (10 CFR) 20.2002 (the NRC's radiation protection regulations are set forth in 10 CFR Part 20). Section 20.2002 is one of the NRC's regulations governing the disposal of licensed material by NRC licensees. Section 20.2002 concerns licensee applications for alternate disposals (i.e., the licensee proposes procedures not otherwise authorized in NRC regulations to dispose of licensed material generated in the licensee's activities). WEC's proposed disposal would involve low-activity radioactive materials generated by the Hematite Decommissioning Project (HDP). The material would contain source, byproduct, and special nuclear material (SNM). WEC proposes to dispose these materials at the US Ecology Idaho, Inc. (USEI) facility located near Grand View, Idaho. As USEI is not a NRC licensee, the July 11, 2014 letter also requested that USEI be exempted from NRC licensing requirements in 10 CFR 30.3 and 10 CFR 70.3 for byproduct material and SNM, respectively. Granting these exemptions would allow these materials to be disposed of at the USEI facility.

By letter dated August 12, 2014, USEI requested that it be considered a party to WEC's July 11, 2014, alternate disposal request and the requested exemptions (ADAMS Accession No. ML14272A425).

WEC did not request, nor does it need, an exemption for its proposed disposal of source material because the quantities of source material involved are below the threshold for licensing and as such, are exempt from licensing under 10 CFR 40.13(a). The 0.05 weight % referenced in 10 CFR 40.13(a) translates to approximately 339 pCi/g for natural uranium (including U-234, U-235, and U-238, but omitting consideration of decay products). Enclosure 1 to WEC's September 25, 2014 submittal shows in Section 6.1 that the average total activity concentration (sum of all nuclides and progeny and not just uranium) for this waste is approximately 226 pCi/g. The data from Appendix K of the December 19, 2014 response to the NRC's Request for Additional Information (ADAMS Accession No. ML15009A166) suggests that the average concentration may actually be lower. Therefore, the 10 CFR §40.13(a) exemption is applicable here and WEC does not require an exemption to transport the material to an unlicensed facility nor is USEI required to have an exemption to possess the material.

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[1] NRC regulation 10 CFR 20.1003 defines the term "licensed material" as "source material, special nuclear material, or byproduct material received, possessed, used, transferred or disposed of under a general or specific license issued by the [NRC]."

Granting the July 11, 2014 request would allow WEC to ship the HDP licensed material to USEI's Resource Conservation and Recovery Act (RCRA) Subtitle C disposal facility in Idaho.

The July 11, 2014 request follows similar requests submitted by WEC (HEM-09-52) on May 21, 2009 (ADAMS Accession No. ML091480071); HEM-12-2 on January 16, 2012 (ADAMS Accession Nos. ML12017A188, ML12017A189, and ML12017A190); and on May 28, 2013 (ADAMS Accession No. ML13149A291). Those requests were approved on October 27, 2011 as Hematite License Amendment No. 58 (ADAMS Accession Nos. ML111441087, ML112560105, and ML112560193); on April 11, 2013, as Hematite License Amendment No 60 (ADAMS Accession No. ML12158A384); and on January 14, 2014 as Hematite License Amendment No. 63 (ADAMS Accession No. ML13280A393).

The presence of SNM requires that Criticality Safety, Material Control and Accountability, and Physical Security be addressed.

### 1.1. USEI Facility

The USEI facility is a RCRA Subtitle C hazardous waste disposal facility permitted by the Idaho Department of Environmental Quality (IDEQ), and is not an NRC licensee. The USEI RCRA facility is located near Grand View, Idaho in the Owyhee Desert. The HDP material would be disposed in Cell 15, which has an area of 88,220 m2 (21.7 acres) and a depth of 33.6 m. The most important natural site features that limit the transport of radioactive material are the low precipitation rate (i.e., 18.4 cm/y (7.4 in. per year)) and the long vertical distance to groundwater (i.e., 61-meter (203-ft) thick on average unsaturated zone below the disposal zone).

As is usual with a RCRA Subtitle C site, a number of engineered features are present to enhance confinement of contaminants over the long term. These features include an engineered cover, liners, and leachate monitoring systems. Operations at the site include a number of systems that minimize the potential for exposure of workers to any waste handled by the facility. These systems include a closed facility with filtered ventilation exhaust for transfer of incoming waste material from the shipping conveyance to trucks for transport to the cell, mechanized equipment for disposition of waste material in the cell, and the application of an asphaltic spray at the end of each day's operations. The site is permitted to receive non Atomic Energy Act material or exempted radioactive material that meets site permit requirements.

### 1.2. Overview of NRC Review

The NRC reviews 10 CFR 20.2002 requests from the standpoint of the safety implications of disposing of licensed material at disposal facilities that are not licensed by the NRC or an NRC Agreement State.

The NRC's review of a 10 CFR §20.2002 request for disposal of low-activity waste at a RCRA facility covers protection of individuals, inadvertent intruders, and the public. The period of performance is 1,000 years after the expected date of license termination of the facility, consistent with paragraph (d) of 10 CFR 20.1401 (the License Termination Rule in Subpart E of 10 CFR Part 20). While the 10 CFR Part 20 dose limit for individual members of the public is 1 mSv/yr (100 mrem/yr) (10 CFR 20.1301), the NRC's practice, as described in NUREG-1757 Vol. 1, Rev. 2, section 15.12.1, is to approve 10 CFR 20.2002 requests if calculations demonstrate that disposal would not result in an annual dose to a member of the public exceeding more than a few millirem per year. In this regard, if the annual dose limits to the public are shown to be only a "few millirem," and as such, significantly below the public dose limit of 100 mrem/yr, then the NRC staff will find that the proposed section 20.2002 disposal meets the NRC's "as low as is reasonably achievable" (ALARA) standard.[2] In accordance with 10 CFR 20.2002(d), the licensee requesting an alternate disposal must demonstrate in its application that doses arising from the proposed disposal are maintained ALARA and within the applicable dose 10 CFR Part 20 limits.

Because this 10 CFR 20.2002 disposal request includes SNM, the NRC's review must include -- in addition to a dose limit analysis – an evaluation of nuclear criticality safety, material control and accounting, and physical security issues.

The potential exists that the waste material[3] approved for disposal by Amendments 58, 60, 63 and the material approved for disposal in this Safety Evaluation Report (SER) will be available for shipment to USEI at the same time. Therefore, this SER will discuss the cumulative impact of the alternative disposal of material from all previous requests and this request.

### 1.3. Additional Westinghouse Supporting Information

On September 25, 2014, Westinghouse submitted (ADAMS Accession No. ML14293A614) a revised technical basis document (HDP-TBD-WM-911). In that revision Westinghouse introduced that fact that their July 11 2014 request involved not only an increase in the amount of material to be shipped to USEI, but also new material and components and buildings which had not been previously characterized or approved for disposal at USEI. One type of new material identified in the September 25, 2014 submittal involved the Water Treatment System

[2] The NRC regulation 10 CFR 20.1003 defines "ALARA" "as making every reasonable effort to maintain exposures to radiation as far below the dose limits in this part [20] as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest."

[3] In the context of referring to HDP disposals, the term "waste," "waste material," and "material," as used in this SER, consists of or includes "licensed material" (see footnote 1). For example, the disposal of soil would include soil containing, or mixed, with licensed material.

(WTS) components and material collected in the components. Consequently, the July 11, 2014 request was not only an increase in the quantity to be disposed at USEI but also a request for approval for disposal of items not previously identified.

The NRC's review of the September 25, 2014 revision identified that Westinghouse had provided insufficient information on the new materials with respect to quantity and characterization data. This was reflected in the NRC October 29, 2014, Request for Additional Information (RAI) numbers 1, 4 - 8, 10 – 11, and 13 (ADAMS Accession Nos. ML14294A141, ML14294A146).

On December 19, 2014, Westinghouse provided their response (ADAMS Accession No. ML15009A166) to the NRC's RAI. This response contained Revision 2 of the technical basis document, HDP-TBD-WM-911. Beginning on January 27, 2015, three weekly publicly noticed calls were held to discuss the December $19^{th}$ response. As a result of the three calls, Westinghouse provided additional information in a February 18, 2015, submittal (ADAMS Accession No. ML15063A033). This submittal and other 10 CFR 20.2002 topics were subsequently discussed in publicly noticed calls on March 5, 2015 and March 12, 2015.

In a letter dated April 21, 2015, (ADAMS Accession No. ML15111A462) WEC indicated that they no longer wanted the NRC to consider material from the WTS nor its components as material under consideration for disposal at USEI.

## 2. BACKGROUND

The Hematite site was used for the manufacture of low-enriched, intermediate-enriched, and high-enriched materials during the period of 1956 through 1974. In 1974, the production of intermediate- and high-enriched material was discontinued, and all associated materials and equipment were removed from the facility. From 1974 to the cessation of manufacturing operations in 2001, the Hematite facility produced nuclear fuel assemblies for commercial nuclear power plants. In 2001, fuel manufacturing operations terminated, and the facility license was amended to authorize only decommissioning operations.

Activities at the Hematite site generated a large volume of process wastes contaminated with uranium of varying enrichment. Based on historic documentation, 40 unlined pits were excavated and used for the disposal of contaminated materials generated by fuel fabrication processes at Hematite between 1965 and 1970. The May 2009 alternate disposal request and License Amendment 58 approval cover the disposal of material from these burial pits, other undocumented burial pits, and other soil associated with the remediation of the Hematite site. The January 16, 2012 request and License Amendment 60 approval cover the disposal of source, byproduct, and special nuclear materials contained in building slabs, asphalt, soils, buried piping and miscellaneous equipment associated with the HDP. The May 28, 2013 request and License Amendment 63 approval cover additional soil and soil-like material associated with the HDP. Associated with this fourth alternate disposal request are waste types similar to the types described in the three previous alternate disposal requests. A description of these wastes is provided in the July 11, 2014 and September 25, 2014 submittals, in the December 19, 2014 response to the staff RAI request, and in the additional information provided on February 18, 2015.

WEC plans to ship the material associated with the this alternate disposal request to the USEI facility by rail if the material meets the criteria established by WEC and approved by the NRC for this 10 CFR 20.2002 disposal request. Discrete quantities of highly enriched uranium (HEU) will not be shipped to the USEI facility. However, the proposed rail shipments may contain diffuse quantities of HEU spread throughout the waste materials, as discussed further in Section 6 below.

This fourth alternate disposal request encompasses the following two actions:

- Request for increase in volume of material previously approved.
- Request for approval of material not previously identified.

Firstly, this request addresses the fact that previous 10 CFR 20.2002 requests had underestimated the amount of material which would be excavated and would qualify for disposal at USEI. Therefore, the July 11, 2014 submittal requested that the amount of material which would be allowed to dispose at USEI be increased by an additional 87,100 $m^3$. Approval of this additional amount of material being shipped to and disposed at USEI necessitates a revision to Hematite License Condition 17.

The additional material is soil and soil-like material, concrete, asphalt and piping.

The second action requests approval for sources of material not previously identified as candidate material for shipment to USEI. The inclusion of these sources necessitates that the staff review the characterization of the material, criticality safety aspects associated with the material, and the dose consequences associated with the shipment, treatment and burial of that specific material.

## 3. DOSE EVALUATION

This SER section evaluates WEC's description of the types of licensed material it plans to ship and the material's potential to generate radiological dose to various members of the public. WEC supplied information on the source material and a description of the job functions which permitted them to evaluate different possible exposures for various members of the public. These scenarios included the doses to the transportation workers and USEI workers, as well as the post-closure dose to the general public, and to an intruder. For 10 CFR 20.2002 reviews, all the scenarios analyzed in this SER treat exposed individuals as members of the public because the material is proposed to be sent to a facility that is not licensed by the NRC or an NRC Agreement State. Thus, all potentially exposed individuals would be subject to the more conservative public dose limit (the 100 mrem/yr set forth in 10 CFR 20.1301(a)), as opposed to the occupational dose limit.[4] Therefore, the NRC's occupational dose criteria do not apply to workers at USEI.

### 3.1. Types and Quantities of Material

WEC estimates the volume of the waste that will be a candidate for disposal at USEI associated with the July 2014 request to be approximately 87,000 $m^3$. The waste covered by this and prior requests consists of buried debris and contaminated soil, as well as concrete, asphalt, and piping. WEC originally included various items in the request which it subsequently withdrew. This was the WTS components and the material collected in the WTS components. These materials are listed in Table 3-5.

The waste material contains low concentrations of source, SNM, and byproduct material contaminants. WEC determined the radionuclides of concern based on studies in the Hematite Historical Site Assessment (ADAMS Accession Nos. ML092870417 and ML092870418). This is summarized in Chapter 4 of the Hematite DP (ADAMS Accession No. ML092330136). Density measurements performed by WEC indicated that the average waste overall density is 1.72 $g/cm^3$ (ADAMS Accession No. ML15063A024). Although WEC originally requested a volume of 87,100 $m^3$ in the July 2014 submittal, a volume of 86,948 $m^3$ will be an upper bound on the additional amount of waste that WEC is permitted to send to USEI under this specific request after deducting the estimated volume of the WTS material. License Amendment 58 had approved for disposal 22,809 $m^3$ at a waste density of 1.69 $g/cm^3$ (i.e., approximately 50,000 tons), License Amendment 60 approved for disposal of 23,000 $m^3$ at a waste density of 1.5 $g/cm^3$ (i.e., approximately 38,700 tons), and License Amendment 63 had approved for disposal of 22,000 $m^3$ at a waste density of 1.69 $m^3$ (approximately 41,000 tons). The combined approved waste volume for all requests, including the current or fourth request, is 154,757 $m^3$.

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[4] The NRC's occupational dose limits are set forth in 10 CFR 20.1201. The primary occupational dose limit is 500 mrem/yr (10 CFR 20.1201(a)(1)(i)).

### 3.1.1. Characterization of Material

WEC provided characterization information on the waste to be shipped by rail to USEI in Section 6.0 (Material Description and Characterization) of HDP-TBD-WM-911, which was provided as Attachment 1 (*Safety Assessment for Increasing the Volume of Hematite Project Waste Authorized for Transfer to USEI*) to the July 11, 2014, alternate disposal request (ADAMS Accession No. ML14193A008) and subsequently revised in the December 19, 2014 response to RAIs (ADAMS Accession No. ML15009A166). A subsequent revision to Appendix K of HDP-TBD-WM-911 was included in the February 18, 2015 response to requests for additional information (ADAMS Accession No. ML15063A024). The expected concentrations for the radionuclides are based on the information associated with WEC's May 21, 2009, submittal (approved as Amendment 58) (ADAMS Accession No. ML091480071), as well as the new information contained in the revised Appendix K submitted February 18, 2014 (ADAMS Accession No. ML15063A024).

The following regarding characterization is also noted:

- the total amount of Tc-99 will not exceed the numerical limits identified in Table 4-1;
- the Ra-226 concentration was increased from 1 pCi/g to 1.3 pCi/g based on the mean of the sample data for waste shipped to USEI through March 26, 2014.

The expected concentrations of the previously approved types of materials are reproduced below in Table 3-1, Table 3-2, Table 3-3, and Table 3-4. The tables list material that had previously been characterized and identified in prior submittals, as well as sources of newly identified or characterized material (noted by [new] in the tables). The volume of material associated with this request, approximately 87,000 $m^3$, represents the sum of various sources increased by a 50 percent contingency factor.

**Table 3-1. Expected Soil Radionuclide Concentrations of Approved Materials***

| Material Type | Volume ($ft^3$) | 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) |
|---|---|---|---|---|---|---|---|---|
| Burial Pits, Rejected Reuse Soil & Parking Lot, and Soil Beneath Slabs | 743,300 | 21,048 | 49.9 | 2.7 | 9.7 | 6.9 | 1.3 | 1.0 |
| Soil from Various Locations[a] | 1,003,900 | 28,255 | 113 | 5.5 | 18 | 27 | 1.3 | 1.2 |
| Haul Roads and Surface Soil impacted during site work [new] | 152,100 | 4,480 | 113 | 5.5 | 18 | 27 | 1.3 | 1.2 |
| Soil from Site Pond Dam to Railroad Culvert | 19,400 | 549 | 185 | 10 | 39 | 19 | 1.4 | 1.1 |
| **Soil Total** | **1,918,700** | **54,332** | | | | | | |
| **Soil 50% contingency** | **2,878,050** | **81,497** | | | | | | |

* Multiply Ci by $3.7 \times 10^{10}$ to obtain Bq

**The total Ci amount of Tc-99 will not exceed the limits established in Table 4-1

[a] Includes Site Pond, Evaporation Ponds, Leach Field, Area between Process Building and Rail Road (Tc-99 Area, VOC area, natural gas pipeline area), Soil associated with Subterranean Piping, Soil associated with SWTP (Sanitary Wastewater Treatment Plant), and Soil associated with Rail Apron/Load Out Area.

The expected concentrations for the Burial Pits, Rejected Reuse Soil & Parking Lot, and Soil Beneath Slabs is based on the railcar data as of September 5, 2014. These data were provided in WEC's December 19, 2014 response to the NRC's RAIs (ADAMS Accession No. ML15009A166). The expected concentrations of the "Soil from Various Locations" described in the footnote of Table 3-1 are the same assumed for the soil in the May 21, 2009 alternate disposal request (ADAMS Accession No. ML091480071). WEC also assumes these concentrations for the Haul Roads and Surface Soil impacted during site remediation as the soil and the roads had become contaminated as a result of excavation activities. WEC indicated that the haul roads are surveyed daily to ensure there is not a build up of activity on them. WEC reviews the survey data to check for variability in concentrations. The expected concentrations of the Soil from Site Pond Dam to Railroad Culvert are based on sample results for the soil in this area that were provided in Table 4-6 and Table 2 in Attachment I to HEM-10-126 (Reference 17 of ADAMS Accession No. ML103490100). The appropriateness of these assumed concentrations for soil is discussed further in the evaluation section.

**Table 3-2. Expected Asphalt Radionuclide Concentrations of Approved Materials***

| Material Type | Volume ($ft^3$) | Volume ($m^3$) | U-234 (pCi/g) | U-235 (pCi/g) | U-238 (pCi/g) | Tc-99** (pCi/g) |
|---|---|---|---|---|---|---|
| Asphalt over piping[a] | 865 | 24 | 48 | 1.94 | 8.3 | 2.7 |
| Asphalt Around Plant | 24,480 | 693 | 48 | 1.94 | 8.3 | 2.7 |
| Asphalt Pads | 6,000 | 170 | 48 | 1.94 | 8.3 | 2.7 |
| Cushman Road | 3,000 | 85 | 48 | 1.94 | 8.3 | 2.7 |
| SWTP Pad | 1,250 | 35 | 48 | 1.94 | 8.3 | 2.7 |
| Parking Lot by Barns Area[b] | 12,600 | 357 | 48 | 1.94 | 8.3 | 2.7 |
| **Asphalt Total** | **48,195** | **1,365** | | | | |
| **Asphalt 50% Contingency Total** | **72,293** | **2,048** | | | | |

* Multiply Ci by $3.7 \times 10^{10}$ to obtain Bq
**The total Ci amount of Tc-99 will not exceed the limits established in Table 4-1
[a] The portion of the parking lot above the stormwater drains near Building 230.
[b] The portion of the parking lot and soil that is south of the former barns area, extending from the northern edge of the parking lot to halfway to Building 230.

The expected concentrations for all the asphalt material is based on the “Asphalt” row of Table 6-5 of HDP-TBD-WM-906 (ADAMS Accession Nos. ML12209A201 and ML12293A029), which is derived from the samples of the Process Buildings and vaults listed in Table 6-3 of HDP-TBD-WM-906 (ADAMS Accession Nos. ML12209A201 and ML12293A029). The appropriateness of these assumed concentrations for asphalt is discussed further in the evaluation section.

**Table 3-3. Expected Concrete Radionuclide Concentrations of Approved Materials**

| Material Type | Volume ($ft^3$) | Volume ($m^3$) | U-234 (pCi/g) | U-235 (pCi/g) | U-238 (pCi/g) | Tc-99** (pCi/g) |
|---|---|---|---|---|---|---|
| Concrete from Building 235 Slab, Footers, Walls and the Process Building Slab for Haul Roads | 2,500 | 71 | 233 | 10 | 45 | 2.7 |
| Concrete from Building 110, Building 230-231 Slab and Footers [new] | 35,790 | 1,013 | 233 | 10 | 45 | 2.7 |
| Concrete from Various Locations[a] | 36,577 | 1,048 | 48 | 1.9 | 8.3 | 2.7 |
| **Concrete Total** | **74,867** | **2,120** | | | | |
| **Concrete 50% contingency** | **112,300** | **3,180** | | | | |

* Multiply Ci by $3.7 \times 10^{10}$ to obtain Bq
**The total Ci amount of Tc-99 will not exceed the limits established in Table 4-1
[a] Includes concrete from Sanitary Wastewater Treatment Plant (SWTP) Shed, Building 115, Site Pond Dam, Site Pond Head Wall, Slab North of Building 260, Tank Base North of Limestone Building, Slab North of Building 255, Basin South of Building 235, Basin South of Building 240, Piers South of Building 240, Office West of Building 240, Ventilation Room West of Building 240, Sidewalks, and Pad South of Building 230.

The expected concentration of Concrete from Building 235 Slab, Footers, Walls and the Process Building Slab for Haul Roads is based on the row for the Balance of Process Buildings Excluding Areas (I-4), Area I cap, Area 5 and Vaults in Table 6-5 of HDP-TBD-WM-906 (ADAMS Accession Nos. ML12209A201 and ML12293A029). These values bound the averages of Building 235 sample results in Appendix D of HDP-TBD-WM-906 (ADAMS Accession Nos. ML12209A201 and ML12293A029) and Appendix G, Additional Concrete Slab and Asphalt Sample Results, provided with HDP-TBD-WM-911, Rev 1 as an attachment to HEM-14-74 submitted on September 25, 2014 (ADAMS Accession No. ML14293A614). The same concentrations (based on the Balance of the Process Buildings) are also assumed for concrete from Building 110, Building 230 and Building 231 Slab and Footers. Given that these buildings are new material to this request, which have not previously been identified as going to USEI or characterized, WEC provided additional information on the historical use of these buildings in Appendix K of the response to RAIs dated December 19, 2014 (ADAMS Accession No. ML15009A166) to support the concentrations assumptions. The expected concentration of the remainder of the “Concrete from Various Locations” as described in the footnote to Table 3-3 is based on the row for "concrete outside Process Buildings" in Table 6-5 of HDP-TBD-WM-906, which is derived from the samples of the Process Buildings and vaults listed in Table 6-3 of HDP-TBD-WM-906 (ADAMS Accession Nos. ML12209A201 and ML12293A029). The appropriateness of these assumed concentrations for concrete is discussed further in the evaluation section.

**Table 3-4. Expected Piping Radionuclide Concentrations of Approved Materials***

| Material Type | Volume ($ft^3$) | Volume ($m^3$) | U-234 (pCi/g) | U-235 (pCi/g) | U-238 (pCi/g) | Tc-99** (pCi/g) |
|---|---|---|---|---|---|---|
| Piping from Various Locations Previously Identified[a] | 3,825 | 111 | 1,500 | 54.2 | 166.7 | 37.9 |
| Outside Piping from Sanitary Wastewater Treatment Plant To Outfall [new] | 613 | 17 | 1,500 | 54.2 | 166.7 | 37.9 |
| Piping remaining under haul road that crosses the Process Building | 818 | 23 | 1,276 | 48.1 | 140.5 | 31.4 |
| **Piping Total** | **5,256** | **149** | | | | |
| **Piping 50% Contingency** | **7,884** | **224** | | | | |

* Multiply Ci by $3.7 \times 10^{10}$ to obtain Bq
**The total Ci amount of Tc-99 will not exceed the limits established in Table 4-1
[a] Includes piping from Building 110, Building 230, and Outside the Process Buildings. Details of the various piping segment locations are listed in a previous submittal; refer to Appendix K of RAIs dated February 18, 2015 (ADAMS Accession No. ML15063A024)

The expected concentrations for 'Piping from Various Locations Previously Identified' (Building 110, Building 230, and Outside the Process Buildings) are derived by assuming the piping curie content from the row labeled "outside" of Table 7-5 of HDP-TBD-WM-906 and dividing by the total mass from Table 7-3 of HDP-TBD-WM-906 (ADAMS Accession Nos. ML12209A201 and ML12293A029). These same concentrations are assumed for the newly identified piping from Sanitary Wastewater Treatment Plant (SWTP) to the outfall. The concentrations for the piping remaining under the haul road that crosses the Process Building is based on the sum of the Building 255 piping curie content from Table 7-5 of HDP-TBD-WM-906 divided by the total mass for Building 255 piping from Table 7-3 (ADAMS Accession Nos. ML12209A201 and ML12293A029). The appropriateness of these assumed concentrations for piping is discussed further in the evaluation section.

Table 3-5 lists the expected concentrations for the materials which were originally included in the request and are listed in the Appendix K of the December 19, 2014 response to RAIs (ADAMS Accession No. ML15009A166), but were either withdrawn by WEC, or rejected for shipment to USEI at this time by the NRC staff based on its review. The basis for not accepting this material is discussed in the evaluation section.

**Table 3-5. Materials Not Approved for Shipment to USEI***

| Material Type | Volume ($ft^3$) | 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) |
|---|---|---|---|---|---|---|---|---|
| Concrete from SWTP Tank (withdrawn) | 1,500 | 42 | 1,334 | 74 | 242 | 71 | 1.2 | 0.8 |
| Old Septic Tank (withdrawn) | 425 | 12 | 48 | 1.9 | 8.3 | 2.7 | ** | ** |
| Metal from Subsurface Sanitary System Tank (withdrawn) | 96 | 3 | 1,500 | 54.2 | 166.7 | 37.9 | ** | ** |
| Water Treatment System (WTS) Sediment, Filter Media, Resin (rejected) | 770 | 22 | 1,466 | 80.6 | 408 | 43 | <MDA (0.20) | <MDA (0.28) |
| WTS Components, except for tanks[a] (rejected) | 780 | 22 | ** | ** | ** | ** | ** | ** |
| Internal debris/scale for WTS[b] (rejected) | ** | ** | 1,466 | 80.6 | 408 | 43 | <MDA (0.20) | <MDA (0.28) |

* Multiply Ci by $3.7 \times 10^{10}$ to obtain Bq
**an estimate for this value was not provided by WEC
[a] includes 950 ft piping, 4 Granulated Activated Carbon (GAC) vessels, 2 Ion Exchange (IX) vessels, 4 duplex bag filter vessels, 12 pumps, 83 valves, 5 meters - drained and emptied except for residue
[b] includes debris from piping, various filter components, pumps, valves, meters - drained and emptied except for residue

In addition to the expected concentrations of materials to be shipped, WEC provided a summary of the supplementary characterization of the material that has already been shipped to USEI. As of March 26, 2014, WEC has shipped approximately 45,036 $m^3$ of material. WEC provided a summary of the characterization data of the material in Table 4 (Summary Data for Shipments to USEI as of March 26, 2014) of HDP-TBD-WM-911, (ADAMS Accession No. ML14193A008). As shown in Table 3-6, the average total concentration for material already shipped is less than (or equal to for Ra-226) the expected concentrations assumed in the dose assessment for the May 21, 2009 alternate disposal request (ADAMS Accession No. ML091480071). The average Tc-99 concentration for the material already shipped is 6.9 pCi/g. In addition to providing the mean concentration, WEC provided the highest historical railcar data which represents the maximum sample from an individual railcar which has already been shipped as of March 26, 2014. WEC has committed to apply these historical railcar values (for all radionuclides with the exception of Tc-99) as a limit on the cumulative mean concentration for material shipped and pending shipment (see Table 4-1).

**Table 3-6. Characterization of Soil Material Sent to USEI as of March 26, 2014 Compared to Expected Concentrations Previously Assumed***

| | U-234 (pCi/g) | U-235 (pCi/g) | U-238 (pCi/g) | Tc-99 (pCi/g) | Ra-226 (pCi/g) | Th-232 (pCi/g) |
|---|---|---|---|---|---|---|
| Mean of Soil Sample Data for Waste Already Shipped (Burial Pits, Barn Area, and Footprint of Process Building) | 33.1 | 1.6 | 7.4 | 6.9 | 1.3 | 1.0 |
| Soil Concentration Assumed for Dose Assessment in the May 21, 2009 alternate disposal request (ADAMS Accession No. ML091480071) | 113 | 5.5 | 18 | 27 | 1.3** | 1.2 |
| Highest Historical Railcar Soil Data for Waste Already Shipped | 180 | 9.9 | 31 | 91 | 7.7 | 9.9 |

* Multiply Ci by $3.7 \times 10^{10}$ to obtain Bq

** Ra-226 concentration was assumed to be 1 pCi/g in the May 2009 request, but was increased to 1.3 pCi/g for the majority of soil in this request based on the mean of the sample data for waste shipped to USEI through March 26, 2014.

## 3.2. NRC Evaluation of WEC's Material Characterization

In its response to request for additional information dated December 19, 2014, WEC presents a comprehensive listing of the existing characterization data in Appendix K, along with the basis for the characterization assumptions (ADAMS Accession No. ML15009A166). A revision to Appendix K in MS Excel spreadsheet format was submitted along with the February 18, 2015 letter (ADAMS Accession No. ML15063A024). The NRC staff notes that this version of the spreadsheet did not contain all the references or notes on the basis for characterization contained in the December 19, 2014 submittal. So, therefore, the evaluation relied on both versions.

NRC staff notes that for some materials, the expected concentration of Tc-99 is higher than that which was assumed to estimate post-closure dose. However, since the total Ci amount as opposed to the concentration of Tc-99 determines the post-closure dose, it is acceptable to apply the same post-closure dose assessment as long as the plan for further sampling appropriately characterizes the additional material so that WEC maintains the total Ci limits for Tc-99. The expected uranium concentrations, which are important for the intruder dose, are also elevated in some of the material in comparison to the original assumptions in some of the intruder dose assessment scenarios. However, since WEC has committed to further characterization of this material and is also imposing contingency limits on the average concentration of uranium isotopes (Table 4-1), WEC provided an updated dose evaluation for the intruder as discussed later in this report.

With regard to the soil material listed in Table 3-1, the staff finds that it is appropriate to apply the concentrations of the "already shipped" data from these areas as the expected concentrations for the Burial Pits, Rejected Reuse Soil & Parking Lot, and Soil Beneath Slabs. The staff also finds that it is appropriate to use the concentrations assumed for the soil in the May 21, 2009 alternate disposal request (ADAMS Accession No. ML091480071) for the 'Soil from Various Locations' since the characterization data from the May 2009 request is from across the site and includes the locations in this group of material. It is also reasonable to assign these same values for the newly identified haul roads and surface soil since these areas have been impacted as a result of excavation from across the site. The future sampling plan approved for soil is appropriate to apply to this material given that the soil on the haul roads and surface soil is originally from the excavation. The future sampling will ensure that WEC meets the concentration and contingency limits in Table 4-1. With regard to the soil from Site Pond Dam to the Railroad Culvert, the Tc-99 standard deviation associated with the samples of soil between the Site Pond Dam and Railroad Culvert is 19.95 pCi/g for an average of 19.44 pCi/g. This is less than the standard deviation of 225 pCi/g for an average of 27 pCi/g that was used in Attachment 2 to HEM-10-46 (ADAMS Accession No. ML101450240) to determine the soil sample frequency.

With regard to the asphalt material listed in Table 3-2, the NRC staff finds the assumed values for asphalt to be adequate because they are derived from samples taken from inside the Process Building and vaults (Table 6-3 of HDP-TBD-WM-906) which are expected to have higher levels of contamination than the asphalt (ADAMS Accession Nos. ML12209A201 and ML12293A029).

With regard to the concrete material listed in Table 3-3, the staff finds the concentrations assumed for material associated with Building 235 to be appropriate since they are based on multiple samples from across the Process Buildings and because the concentrations assumed are greater than the average of the samples already taken specifically from Building 235.

For the newly identified Buildings 110, 230 and 231, WEC provided information about the historical use of these buildings to rationalize why the concentrations associated with the balance of the Process Buildings was conservative for these buildings. Building 110 is an office building. Building 230 was used for assembling fuel rods in which completely formed uranium pellets were handled, but uranium was not processed, whereas Building 231 was used for storage. Because of the historical use, the overall mean and variance of radionuclide concentrations are expected to be less for these buildings as compared to the balance of the Process Buildings. Therefore, the previously approved sampling plan for concrete, which incorporates data from the Process Buildings, is appropriate for ensuring that WEC maintains the limits established in Table 4-1.

The staff finds the assumed values for the 'Concrete from Various Locations' as described in the footnote to Table 3-3 to be adequate for areas outside the Process Buildings because they are estimated from samples in the Process Building and vaults as listed in Table 6-3 of HDP-TBD-WM-906 (ADAMS Accession Nos. ML12209A201 and ML12293A029). Also, existing gamma survey data indicate an absence of areas of elevated contamination in these materials such as those present in the Process Building and vaults. WEC indicated that SWTP Shed and Building 115 are smaller or equivalent in size to Building 235.

With regard to the piping material listed in Table 3-4, the NRC staff does not agree with the method for deriving the concentrations assumed for piping. WEC derived these values by dividing the total curie content from Table 7-5 of HDP-TBD-WM-906 (for the row labeled "outside" or the sum of the rows for Building 255), by the total mass of the piping in Table 7-3, which included the mass of the actual pipes as well as the debris inside the pipes. The total curie content in Table 7-5 of HDP-TBD-WM-906 was calculated by assuming the maximum concentration for each radionuclide of 10 samples taken from Building 255 or outside the Process Buildings and multiplying by the total mass of debris assumed to be inside the pipes. In this case, the assumed concentrations for the piping from Building 110, Building 230, and from outside the Process Buildings as well as the concentrations for piping remaining under the haul road that crosses the Process Building could have more appropriately been based directly on the concentrations in Table 7-5 of HDP-TBD-WM-906. This would have been in lieu of converting a concentration to a curie amount based on the debris mass and then dividing by a larger total mass of the piping plus debris. Similarly, the NRC staff notes that the estimated concentrations for the piping from the SWTP to the outfall would have more appropriately been based on the available data from the SWTP tanks. However, even though the expected concentrations for the piping provided by WEC and listed in Table 3-4 may not be appropriate, the NRC staff has determined, through independent review of the available sample data for Building 255 and piping outside the Process Buildings, that the future sampling plan for piping is appropriate to ensure that WEC maintains the contingency limits in Table 4-1. In the case of the piping from the SWTP to the outfall, the NRC staff independently reviewed the available concentration data from the SWTP tanks contained in of HDP-TBD-WM-909 (ADAMS Accession No. ML13310A625). These data adequately bound the concentrations in the piping to ensure that sampling plan for other piping is also appropriate for this material. The staff notes that the averages of the SWTP samples provided in HDP-TBD-WM-909 are approximately equal to or less than the maximum values assumed in the intruder dose assessment. Therefore, even though the NRC staff does not agree with the concentrations listed in Table 3-4, the derivation of the expected concentrations listed in Table 3-4 are not important for approval of this piping material given the adequacy of the future sampling plan and contingency limits.

The NRC staff also requested additional information regarding the characterization of the Metal Subsurface Sanitary System Tank, the concrete associated with the Old Septic Tank, and the concrete from the SWTP. Upon review of the December 19, 2014 response to the RAIs, the staff had remaining questions regarding these items. However, in a letter to the NRC dated February 18, 2015, WEC excluded this material from the request for exemption (ADAMS Accession No. ML15063A024). Specifically, a portion of the Old Septic Tank has already been removed and was segregated for shipment to a disposal site licensed per NRC requirements.

WEC committed to segregating any other removed portion of this Old Septic Tank for shipment to a disposal site licensed per NRC requirements. WEC committed that any non-removed portion of the Old Septic Tank that is planned to remain in situ will be decontaminated as necessary and undergo final status survey (FSS). Similarly, also in the letter to the NRC dated February 18, 2015, WEC committed to sending the Metal Subsurface Sanitary System Tank and the concrete from the Sanitary Wastewater Treatment Plant to a disposal site licensed per NRC requirements. Because these withdrawn materials will not be shipped to USEI, their characterization information is not important for this 10 CFR 20.2002 request.

Given that the source term values presented by WEC are an estimate, WEC continues its commitment to perform additional characterization of soils, piping, concrete, and asphalt prior to shipment. This commitment is to verify amounts and to ensure adherence to the Tc-99 limits associated with License Condition 17 of the Hematite license. The adequacy of these future sampling plans is further discussed in Section 4 of this SER. NRC staff evaluated the available characterization data, which was used to estimate the dose and help define the limits imposed under License Condition 17, and the findings are summarized below.

#### 3.2.1. NRC Findings

The NRC has concluded that WEC has presented reasonable explanation of the existing characterization data. The NRC staff finds the use of the concentrations assumed in the prior requests to remain appropriate for the post-closure dose estimation because WEC has committed to further characterization of the Tc-99 concentrations to ensure the shipments remain within the previously established limits. Therefore, in this case, the staff’s safety analysis relies on the plans for supplementary characterization and adherence to limits as described in the following sections.

### 3.3. WEC Assessment of Doses

#### 3.3.1. Transportation and USEI Worker Doses

WEC analyzed the dose to USEI workers as well as the potential dose to a member of the general public during transportation of the waste to USEI. This analysis was provided in HDP-TBD-WM-911, Revision 2 (ADAMS Accession No. ML15009A166). The USEI workers included a gondola surveyor, an excavator operator, gondola cleanout worker, truck surveyor, truck driver, stabilization operator, and cell operator. These dose assessments were similar to those provided by WEC in its previous alternate disposal requests. WEC assumed the same concentrations for the radionuclides as the soil concentration assumed for dose assessment in the first request submitted on May 21, 2009 (ADAMS Accession No. ML091480071) and also in the third request submitted on May 28, 2013 (ADAMS Accession No. ML13149A291), with the exception of Ra-226. The concentration of Ra-226 was increased to 1.3 pCi/g from 1.0 pCi/g in the current request. The concentrations are listed in the second row of Table 3-6 of this SER. WEC estimated that 1,475 gondola railcars will be used to transport the waste from the

Hematite site to USEI. The contents of the gondola railcar will be enclosed in wrappers meeting the U.S. Department of Transportation (DOT) Industrial Type-1 Package (IP-1) requirements, which preclude dispersal of waste to the air or loss of material during transport. Once the waste is received at the USEI site, the gondola railcar will be surveyed and then off-loaded into trucks for transport to the USEI disposal cell. Once the waste is off-loaded, USEI personnel will remove any residual material in the railcar using shovels and brooms. The truck is surveyed prior to being driven to the USEI disposal cell, where the waste is spread and compacted in the cell. The waste may contain hazardous constituents that require treatment prior to disposal. The treatment will be performed either inside the Indoor Stabilization Building in a 125 cubic yard tank or in the Outdoor Stabilization Area in a 54 cubic yard container. In the dose assessment for the USEI workers, it was assumed that all of the waste will require treatment, though none of the waste shipped from Hematite as of July 3, 2014 has required treatment.

Table 3-7 summarizes the job function scenario assumptions. The times assigned are the times for one person to perform each function once. In WEC's analysis, it is assumed that a specific number of workers per year will be available to carry out each of the job functions, and the total dose for the job function is divided equally among all workers within a job function group. Job functions are not shared among employees tasked as an excavator operator, truck driver, stabilization operator, or cell operator. These workers' responsibilities are not assumed to overlap. However, the groups performing tasks as gondola surveyors, gondola clean-out crews, and truck surveyors may involve the same individual employees.

**Table 3-7: Job Function Scenario Assumptions**

| Job Function | Number of Workers in Group | Minutes to Perform Task | Type of Conveyance (count) |
|---|---|---|---|
| Gondola Surveyor | 8 | 20 | Gondola (1475) |
| Excavator Operator | 4 | 45 | Gondola (1475) |
| Gondola Cleanout | 8 | 10 | Gondola (1475) |
| Truck Surveyor | 8 | 5 | Truck (4425) |
| Truck Driver | 14 | 45 | Truck (4425) |
| Stabilization Operator | 6 | 45 | Cube (4425) |
| Cell Operator | 2 | 15 | Gondola (1475) |

Table 3-8 summarizes the external and internal worker doses calculated in this analysis. The external dose rates used in this dose assessment were equal to those calculated by WEC in their third 10 CFR 20.2002 request increased by 30 percent to conservatively account for the 30 percent increase in the radium concentration in the current 10 CFR 20.2002 request. These dose rates were calculated using the MicroShield 7.02 code. The method and parameters used by WEC to calculate the internal dose are the same as those used in the three previously approved 10 CFR 20.2002 requests. The internal dose from the inhalation of contaminated dust was calculated based on an assumed concentration of dust in the building of 0.23 $mg/m^3$, an assumed inhalation rate of 1.2 $m^3/hr$, the concentrations of radioactivity in Table 3-1, and the FGR 11 Inhalation Dose Conversion Factors (DCFs). The assumed dust concentration was based on a study that found that the respirable dust concentrations at the USEI facility ranged from 0.17 to 0.23 mg/m$^3$. WEC did not take credit for the respiratory protection program at USEI, so the actual inhalation dose would likely be smaller than what was calculated. Unlike in the first approved 10 CFR 20.2002 request, an internal dose was not calculated for the gondola surveyor, truck surveyor, or the truck driver. WEC clarified that internal doses were not assigned to these workers because the truck bed and gondola railcar remains covered while they are being surveyed and the truck bed remains covered during the trip to the disposal cell, so these workers would not be expected to receive an internal dose.

The dose to the general public during transportation to USEI is bounded by the dose to the workers at USEI. WEC calculated that in order for the dose to the general public during transportation to be higher than the dose to a USEI worker, an individual member of the general public would have to spend approximately 1500 hours at a distance of 1 m from the waste or 1200 hours at 1 foot from the waste, which is not a credible scenario. Therefore, WEC did not estimate an actual dose to the general public during transportation.

**Table 3-8: Dose per Person for Individual Job Function***

| *Job Function* | *Internal Dose (mrem/worker)* | *External Dose (mrem/worker)* | *Total Dose (mrem/worker)* |
|---|---|---|---|
| Gondola Surveyor | NA | $2.0 \times 10^{-1}$ | $2.0 \times 10^{-1}$ |
| Excavator Operator | 1.5 | $1.5 \times 10^{-1}$ | 1.7 |
| Gondola Cleanout | $1.7 \times 10^{-1}$ | $6.4 \times 10^{-2}$ | $2.3 \times 10^{-1}$ |
| Truck Surveyor | NA | $1.2 \times 10^{-1}$ | $1.2 \times 10^{-1}$ |
| Truck Driver | NA | $7.1 \times 10^{-1}$ | $7.1 \times 10^{-1}$ |
| Stabilization Operator | 3.0 | $5.0 \times 10^{-1}$ | 3.5 |
| Cell Operator | 1.0 | $5.5 \times 10^{-1}$ | 1.6 |

*multiply mrem/yr. by 0.01 to obtain mSv/y

In the calculation of the cumulative annual dose from the current HDP §20.2002 request and the previous requests, WEC assumed that 58,100 m$^3$ of waste from the current request will be shipped in 2015 with 29,000 m$^3$ of waste being shipped in 2016. Additionally, WEC projects that 7000 m$^3$ of the 22,000 m$^3$ of waste that was approved in the third HDP §20.2002 request will be shipped in 2015. The cumulative annual doses were calculated using the following equations and the calculated doses are summarized in Table 3-9.

Cumulative Dose 2015 = (7000/22000)(Dose from 3$^{rd}$ Request)+0.67(Dose this Request)

Cumulative Dose 2016 = 0.33(Dose this Request)

**Table 3-9: Dose per Person per Year for Individual Job Function***

| *Job Function* | *Dose Estimate for 2015 (mrem/worker)* | *Dose Estimate for 2016 (mrem/worker)* |
|---|---|---|
| Gondola Surveyor | $1.5\times10^{-1}$ | $6.6\times10^{-2}$ |
| Excavator Operator | 1.2 | $5.5\times10^{-1}$ |
| Gondola Cleanout | $1.7\times10^{-1}$ | $7.6\times10^{-2}$ |
| Truck Surveyor | $8.8\times10^{-2}$ | $4.0\times10^{-2}$ |
| Truck Driver | $5.2\times10^{-1}$ | $2.3\times10^{-1}$ |
| Stabilization Operator | 2.4 | 1.2 |
| Cell Operator | 1.2 | $5.1\times10^{-1}$ |

*multiply mrem/yr. by 0.01 to obtain mSv/y

### 3.3.2. Post-Closure Dose

The appropriateness of the RESidual RADioactive (RESRAD) materials model for the USEI site was reviewed by USEI staff upon USEI purchasing the site from Envirosafe in 2001. The USEI staff concluded that the code was appropriate for the site conditions. In 2005, USEI hired consultants to review the input values used for RESRAD, and determine site-specific inputs that should be used with the code to more accurately reflect the site environmental conditions. Most of the site-specific parameters are explained in the 2005 report titled “Site-specific RESRAD Water Pathway Parameters for the Contaminated Soil, Vadose Zone, and Saturated Zone”. This report was provided in WEC’s December 29, 2009, RAI response to the May 2009 alternative disposal request noted as HEM-09-146 (ADAMS Accession No. ML100320540). For those parameters not described in the report, WEC provided additional justification with its March 31, 2010 (HEM-I0-38) submittal (ADAMS Accession No. ML100950397).

Since Tc-99 is the primary contributing radionuclide and the dose is delivered through the groundwater, the total quantity of Tc-99 (as opposed to the concentration) will drive the post-closure dose consequences. RESRAD applies the concentration of Tc-99 and the volume of soil in the contaminated zone to determine the total quantity of Tc-99 that is available in uptake pathways. WEC will ensure that the total amount of Tc-99 will not exceed the previously approved limit in the 2012 request (ADAMS Accession Nos. ML12017A188, ML12017A189, and ML12017A190). Therefore, the prior post-closure dose remains valid since the dose will not be impacted by the additional volume of material.

WEC plans to treat the material identified in this request cumulatively with the material from the three previous requests. To ensure that the inventory calculated from the mean activity concentrations (derived from the mass-weighted concentrations of each stockpile) remains below the cumulative limit for Tc-99, WEC plans to sample the outgoing shipments of material. WEC concluded that their sampling plans and associated contingency limits, which are reiterated in Section 4 of this SER, will ensure that the limits established for the cumulative mean and 95th Upper Confidence Limit (UCL) of the mean will not be exceeded. WEC selected the UCL of the mean in order to maintain the dose at the UCL within the ‘few mrem’ criterion.

Table 3-10 shows the Tc-99 mean and UCL inventory limits for the prior three requests, as well as the cumulative limit. Since WEC is ensuring that the total amount of Tc-99 remains within the previously approved limits, the cumulative action threshold for Tc-99 is not impacted by this additional request. The other radionuclides (besides Tc-99) contribute insignificant amounts to the overall post-closure dose. These radionuclides may become more concentrated in the USEI cell as a result of the additional material being sent. However, the impact of this on post-closure dose is not significant (on the order of $10^{-2}$ mrem/yr ($10^{-4}$ mSv/yr)).

**Table 3-10. Cumulative Tc-99 Limits for the Previous §20.2002 Requests***

| | A58 Request | A60 Request | A63 Request | Cumulative Action Threshold |
|---|---|---|---|---|
| Total Quantity of Tc-99 shipped to USEI (Mean) | 1.0 Ci | 0.3 Ci | N/A | 1.3 Ci |
| Equivalent Dose for Mean | 1.9 mrem/yr | 0.8 mrem/yr | N/A | 2.7 mrem/yr |
| 95% UCL of the Mean of Tc-99 shipped to USEI | 1.6 Ci | 0.45 Ci | | 2.05 Ci |
| Equivalent Dose for the 95% UCL of the Mean | 3 mrem/yr | 1.2 mrem/yr | N/A | 4.2 mrem/yr |

*multiply mrem/yr by .01 to obtain mSv/y

### 3.3.3. Inadvertent Intruder Dose

To calculate dose to the intruder post-burial, WEC used the methods from NRC Guidance NUREG/CR 4370, Volume 2 (ADAMS Accession No. ML100250917). WEC assumes the same parameter values for the intruder scenarios as in the response to additional information HEM-12-67 (ADAMS Accession No. ML121740265), with the exception of radionuclide concentrations, weights, and the use of the Class W lung clearance classes for chemical compounds (instead of the slightly lower Class Y value) from Federal Guidance Report (FGR) 11 - Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion) contains dose coefficient, for the Th-232 inhalation dose conversion factor (DCF). WEC provided the intruder dose assessment calculations in Appendix C to HDP-TBD-WM-911, Rev. 0 (ADAMS Accession No. ML14193A008), revised with the September 25, 2014 submittal (ADAMS Accession No. ML14293A614). WEC subsequently provided an updated cumulative intruder dose assessment calculation in the response to RAIs dated December 19, 2014 (ADAMS Accession no. ML15009A166). WEC assumes a density of 1.5 g/cm$^3$ in these calculations, since that is the density of the waste after it is disposed in the cell at USEI.

The analyses included variations on assumptions about the concentration of the material as it is shipped and the extent to which the shipping concentrations are diluted with non-Hematite waste once the material has been disposed of in the cell as detailed in Figure 3-1.

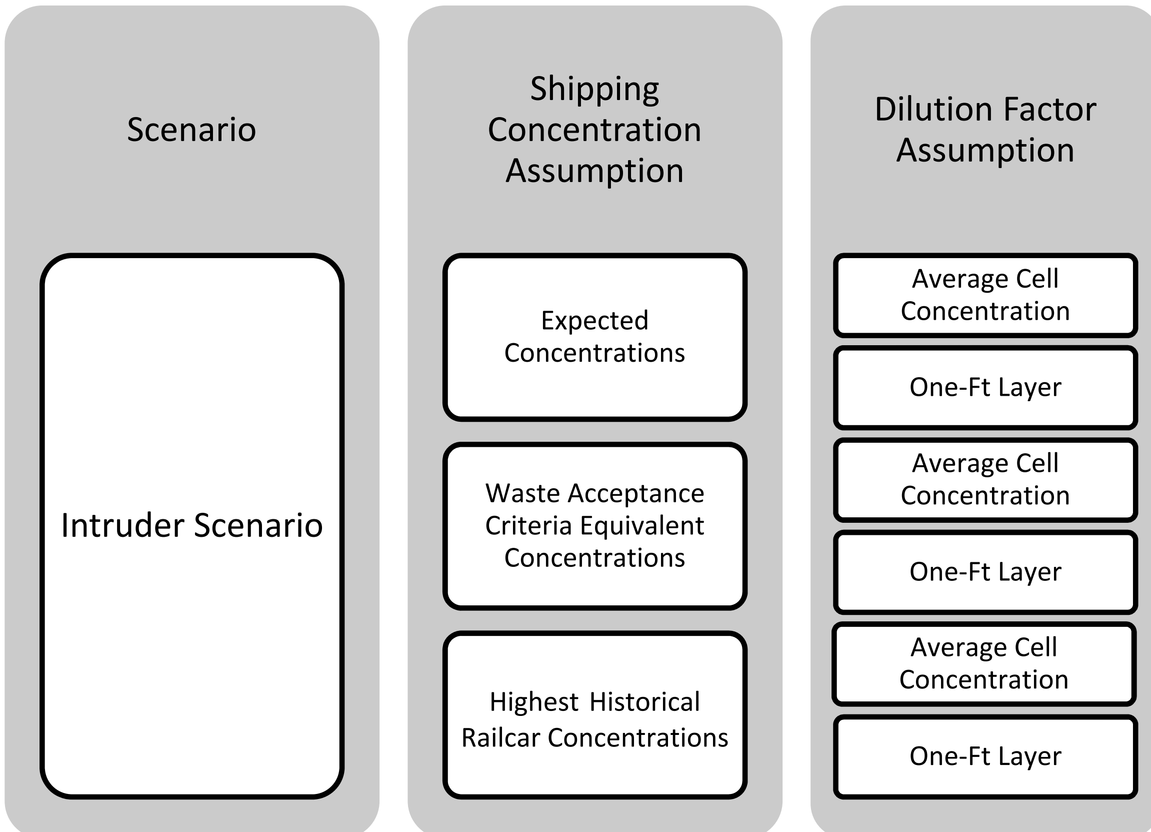


**Figure 3-1: Intruder Scenario Waste Concentration Assumptions**

WEC assumes four different shipping concentrations as summarized in Table 3-11. The Expected Concentrations, Waste Acceptance Criteria Equivalent Concentrations, and the Highest Historical Railcar Concentrations are assumed for material that is yet to be shipped. The concentrations of waste shipped through September, 5, 2014 are applied for the waste which has been shipped in certain cumulative calculations as described below. The Expected Concentrations are based on the soil concentration assumed for dose assessment in the May 21, 2009 alternate disposal request (ADAMS Accession No. ML091480071). These are also the concentrations assumed for the majority of the material in this request (see Table 3-1).

**Table 3-11. Shipping Concentrations Assumed for Intruder Dose Assessment Scenarios***

| | U-234 (pCi/g) | U-235 (pCi/g) | U-238 (pCi/g) | Tc-99 (pCi/g) | Ra-226 (pCi/g) | Th-232 (pCi/g) |
|---|---|---|---|---|---|---|
| Expected Concentrations of Waste To Be Shipped[a] | 113 | 5.5 | 18 | 27 | 1.3 | 1.2 |
| Waste Acceptance Criteria (WAC) Equivalent Concentrations | 1500 | 73 | 240 | 360 | 13 | 16 |
| Highest Historical Railcar Concentrations | 180 | 9.9 | 31 | 91 | 9.9 | 7.7 |
| Concentrations of Waste Shipped Through 9/5/2014 | 49.9 | 2.7 | 9.7 | 6.9 | 1.3 | 1.0 |

* Multiply Ci by $3.7 \times 10^{10}$ to obtain Bq

There are two sub-scenarios for the dilution when disposing of the shipped material. The Average Cell Concentration Sub-scenarios assume that the waste which is shipped is diluted by an additional factor of 0.57 due to mixing of Hematite waste with non-Hematite waste (approximately 162,500 tons to 283,518 tons). The assumed annual mass of 283,518 tons for non-Hematite waste is based on the total amount of waste disposed during calendar year 2013 in Cell 15. The One-Ft Layer Sub-scenarios assume the intruder contacts a one-ft layer of waste at its shipping concentration with no additional dilution while it is buried. Further dilution as a result of exhuming the waste is discussed for each scenario below.

### 3.3.4. Intruder Well-Driller Scenario

WEC evaluated two intruder well-driller scenarios (acute and chronic) as detailed in Tables 3-12 and 3-13.

**Table 3-12. Acute Well-Driller Intruder Scenario**

| | |
|---|---|
| *Description* | *Intruder digs a 0.28 m radius (11 inch) well by drilling through the waste disposal cell to reach the underlying aquifer at a depth of 93.1 m (305 ft). The total period of exposure is 40 hours, 8 of which occur during the drilling through the contaminated layer.* |
| Concentration of Contaminated Layer | The contaminated layer of Hematite waste for the Average Cell Sub-scenarios is 33.6 m (110 ft) thick and is equal to the shipped concentration multiplied by 0.57 (162,500 tons Hematite Waste)/(283,518 tons Total Waste). Under the One-Ft Layer Sub-scenario, it is the shipped concentration in a 0.31 m (1 ft) thick layer. |
| Additional Dilution of Contaminated Layer During Exhumation | • For the Average Cell Concentration Sub-scenarios, the concentration of the contaminated layer is multiplied by the ratio of 33.6/93.1, or 0.36, which is the ratio of the USEI Cell depth (33.6 m) to the total depth of the well (93.1 m).<br>• For the 1-ft Layer Scenarios, the concentration of the contaminated layer is multiplied by the ratio of 0.31/93.1 or $3.3x10^{-3}$, which is the ratio of a 1-ft contaminated layer (0.31 m) to the total well depth (93.1 m). |
| Dose | Dose results range from 0.2 - 3.6 mrem/yr (0.002 - 0.036 mSv/yr). The maximum value is based upon the intruder drilling through a 33.6 m deep contaminated zone of waste that was shipped at the WAC and mixed with other non-Hematite Waste. |

**Table 3-13. Chronic Well-Driller Intruder Scenario**

| | |
|---|---|
| *Description* | *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 (1,700 hours) or indoors (4,380 hours).* |
| Concentration of the Waste | The same concentrations resulting from the acute well-drilling subscenarios are applied for the Chronic Well-Driller. |
| Dose | Dose results range from 0.03 – 28 mrem/yr (0.0003 - 0.28 mSv/yr). The maximum value is based upon the acute intruder drilling through a 33.6 m deep contaminated zone of waste that was shipped at the WAC and mixed with other non-Hematite Waste. |

### 3.3.5. Intruder Construction Scenario

WEC evaluated the intruder construction scenario as detailed in Table 3-14.

**Table 3-14. Construction Intruder Scenario**

| | |
|---|---|
| *Description* | *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.* |
| Concentration of Waste to Which Intruder is Exposed | • Average Cell Concentration – Shipping concentration multiplied by 0.57, which is calculated by taking the ratio of Hematite waste to total waste received at USEI (162,500 tons Hematite Waste)/(283,518 tons Total Waste).<br>• 1-Ft Layer – Shipping concentration multiplied by a factor of 0.31 (12 in/39 in) to account for USEI's practice of layering waste into pits in 1-ft layers and an assumption that 1 meter (39 in) of waste is excavated during construction. |
| Dose | Dose results range from 1 mrem - 26 mrem/yr (0.01 mSv/yr – 0.26 mSv/yr), with the highest value assuming the intruder encounters waste that was shipped at the WAC and mixed with other non-Hematite Waste. |

## 3.4. NRC Assessment of Doses

### 3.4.1. NRC Evaluation of Transportation and USEI Worker Dose

The NRC staff finds that the scenarios selected for the transportation and USEI worker dose assessment are consistent with the manner in which the waste will be transported to and handled at USEI. Additionally, the NRC staff finds that the parameter values selected appropriately represent the job functions and the site conditions at USEI. NRC staff performed independent calculations of the internal dose and obtained similar results to those obtained by WEC. Additionally, the NRC staff reviewed the parameters used in the calculation of the external doses performed by WEC for the third §20.2002 request. Those parameters were reviewed to evaluate the appropriateness of WEC basing the external dose rates in the current request on the third §20.2002 request dose rates. For this fourth §20.2002 request, WEC chose to increase the dose from the third §20.2002 request by 30 percent to account for the 30% increase in the concentration of Ra-226. Increasing these dose rates by 30 percent in the current request to account for the increased concentration of Ra-226 is conservative and is acceptable because other radionuclides also contributed to the calculated external dose. The expected concentrations of the remaining radionuclides are the same for this request as for the third §20.2002 request (Table 3-6), so no adjustment was needed for these radionuclides. As described in Section 3.1, the material included in the current request includes buried debris and contaminated soil, as well as concrete, asphalt, and piping. However, the material included in the third §20.2002 request only included soil and soil-like material. In response to an NRC RAI on the applicability of the external dose rates calculated for soil to the other material (Attachment 1 to HEM- 14-99, ADAMS Accession No. ML15009A166), WEC stated that the external dose rates for the second §20.2002 request (A60) were for soil, piping, and asphalt and that these dose rates were less than the external dose rates in the third §20.2002 request and therefore WEC reasoned that it is conservative to assume the external dose rates associated with the third request as opposed to those associated with the second request. The NRC staff notes that for some materials the expected concentrations for materials reported in Appendix K are greater than those assumed in either the second §20.2002 request or the third request. However, the external dose rates calculated in the second and third §20.2002 requests are much lower than a few millirem and are directly correlated with concentration, so the NRC staff concludes that the dose to the workers would be less than a few millirem even at the Appendix K concentrations. Furthermore, the weighted average concentration of the Appendix K materials are less than the concentrations assumed for the external dose rate calculations. For these reasons, NRC staff concluded that it is appropriate to use the external dose rates calculated for the third §20.2002 request as the basis for the external dose rates in the current request. In the review of the third §20.2002 request, NRC staff performed independent calculations of the external doses using MicroShield and obtained similar results to those obtained by WEC.

#### 3.4.1.1. NRC Findings

Based on the evaluation described above, the NRC staff concludes that the calculation of transportation and USEI worker dose performed by WEC is acceptable and well within the 100 mrem/yr public dose limit. In addition, as seen in Table 3-9, the results of the dose assessment for the USEI workers indicate that the cumulative dose to these individuals will be within the ‘few millirem’ criteria, thus satisfying the ALARA requirement.

### 3.4.2. NRC Evaluation of Post-Closure Dose

The staff finds that approval of the July 11, 2014 request will not yield a post closure long-term dose that is more than a few mrem/yr provided the total inventory of Tc-99 remains within the limits established by the previous requests as summarized in Table 3-6. The staff finds this upper confidence limit to be acceptable because the dose resulting from the total inventory is also within a few mrem. A detailed discussion of the review of the sampling plan to maintain the quantity of Tc-99 to these contingency limits is contained in Section 4 of this SER.

Regarding cumulative post-closure doses, the staff agrees that it is acceptable in this case to treat the material cumulatively and to calculate a cumulative long term post-closure dose given that Tc-99 (through the groundwater pathway) is the primary contributor to dose. The staff finds the expected cumulative dose of 2.7 mrem (0.027 mSv) to be within the acceptable range of “a few millirem.”

The staff notes that, in documentation supporting the prior requests, WEC performed a sensitivity analysis to evaluate the impact of a shorter project duration and therefore a decrease in the volume of non-Hematite waste that is available for mixing with Hematite waste. These sensitivity analyses showed that the post-closure dose was within a few mrem under bounding conditions and that the post-closure dose was not sensitive to the amount of dilution of Hematite with non-Hematite waste.

The NRC staff performed independent calculations of the post-closure dose assuming an alternative dilution factor to those of the previous requests to verify that the post-closure dose was not sensitive to the amount of dilution of Hematite waste with non-Hematite waste. The NRC staff also performed independent calculations of prior post-closure doses assuming the actual dilution factor for the waste which has already been shipped through March 26, 2014. This corresponds to approximately 97,160 tons Hematite waste compared to 748,137 tons received at USEI in total, or a dilution factor of 0.1299. For the purposes of conservatism, the NRC staff assumed no dilution for the remaining future shipments of Hematite waste. This assessment showed that the post-closure dose is not sensitive to assumptions regarding the dilution of waste associated with this request with non-Hematite waste arriving at USEI.

#### 3.4.2.1. NRC Findings

NRC staff finds the parameter values and assumptions used in calculating the post-closure dose acceptable based on review of the USEI 2005 report and the RAI responses associated with prior requests (HEM-09-146 (ADAMS Accession No. ML100320540), HEM-10-38 (ADAMS Accession No. ML100950397), and HEM-13-101 (ADAMS Accession No. ML13226A385)). NRC staff performed independent assessments of WEC's calculations for post-closure dose and finds the post-closure doses submitted by WEC within the criteria of "a few millirem." With respect to its post-closure dose calculations, WEC is well within the 100 mrem/yr public dose limit and satisfies the ALARA requirement.

### 3.4.3. NRC Evaluation of Intruder Doses

The NRC staff considered the assumptions and pathways for the intruder scenarios to be reasonable based on comparison to the guidance in Appendix G of NUREG-0782 and NUREG/CR–4370, Volume 1 (ADAMS Accession No. ML052590354). The NRC staff considers the various shipping concentrations listed in Table 3-11 assumed for the intruder analysis to be appropriate. Although the "Expected Concentrations for Waste to be Shipped" are based on a subset of the soil data, the bounding scenarios for the intruder apply either the "WAC Equivalent Concentrations" or the "Highest Historical Railcar Concentrations," which adequately bound the concentrations listed for all types of material (i.e., licensed material contained in or mixed with soil, concrete, asphalt, and piping).

Staff considers the additional dilution factor of 0.31 acceptable for the Construction One-Ft Layer Scenario after reviewing the standard practices at USEI. Staff also considered the dilution factor of 0.57 acceptable for the Average Cell Concentration Scenario after reviewing historical data for waste volumes sent to USEI.

The staff notes the following conservatisms were presented in WEC's July 2014 submittal:

- No credit taken for the mixing of the waste with the cover material for the Construction Scenario. (USEI restricts emplacement of any radioactive waste to within 3.6 meters of the surface of the finished cap of the cell, which could rule out the construction scenario.)

- No credit taken for decay up to the intrusion event, for waste form, or solidification.

- The USEI intruder dose calculations are based on shipping 162,500 tons in one year to maximize the dose estimate. This equates to shipping 3,125 tons/week (approximately 29 railcars/week). As this rate is faster than the planned schedule of 3,006 tons/week, WEC has analyzed a bounding shipping rate (Enclosure 1 to HEM-14-74 (ADAMS Accession No. ML14293A614)).

Table 3-15 shows a summary of the intruder doses for each scenario associated with this request. The NRC staff notes that the Construction Intruder Scenario can be disregarded as infeasible in this case because of the thickness of cover material between the surface and waste once USEI closes Cell 15 and therefore, the dose estimates of 14 and 26 mrem/yr (0.14 and 0.26 mSv/yr) are not realistic.

The NRC staff notes that WEC has committed to limiting the cumulative mean concentration of radium, thorium and uranium isotopes to be below the Highest Historical Railcar Concentrations (Table 3-6, and Table 3-11). The doses associated with this control measure were submitted with the December 19, 2014 submittal (ADAMS Accession No. ML15009A166) and are listed in Table 3-15. By controlling the cumulative mean concentration of radium, thorium and uranium isotopes, the set of assumptions leading to the dose of 28 mrem/yr (0.28 mSv/yr) for the acute driller, or the 26 mrem/yr (0.26 mSv/yr) for the chronic driller are no longer feasible. That particular scenario assumes every railcar would be at the WAC limit. WEC explained that its intention in using that assumption originally was to yield doses that are bounding, but given the new limitations, they are now unrealistic. Note that the cumulative mean concentration of Tc-99 is already limited through prior commitments, and Tc-99 is not a significant radionuclide for the intruder scenarios. Uranium, through the air and direct gamma pathways, is the main contributor to dose for the intruder scenarios. After the infeasible or unrealistic scenarios are eliminated, the maximum intruder dose for this request is 3.9 mrem/yr associated with the Chronic Well Driller. The staff finds the dose to be within the acceptable range of 'a few millirem.'

**Table 3-15: Summary of Intruder Doses**

| Intruder Scenario | Concentration Shipped | Dilution Conditions | July 2014 Request (mrem/yr) [a] |
|---|---|---|---|
| Acute Well Driller | Expected Average | Average Cell | 0.3 |
| Acute Well Driller | Expected Average | 1 Ft Layer | 0.2 |
| Acute Well Driller | WAC | Average Cell | 3.6 [b] |
| Acute Well Driller | WAC | 1 Ft Layer | 2.6 |
| Chronic Well Driller | Expected Average | Average Cell | 2.1 |
| Chronic Well Driller | Expected Average | 1 Ft Layer | 0.03 |
| Chronic Well Driller | WAC | Average Cell | 28 [b] |
| Chronic Well Driller | WAC | 1 Ft Layer | 0.45 |
| Construction | Expected Average | Average Cell | 2.0 [c] |
| Construction | Expected Average | 1 Ft Layer | 1.0 [c] |
| Construction | WAC | Average Cell | 26 [b,c] |
| Construction | WAC | 1 Ft Layer | 14 [c] |
| Acute Well Driller | Highest Railcar | Average Cell | 0.6 |
| Acute Well Driller | Highest Railcar | 1 Ft Layer | 0.4 |
| Chronic Well Driller | Highest Railcar | Average Cell | 3.9 |
| Chronic Well Driller | Highest Railcar | 1 Ft Layer | 0.06 |
| Construction | Highest Railcar | Average Cell | 3.6 [c] |
| Construction | Highest Railcar | 1 Ft Layer | 1.9 [c] |

[a] multiply by 0.01 to convert mrem/yr to mSv/yr
[b] These scenarios are ruled out as infeasible due to the newly imposed limitation on cumulative average concentration.
[c] The Construction Intruder scenario can be ruled out as infeasible given that USEI restricts emplacement of any radioactive waste to within 3.6 meters of the surface of the finished cap of the cell.

Table 3-16 shows the cumulative intruder doses for the bounding assumptions, which is the Acute Well Driller for the first three requests and the Chronic Well Driller for the July 2014 request. The cumulative dose is assumed to be the sum of the doses estimated for the prior and current requests. Given the new limits WEC will impose on the cumulative average concentration for uranium, radium and thorium radionuclides, WEC recalculated the Chronic Well Driller intruder dose for the prior requests in the December 19, 2014 response to RAIs (ADAMS Accession no. ML15009A166). The assumptions were kept the same except that the ratios of Hematite waste to total waste were revised to reflect actual disposal amounts.

The NRC staff notes that assuming an arithmetic sum for the cumulative intruder dose is not the most realistic way to conceptualize the cumulative dose scenario. For the Acute Well-Driller doses associated with the One-ft Layer Sub-scenario, this cumulative dose assumes the intruder encounters a separate one-ft layer of the waste at the WAC from all four requests while drilling the same well. The NRC staff notes that the Highest Historical Railcar Concentrations for waste shipped through March 26, 2014 (see Table 3-6) are lower than the WAC values. Therefore, an intruder encountering multiple 1-ft layers at the WAC from waste already shipped is impractical (only waste that has not yet been shipped could potentially be shipped at the WAC). For the Chronic Well-Driller, the bounding doses are associated with the Average Cell sub-scenario. The cumulative dose for the Chronic Well Driller assumes the intruder encounters cuttings from three separate wells in the same year, each formed from a 33.6 m contaminated layer that existed at the cumulative mean concentration limit.

**Table 3-16: Cumulative Bounding Estimated Intruder Doses**

| | May 2009 Request | Jan 2012 Request | May 2013 Request | July 2014 Request | Cumulative Bounding Dose |
|---|---|---|---|---|---|
| Acute Well Driller[1] | 2.9 | 2.9 | 2.9 | 2.6 | 11.3 |
| Chronic Well Driller[2] | 0.9 | 1 | 1 | 3.9 | 6.8 |

[1] The Acute Well Driller bounding doses are associated with the WAC concentrations buried in a 1-ft layer.[2] The Chronic Well Driller bounding doses are associated with the cumulative average concentration limits (highest historical railcar) with Average Cell dilution assumptions.

As an alternative to simply using the arithmetic sum as a dose estimate for the cumulative intruder doses, the NRC staff requested that WEC provide a more realistic cumulative dose estimate. In response to the request for additional information dated December 19, 2014, WEC provided an additional estimate on the cumulative bounding dose for the Chronic Intruder after Well Drilling (ADAMS Accession no. ML15009A166). This analysis was more realistic than prior analyses in that it accounted for the following: the actual amount of disposed HDP waste; the actual average radionuclide concentration shipped through September 5, 2014; the actual amount of non-HDP waste disposed of through the same time frame; and the volume and potential radionuclide concentrations in the remaining HDP waste for future disposal. WEC assumes that the layer of HDP waste is 33.6 m. In one variation of the analysis WEC takes no credit for dilution with non-HDP waste for past or future shipments. The analysis resulted in a cumulative intruder dose of 5 mrem/yr (0.05 mSv/yr) for the Chronic Well Driller.

#### 3.4.3.1. NRC Findings

The NRC staff finds the assumptions and pathways considered for the intruder scenarios to be reasonable based on comparison to the guidance in Appendix G of NUREG-0782 and NUREG/CR–4370, Volume 1. The staff notes that as USEI restricts the emplacement of any radioactive waste to within 3.6 meters of the surface of the finished cap of the cell, the construction scenario could be disregarded. The NRC staff finds the concentration assumptions for the highest historical railcar scenarios to be appropriate considering that WEC plans to control the cumulative mean concentration to be below the highest historical railcar concentration for uranium, thorium and radium isotopes. The NRC staff finds the cumulative intruder doses acceptable as they are well within the 100 mrem/yr public dose limit and satisfy the ALARA requirement.

### 3.5. Stability of the Disposal Facility Following Closure

#### 3.5.1. Westinghouse Assessment

Site-stability can be impacted by natural surface and subsurface processes, and is also impacted by the stability of the waste and engineered barriers of the disposal facility. In WEC's March 31, 2010, submittal associated with the May 2009 alternative disposal request, WEC provided a technical basis for the stability of the USEI site stating that the facility was "constructed in compliance with the RCRA standards and the applicable Minimum Technology Requirements (MTRs). These requirements provide conservative criteria for cell construction to insure long-term stability and are consistent with the erosion design requirements in 10 CFR Part 61, and the joint NRC/EPA guidance document with guidelines on drainage and processes impacting stability."

#### 3.5.2. NRC Evaluation and Findings

The NRC has noted that site-stability can be impacted by natural surface and subsurface processes and by the stability of the waste and engineered barriers of the disposal facility. The NRC staff has evaluated WEC's technical basis for the stability of the USEI site. The NRC staff has concluded that construction of the USEI facility to RCRA standards and to the applicable MTRs are sufficient to provide long-term stability and to be consistent with the erosion design requirements in 10 CFR Part 61 as well as Guidelines 5 and 8(2) of the March 13, 1987 the U.S. NRC and U.S EPA published "Joint NRC-EPA Siting Guidelines for Disposal of Commercial Mixed Low-Level Radioactive and Hazardous Wastes." NRC/EPA guidance document addresses drainage and processes impacting stability.

## 4. HEALTH PHYSICS ASSESSMENT

### 4.1. Soil/Debris Characterization and Sampling Plans

With regard to soil/debris, WEC indicated in Section 6.3 of HDP-TBD-WM-911, Revision 0 (ADAMS Accession No. ML14193A008), that detailed characterization data, accompanying analyses, and the characterization plan for soil/debris waste are contained in references related to Amendment 58. WEC also indicated that “this characterization information continues to apply to the soil/debris waste subject to this request, and is augmented by the characterization of waste shipped through March 26, 2014, described in Table 4 and Appendix D [of HDP-TBD-WM-911].” In order to demonstrate that previously approved characterization and sampling plans remain applicable, NRC staff requested from WEC additional information on the characterization of soils related to this current alternate disposal request. WEC provided additional details on the characterization data in Appendix K to Revision 2 of HDP-TBD-WM-911 (ADAMS Accession No. ML15009A166). A summary of these characterization results is provided in Section 3.1.1 of this SER. NRC staff determined that previous soil characterization results (as described in Revision 2 of HDP-TBD-WM-911) are adequate to represent soil and debris related to the current disposal request. The staff also determined that the characterization data sufficiently bound areas that are new to the current disposal request. The only exception was the WTS sediment, filter media, and resin which are no longer designated as potential disposal material at USEI.

The previously approved soil sampling plan, that WEC has committed to follow, was provided in HEM-11-16 (ADAMS Accession No. ML110530155). This sampling plan was transmitted to the NRC in WEC’s February 18, 2011, submittal and was previously approved by the NRC with the issuance of Amendment 58 to the Hematite license (ADAMS Accession No. ML112560105). Sampling protocols, detection capabilities, and activity limits for U-234, U-235, U-238, Th-232, Ra-226, and Tc-99 were provided by WEC in the aforementioned technical basis document and remain the same for the current request, with the exception of the Tc-99 limits. The overall limits on the quantity of Tc-99 shipped to USEI will be consistent with those approved for Amendment 60, which are 1.3 Ci total, or a 95% UCL of the mean of 2.05 Ci.

#### 4.1.1. NRC Findings Related to Soil and Debris

WEC’s sampling plans for additional soil and debris represent acceptable sampling protocols and frequencies to adequately characterize materials prior to shipment to USEI. Additionally, sampling contingencies, as discussed in Section 4.3 of this SER, will be in effect to ensure that disposal limits are not exceeded.

### 4.2. Concrete, Asphalt, and Piping Characterization and Sampling Plans

With regard to concrete, asphalt, and piping, WEC indicated in Section 6.3 of HDP-TBD-WM-911, Revision 0 (ADAMS Accession No. ML14193A008), that detailed characterization data, accompanying analyses, and characterization plans are contained in references related to Amendment 60. WEC also indicated that “this characterization information continues to apply to the concrete, asphalt and piping waste subject to this request, and is augmented by the characterization of waste shipped through March 26, 2014, described in Table 4 and Appendix D [of HDP-TBD-WM-911].” In order to demonstrate that previously approved characterization and sampling plans remain applicable, NRC staff requested of WEC additional information on the characterization of concrete, asphalt, and piping related to this current alternate disposal request. WEC provided additional details in Appendix K to Revision 2 of HDP-TBD-WM-911 (ADAMS Accession No. ML15009A166). A summary of these characterization results is provided in Section 3.1.1 of this SER. NRC staff determined that previous concrete/asphalt characterization results (as described in Revision 2 of HDP-TBD-WM-911) are adequate to represent concrete/asphalt related to the current disposal request and sufficiently bound areas that are new to the current disposal request. Additionally, NRC staff determined that previous piping characterization results (as described in Revision 2 of HDP-TBD-WM-911) are adequate to represent piping related to the current disposal request and sufficiently bound areas that are new to the current disposal request.

#### 4.2.1. Sampling Plans for Concrete and Asphalt

The previously approved “Sampling Plan for Concrete and Asphalt” was provided as Enclosure 3 in the July 24, 2012 final responses to the NRC’s RAIs related to Amendment 60 (ADAMS Accession Nos. ML12209A201 and ML12293A029). A sampling approach was developed using the Visual Sampling Plan software to determine the confidence interval on a mean specific to the Hematite decommissioning project. The half-width of the confidence interval was set to half of the mean Tc-99 concentration outside the five elevated areas identified in HDP-TBD-WM-906, Revision 1 (ADAMS Accession Nos. ML12209A201 and ML12293A029), and the standard deviation of the same data set was used. The resultant sampling frequency was 20 samples per sampling area. Because of its small footprint, a sampling frequency of six samples was approved for Building 235 as a part of Amendment 60. Two small areas associated with the current submittal, Building 115 and the SWTP shed, were considered to be equivalent or smaller than Building 235, and will be sampled at the same frequency, six samples. WEC has committed to taking concrete samples on a systematic grid, at depths of 0.75 inches and 1.5 inches. Samples from the 0.75 to 1.5 inch depth will be used to assess the contamination within the remaining thickness of the concrete slab since existing characterization data indicate that radioactivity of concern is located in the upper 0.75 inch layer of concrete. Asphalt will be sampled at a rate of 20 samples per area as was previously described in Enclosure 3 of the July 24, 2012, WEC RAI response (ADAMS Accession Nos. ML12209A201 and ML12293A029). A 100% beta contamination scan will be performed on the accessible designated asphalt sampling areas, and core samples will be biased toward elevated beta areas followed by random samples within each area in order to meet the 20 sample per area frequency. For both concrete and asphalt, uranium will be measured via gamma spectroscopy, and Tc-99 will be measured via laboratory analysis.

### 4.2.2. NRC Findings Related to Concrete and Asphalt

NRC staff concludes that WEC's sampling plans for additional concrete and asphalt represent acceptable sampling protocols and frequencies to adequately characterize materials prior to shipment to USEI. Additionally, sampling contingencies, as discussed in Section 4.3 of this SER, will be in effect to ensure that disposal limits are not exceeded.

### 4.2.3. Sampling Plans for Piping

WEC has committed to using sampling methodologies for piping as previously described in Enclosure 4 to HEM-12-88, Sampling Plan for Piping Destined for USEI (ADAMS Accession No. ML12209A200). This approach utilizes a sampling frequency of at least one sample per 7.1 $m^3$ of piping. Since prior sampling did not indicate a relationship between Tc-99 and uranium in piping, WEC will utilize random sampling for piping that is eligible for disposal at USEI, except for piping that is segregated for criticality safety evaluation at a Material Assay Area/Waste Evaluating Area. In the case of piping that is segregated for criticality safety evaluation, one sample consisting of 4 aliquots will be taken from each batch of segregated material. These samples will be biased since they represent a smaller batch which has been removed from a larger randomly sampled population. As noted in Enclosure 4 to HEM-12-88 (Sampling Plan for Piping Destined for USEI), this represents one sample for each container that was segregated for criticality safety analysis, which will still maintain a sampling frequency of at least one sample per 7.1 $m^3$ of material. WEC intends to quantify uranium and gamma emitting radionuclides using High Resolution Gamma Spectroscopy (HRGS), and Tc-99 concentrations will be determined through laboratory sampling.

### 4.2.4. NRC Findings Related to Piping

WEC used previous Amendment 60 characterization results for "outside" piping to characterize the piping approved for disposal via this SER, with the exception of piping remaining underneath the haul road crossing the Process Building slabs, which utilized previous characterization data associated with Building 255 piping. Characterization of the outside piping related to Amendment 60 was described by four sample results in Appendix G of Revision 1 to HDP-TBD-WM-906, (ADAMS Accession Nos. ML12209A201 and ML12293A029). NRC staff notes that four sample results is a small population to use for characterization purposes, and as previously discussed in Section 3.2 of this SER, NRC staff does not agree with WEC's methodology to determine the concentrations associated with piping. However, for the purpose of additional sampling of piping prior to disposal, NRC staff recognizes the previously approved sampling plan for piping was based on results from Process Building areas where higher levels of radiological contamination would be expected. As such, NRC staff concludes that the sampling frequency of at least one sample per 7.1 $m^3$ of piping remains adequate to represent piping associated with the current alternate disposal request. Additionally, sampling contingencies, as discussed in Section 4.3 of this SER, will be in effect to ensure that disposal limits are not exceeded.

## 4.3. Quality Assurance and Contingency Plans

### 4.3.1. WEC Quality Assurance and Contingency Plans

WEC developed several quality assurance and contingency plans in order to assess the additional soil, piping, concrete, and asphalt sampling results associated with Amendments 58 and 60. Sampling data quality objectives applicable to the disposal of soil, concrete/asphalt, and piping were also previously provided as Appendix P in Revision 1 to HDP-TBD-WM-906, (ADAMS Accession Nos. ML12209A201 and ML12293A029). These data quality objectives, quality assurance plans, and contingency plans remain in effect for this alternate disposal request.

Associated with the May 2009, 10 CFR 20.2002 alternate disposal request, WEC provided a detailed quality assurance plan for soils. This plan was described in the “Technical Basis for Characterization of Decommissioning Soils Waste That is Subject to the Alternate Disposal Request for US Ecology Idaho, Inc” (ADAMS Accession No. ML110530155). This plan was approved as part of the staff’s review and approval associated with Hematite Amendment 58. It was noted in the plan that WEC will implement field duplicate samples, field blanks, and laboratory control samples throughout the excavation process. WEC will collect field duplicates at a frequency of 1 per 20 samples and the results will be evaluated to determine the relative difference or relative percent difference between two data sets. WEC will utilize guidance from the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) to compare results to pre-determined warning and control limits. Field blanks will be collected at a frequency of 1 per 100 samples, and these results will be used to evaluate bias. Laboratory control samples, matrix spikes (if applicable), and replicate counts will be performed at a frequency of 1 per 20 samples in order to assess overall laboratory performance.

Appendix K of Revision 1 of HDP-TBD-WM-906 (ADAMS Accession Nos. ML12209A201 and ML12293A029) describes post-sampling data analyses for concrete and asphalt to verify that a sufficient number of samples were collected to meet the data quality objectives. WEC will review the data from each sampling area to determine if it is normally distributed and that the population values are not spatially or temporally correlated. Additionally, results will be compared to the action levels provided in Table 3 of HDP-TBD-WM-911, Revision 2 (ADAMS Accession No. ML15009A166) and reiterated in Table 4-1 of this SER.

Appendix O of Revision 1 of HDP-TBD-WM-906 (ADAMS Accession Nos. ML12209A201 and ML12293A029) describes post-sampling data analyses for piping, appropriate for the statistical analysis strategy WEC used for piping (True Average vs. Fixed Threshold), to verify that a sufficient number of samples were collected to meet the data quality objectives. These analyses include an assessment that the computed sign test statistic is normally distributed, that the variance estimate is reasonable and representative of the population being sampled, and that the population values are not spatially or temporally correlated. Additionally, results will be compared to the action levels provided in Table 3 of HDP-TBD-WM-911, Revision 2 (ADAMS Accession No. ML15009A166) and reiterated in Table 4-1 below.

**Table 4-1: Pre-Shipment Contingency Plans Proposed by WEC**

| 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;<br>• Resample stockpile and re-evaluate;<br>• 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;<br>• Resample stockpile and re-evaluate;<br>• Ship material to alternate facility. |
| Total activity contribution from all radionuclides within individual railcar | >3000 pCi/g<br>> 40 μR/hr | Laboratory sample results for stockpile evaluated at 95% UCL prior to shipment<br><br>Gamma radiation levels on railcars prior to shipment | • Analyze additional aliquot of composite sample;<br>• Unload railcar (at HDP) and re-load with material containing lower concentration (either blended or alternate material from onsite waste stream);<br>• Ship material to alternate facility. |
| Unexpected Tc-99 results for stockpile samples (soil and dewatered sanitary sludge) | >99th percentile of the site wide dataset<br><br>(573 pCi/g) | Laboratory sample results for stockpile evaluated prior to shipment | • Analyze additional aliquot of composite sample;<br>• Resample stockpile and re-evaluate;<br>• Blend with less contaminated material, resample stockpile and re-evaluate;<br>• Ship material to alternate facility. |
| Unexpected Tc-99 results for concrete slab samples | >99th percentile of the site wide dataset<br><br>(1590 pCi/g) | Laboratory sample results for stockpile evaluated prior to shipment | • Analyze additional aliquot of composite sample;<br>• Resample stockpile and re-evaluate;<br>• Blend with less contaminated material, resample stockpile and re-evaluate;<br>• Ship material to alternate facility. |

| Parameter | Action Level | How Monitored | Actions |
|---|---|---|---|
| Unexpected Tc-99 results for stockpile samples (piping internal debris / residue) | >99$^{th}$ percentile of the dataset<br><br>(162 pCi/g) | Laboratory sample results for stockpile evaluated prior to shipment | • Analyze additional aliquot of composite sample;<br>• Resample stockpile and re-evaluate;<br>• Blend with less contaminated material, resample stockpile and re-evaluate;<br>• Ship material to alternate facility. |
| Unexpected Tc-99 results for stockpile samples (piping average concentration) | >99$^{th}$ percentile of the dataset<br><br>(125 pCi/g) | Laboratory sample results for stockpile evaluated prior to shipment | • Analyze additional aliquot of composite sample;<br>• Resample stockpile and re-evaluate;<br>• Blend with less contaminated material, resample stockpile and re-evaluate;<br>• Ship material to alternate facility. |
| Maximum average concentration of Ra-226 and Th-232 within individual railcar | Ra-226<br>>13 pCi/g<br><br>Th-232<br>>16 pCi/g | Laboratory sample results for each railcar evaluated prior to shipment | • Analyze additional aliquot of composite sample;<br>• Resample stockpile and re-evaluate;<br>• Blend with less contaminated material, resample stockpile and re-evaluate;<br>• Ship material to alternate facility. |
| Cumulative mean concentration of U-234, U-235, U-238, Th-232, and Ra-226 shipped to USEI | U-234>180 pCi/g<br>U-235>9.9 pCi/g<br>U-238>31 pCi/g<br>Th-232>9.9 pCi/g<br>Ra-226>7.7 pCi/g | Cumulative mean concentration (both shipped and pending shipment), based on laboratory sample results prior to shipment | • Ship material to alternate facility. |

4.3.2. NRC Assessment of WEC Quality Assurance and Contingency Plans

The NRC staff has reviewed WEC's quality assurance/quality control programs, data quality objectives, and contingency plans. The NRC staff has found them acceptable, and their implementation should permit WEC to demonstrate that the NRC's alternate disposal dose requirement (of not more than "a few millirem per year" to any member of the public) can be met, thus satisfying both the 100 mrem/yr public dose limit and the ALARA requirement.

## 5. NUCLEAR CRITICALITY SAFETY

This section of the SER addresses those nuclear criticality safety (NCS) aspects of WEC's 10 CFR 20.2002 alternate disposal request dated July 11, 2014, which had not been addressed in previous requests. The first 10 CFR 20.2002 submittal, dated May 21, 2009, and the second 10 CFR 20.2002 submittal, dated January 16, 2012, covered the excavation of waste material from burial pits, and disposal at USEI of burial waste and contaminated soil, concrete/asphalt, subterranean piping and sewage/septic treatment equipment, and various demolition debris and equipment. WEC's third 10 CFR 20.2002 request, dated May 28, 2013, covered the disposal of sanitary sludge and the removal of Volatile Organic Compounds (VOCs) and/or hazardous chemicals from radioactive soil at the USEI facility. This fourth request (July 11, 2014) was also necessary because the volume of waste to be shipped was underestimated in the previous two requests, due to WEC encountering more material during excavation than had been anticipated.

The NRC staff's SER for Amendment No. 63 was premised upon the shipment of material to USEI being limited, for the radioisotope U-235, to an average concentration to 0.1 g U-235/l. The Amendment No. 63 SER indicated that material with no more than 15 g U-235 within an enclosed volume of 5 liters may be aggregated with other waste as long as the average concentration does not exceed 0.1 g U-235/l. Material shipped to USEI that meets these criteria will not require any additional NCS controls, because the material will simply be received and buried. Material received at USEI consignments may be subject to one of four stabilization methods, (chemical, chemical fixation (oxidation/reduction), macro-encapsulation, and micro-encapsulation). These methods have an end goal which is to reduce or immobilize contaminants and reduce the solubility and migration potential of contaminants associated with the waste. Amendment No. 63 noted that these methods stabilize the waste but do not concentrate contaminants, including fissile contaminants (here U-235). The Amendment No. 63, SER concluded that no credible mechanisms exist for concentrating the waste sufficiently to constitute an NCS concern.

WEC submitted its fourth 20.2002 request, dated July 11, 2014, to increase the amount of waste material authorized for disposal in its previous 20.2002 requests, and supplemented this request in a letters dated September 25, 2014, December 19, 2014 and February 18, 2015. This fourth request stated that the types of waste to be disposed of at USEI were the same as those in the previous submittals, but that the quantity of these waste materials had exceeded what was anticipated. However, the staff determined that several types of waste not previously authorized for disposal were described in the submittal. The staff therefore issued a Request for Additional Information, dated October 29, 2014, to which the licensee responded on December 19, 2019. WEC subsequently, in an April 21, 2015 letter, indicated that they no longer wanted the NRC to consider material from the WTS nor its components as material under consideration for disposal at USEI.

## 5.1 WEC Criticality Assessment of Additional Waste Materials

WEC's justification for the disposal of the new waste materials was contained in HDP-TBD-WM-911, "Safety Assessment for Increasing the Volume of Hematite Project Waste Authorized for Transfer to USEI," Rev. 2, dated December 19, 2014 (ADAMS Accession No. ML15009A166). Section 9.0 of this document, "Nuclear Criticality Safety," states that the request is based, in part, on nuclear criticality safety assessment NSA-TR-HDP-11-11, "Nuclear Criticality Safety Assessment of the US Ecology Idaho (USEI) Site for the Land Fill Disposal of Decommissioning Waste from the Hematite Site," Rev. 0, dated December 2011 (starting at page 45 of ADAMS Accession No. ML12017A190). Based on this assessment, waste having an average fissile nuclide concentration of up to 0.1 g $^{235}$U/l is considered safe for disposal at the USEI site. This determination referenced two results from NUREG/CR-6505, Vol. 1, "The Potential for Criticality Following Disposal of Uranium at Low-Level Waste Facilities: Uranium Blended with Soil," dated January 1997: (1) a minimum critical "infinite sea" concentration of 1.4 g $^{235}$U/l for an infinite, homogeneous uranium-soil medium (modeled as a $^{235}$U-$SiO_2$ mixture), and (2) a maximum credible concentration factor of 10 resulting from uranium migration, based on hydrogeochemical modeling. The average concentration will be determined on a per railcar basis, and each railcar will be limited to no more than 700 g $^{235}$U. Furthermore, USEI will only process a single railcar in a treatment bin at a time.

## 5.2 NRC Staff's Criticality Assessment of Additional Waste Materials

WEC's nuclear criticality safety assessment, NSA-TR-HDP-11-11, was the same as that used to justify previous 10 CFR 20.2002 requests. In RAI responses, WEC stated that the same limits would apply to the additional waste streams as for the previous 10 CFR 20.2002 requests, which are described in Section 9.0 of WEC's criticality assessment and summarized in this Section 5 of this SER. In addition, WEC stated that the same chemical treatment methods will be used for the new waste as for existing waste streams. These methods are described in Section 4.2 of the criticality assessment, and this section has been clarified to state that WEC will assay Water Treatment System (WTS) sediment, filter media, and ion exchange resin before they are combined with other material for disposal.

To support the determination that the new waste streams are bounded by the existing criticality analysis, WEC added radionuclide characterization data to Appendix K of HDP-TBD-WM-911, Revision 2. For each waste stream, App. K contains the expected total waste volume, mass, and inventory of several radionuclides, including $^{235}$U and $^{238}$U. From this information, the NRC staff was able to determine the average density, radionuclide concentration, and enrichment. The NRC staff then compared the information from each waste stream and its associated radionuclides to the bounding materials modeled in the criticality safety assessment and the characteristics of several existing waste forms approved in previous 10 CFR 20.2002 requests. In making such a comparison, two effects must be considered: (1) the impact on the infinite system reactivity, $k_\infty$, and (2) the impact on waste characterization, particularly the ability to perform nondestructive assay (NDA).

The staff determined that, based on the information in App. K, the average density of the WTS sediment, filter media, and ion exchange resin was approximately 1.54 $g/cm^3$. The existing soil-like materials are close to the bounding density used in the criticality assessment (1.69 $g/cm^3$). In a finite system, higher density is generally more reactive since it leads to reduced neutron leakage. The new waste types would therefore, if evaluated in a finite geometry, have added safety margin over the existing waste types. However, in an infinite system such as that used to derive the minimum critical infinite concentration, the overall density has little impact. A lower density will however generally facilitate the ease and accuracy of NDA measurements due to reduced self-shielding, which can cause the amount of fissile material to be underestimated. Besides being somewhat lower than that of the existing soil-like materials, the density of the new waste forms is significantly lower than that of existing waste streams involving concrete (which has an average density of around 2.4 $g/cm^3$).

The NRC staff determined that, based on App. K, the average enrichment of the WTS sediment, filter media, and ion exchange resin was approximately 2.9 wt% $^{235}U$, whereas that of other soil-like materials is about 4 wt% $^{235}U$, and that of several other waste types up to about 4.7 wt% $^{235}U$. While enrichment may vary locally (as may density), the average enrichment—found by dividing the total mass of $^{235}U$ by the total mass of uranium in this type of waste—is substantially lower than that of other waste streams, meaning that in general there is additional safety margin over these existing waste streams. There is already considerable safety margin in the analysis for existing soil-like waste, because NUREG/CR-6505 conservatively assumed all the uranium is $^{235}U$ (or 100 wt% enrichment).

The NRC staff determined that, based on App. K, the fissile radionuclide concentration—found by dividing the total $^{235}U$ mass (as it is the only fissile nuclide present) by the total mass of waste—is higher than that of other soil-like materials. While this would tend to increase reactivity, it also would facilitate the ease and accuracy of NDA measurements. While higher than that of the existing soil-like materials, the fissile nuclide concentration is comparable to that of other waste streams listed in App. K, and there is sufficient conservatism in other modeling assumptions to provide for adequate safety margin.

Forms of waste newly added to App. K consist of concrete, piping, tanks, and associated other process equipment (filters, pumps, valves, meters, etc.), which from their description are all similar in terms of physical and chemical form and fissile content to the existing waste types. The staff also looked at the inventory of other, non-fissile radionuclides in the waste ($^{234}U$, $^{99}Tc$, $^{226}Ra$, and $^{232}Th$), and determined they would not prevent the licensee from being capable of accurately measuring the uranium content to ensure compliance with the criticality safety limits (e.g., by discriminating the 185 keV gamma peak from $^{235}U$).

WEC also submitted the document NSA-TR-10-14, Rev. 1, "Calibration Analysis for Measuring $^{235}U$ in the Water Treatment System at the Hematite Facility," dated May 2011 (ADAMS Accession No. ML15063A035. This analysis determined count rates corresponding to uranium at the concentration limit of 0.1 g $^{235}U$/l in various matrix media, including dry and saturated soil, saturated GAC, and saturated ion exchange resin, and in various geometries. Count rates were also determined for 350 g $^{235}U$ standards embedded in the same matrix media. The count rates, or "calibration results," were calculated using the MCNP-5 Monte Carlo transport code. This analysis gives assurance that the new waste materials can be adequately characterized by the existing NDA methods, and that these methods are capable of ensuring compliance with the applicable NCS limits.

Based on the above review, the NRC staff has determined that the new waste materials are bounded by the existing and approved waste forms, primarily due to their lower average enrichment and presence of neutron absorbing impurities accompanying the fissile material, and resulting in a larger safety margin. The NRC staff has also determined that the lower density and higher fissile concentration of the new waste materials will facilitate the performance of NDA, for ensuring compliance with the criticality safety limits. It should be noted that in Westinghouse Response No. 12 of Attachment 1 of their February 18, 2015 submittal they indicated that GAC was not a candidate for disposal at USEI. As noted above, WEC also indicated that they no longer wanted the NRC to consider material from the Water Treatment System (WTS) nor its components as material under consideration for disposal at USEI.

## 5.3 NRC Staff Findings

The staff therefore has reasonable assurance that the waste forms are adequately bounded by the existing criticality safety assessment, with an acceptable margin of safety, and that controls established for the previous 10 CFR 20.2002 requests, both at the Hematite site and upon receipt and disposal at USEI, are adequate. The staff further has reasonable assurance that WEC's methods for characterizing waste are capable of ensuring compliance with the aforementioned criticality safety limits.

# 6. PHYSICAL SECURITY

## 6.1. Assessment

This section of the SER addresses the physical security aspects of WEC's July 11, 2014 request. As noted previously, this material is nearly identical to the material proposed and approved in Hematite Amendment Nos. 58 and 60.

From Appendix K of Westinghouse's December 19, 2014 submittal, WEC estimated a total curie content of 0.9 Ci of U-235 in total would be shipped to USEI for disposal. This curie amount equates to approximately 416 kg of U-235.

The physical security issues associated with Amendment 58 remain relevant, with regard to: (1) rail shipment of waste that may contain SNM of average enrichment less than 10% U-235 to USEI; (2) transferring such SNM from the gondola cars to trucks for transport to the USEI burial cell; and (3) disposal of the SNM in the burial cells. From a physical security standpoint, any assessment needs to consider 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 disposal.

In License Amendment 58, the average concentration of U-235 estimated to be shipped to USEI was 5.5 pCi/g. For the July 11, 2014 request, the average expected U-235 concentration is expected to be the same as the concentration in Amendment No. 58. The volume of waste associated with the disposal in Amendment 58 and this 10 CFR 20.2002 request is approximately four times greater, about 87,000 $m^3$.

While some of the SNM going to USEI will be HEU, WEC will not be shipping to USEI any HEU that is in a discrete form. Rather, the HEU will be dispersed throughout the waste material being shipped.

In terms of the attractiveness of the SNM for malicious use and its form, the SER for Hematite Amendment No. 58 bounds the analysis here. In neither case is the SNM in a useful form, because it is mixed with dirt. Thus, the timely and efficient removal of the SNM by an adversary for unauthorized purposes is improbable. The combination of the existing physical security at the USEI site and the effort to identify SNM under such conditions would effectively prevent any opportunities for extracting SNM from its disposal cell.

## 6.2. NRC Findings

The NRC staff finds that, from a physical security perspective, the physical security section (Chapter 7) of the SER associated with Hematite Amendment No. 58 presents a bounding analysis for the July 11, 2014, request. The elements of that conclusion are presented below as well as the relationship of the present request to the request associated with Amendment 58.

The NRC staff has reviewed the physical security aspects of the July 11, 2014, request. The staff has concluded that there are no physical security concerns associated with the disposal of the Hematite material at the USEI facility. The average U-235 activity levels are low. While SNM will be disposed at USEI, WEC has committed to removing discrete forms of HEU. The SNM will be dispersed throughout the waste material, thereby not lending itself for efficient and timely removal for unauthorized purposes.

## 7. POTENTIAL FOR RECONCENTRATON

### 7.1. Assessment

The NRC staff assessed the potential for reconcentration of U-235 in the leachate system at the USEI facility given the half-lives of the SNM and the impact of leachate control system.

In 2008, USEI's permit was modified by the Idaho Department of Environmental Quality (IDEQ) to authorize receipt of specified quantities of SNM, provided that the SNM was made exempt from NRC regulations and licensing requirements. The potential for the generation of leachate is minimized by the site's acceptance requirement that any incoming waste contain no free liquids. Further reducing the potential for leachate generation is the site's location in a desert environment that averages approximately 7.3 inches of precipitation per year with an evaporation rate of approximately 42 inches per year.

The potential to generate leachate is further reduced by the USEI facility's design to completely encapsulate the waste in a low permeability (1 x 10-7 cm/sec) cover system. Requirements for the construction of a waste cell include a base layer of compacted clay three-feet thick overlain by a composite liner with a sump to collect any leachate that might be generated. The composite liner is overlain by a 30-inch soil layer as a protection barrier for the liner. Waste placed in the cell is compacted to minimize the potential for future subsidence and when the cell is full, it is overlain by a low permeability, multi-layer cap that is 11.8 feet thick, including nine feet of non-radiological material.

### 7.1. NRC Findings

As a result of design features such as a low permeability cover, the base layer of compacted clay with a composite liner as an overlay and the compaction of the waste upon burial, the NRC staff has concluded that reconcentration in the leachate system is unlikely to be an issue with respect to the disposal of the SNM at USEI.

## 8. MATERIAL CONTROL AND ACCOUNTING

This section of the SER addresses the material control and accounting (MC&A) aspects of WEC's July 11, 2014, request. The NRC staff conducts such a review due to the general reporting and recordkeeping requirements of subpart B of 10 CFR Part 74, which are applicable to those who possess SNM of 1 g or more of U-235.

WEC Hematite maintains an overall MC&A program in accordance with the NRC-approved Fundamental Nuclear Material Control Plan (FNMCP) per 10 CFR Part 74, Material Control and Accounting of Special Nuclear Material. The FNMCP contains the reporting requirements of 10 CFR 74.15 associated with DOE/NRC Form 741, Nuclear Material Transaction Reports, for the WEC Hematite facility.

WEC's July 11, 2014, request is similar to previous alternate disposal requests. The only difference between the requests is that the July 11, 2014 request is approximately a factor of 1.3 greater than the sum of all of the previous requests. Other than that, the type of material; and the concentration of radionuclides are, for all intents and purposes, identical.

It was indicated in WEC's submittal that the proposed waste to be disposed of at USEI is diffuse material as defined in Hematite's February 18, 2011, FNMCP. WEC's submittal indicated that it will continue to meet the 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 Materials Management and Safeguards System (NMMSS).

### 8.2 NRC Evaluation and Findings

As noted above, WEC will continue to use DOE/NRC Form 741 to document all transfers of 1 gram or more of SNM to NMMSS and USEI will report all SNM receipts, including SNM contained in waste, to NMMSS. Once all of the WEC material is received and disposed of below ground at the USEI facility, USEI may request that its NMMSS account be de-activated, as previously approved. Based upon the above-noted WEC and USEI commitments, the staff has concluded that WEC's alternate disposal request meets the requirements of the NRC's MC&A regulations in 10 CFR Part 74.

9. LICENSE CHANGES

Approval of WEC's July 11, 2014, request will be effectuated by amending the Hematite License. Amendment No. 65 to the Hematite License includes the following changes to the Hematite License Conditions.

The first change to the Hematite license revises License Condition 15 to list the documents referenced in this SER.

The second change revises License Condition 17 to include the total volume of waste material that WEC is authorized to ship to USEI for disposal there. This includes the 22,809 $m^3$ of soils and associated debris covered by Amendment 58; the 23,000 $m^3$ of concrete/asphalt, piping, soil and miscellaneous equipment covered by Amendment 60; and the 22,000 $m^3$ covered by Amendment 63 and 81,497 $m^3$ of soil and soil-like material and 5,451 $m^3$ of piping, concrete, and asphalt associated with this Amendment 65.

Therefore, the revisions to License Conditions 15 and 17 result in the following license changes:

15. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below. The NRC's regulations shall govern unless the statements, representations, and procedures in the licensee's application and the following correspondence are more restrictive than the regulations.

    A. Westinghouse HEM-11-96, "Final Supplemental Response to NRC Request for Additional Information on the Hematite Decommissioning Plan and Related Revision to a Pending Licensing Action", July 5, 2011 except for Attachment 18. (ADAMS Accession Nos. ML111880290 and ML111880292)

    B. Documents identified in Chapter 1 of NRC Decommissioning Plan SER ADAMS Accession No. (ML112101630).

    C. Westinghouse HEM-11-56, "*Evaluation of Technetium-99 Under the Process Buildings*", May 5, 2011. (ADAMS Accession No. ML111260624).

    D. Documents identified in the NRC's 10 CFR 20.2002 SERs associated with Amendment Nos. 58, 60, 63 and 65. (ADAMS Accession Nos. ML111441087, ML12158A401, ML13280A368 and ML15086A413)

    E. Westinghouse HEM-12-101, "Special Nuclear Material License Application for the Hematite Decommissioning Project", August 16, 2012. (ADAMS Accession No. ML12233A362)

17. Pursuant to 10 CFR 20.2002, the licensee may dispose of solid materials [consisting of a total of 126,306 $m^3$ of soils, soil-like material (dewatered sanitary sludge) and associated debris and 28,451 $m^3$ of concrete/asphalt, piping, soil and miscellaneous equipment] provided the total inventory of Tc-99 based on the average concentration and total mass shipped remains below 1.3 Ci or 2.05 Ci based upon the 95$^{th}$ upper confidence limit as waste at the US Ecology Idaho facility in Grand View, ID. Pursuant to 10 CFR 30.11 and 10 CFR 70.17, this material is exempt from the requirements in 10 CFR 30.3 and 10 CFR 70.3. Any waste material which will be chemically treated at the US Ecology Idaho facility in Grand View Idaho will be shipped in a rail car and total U-235 content per rail car will be limited to 700 grams or less. In addition, Westinghouse will ensure that any chemical treatment which occurs at US Ecology Idaho is limited so that no treated batch contains more than the contents of one railcar.

## 10. CONCLUSIONS

On July 11, 2014, WEC requested that the NRC approve an increase in the amount of materials to be disposed in accordance with 10 CFR 20.2002. This request involved low-activity radioactive materials from the HDP totaling 87,100 $m^3$ of soil, soil-like material, concrete/asphalt, piping, and piping that contains low concentrations of source, SNM and byproduct material contaminants. WEC plans to ship these materials by rail to the USEI RCRA Subtitle C disposal facility near Grand View, Idaho.

Activities and potential doses associated with transportation, waste handling and disposal have been evaluated in reviewing WEC's 10 CFR 20.2002 application. The NRC staff has determined that WEC has provided an adequate description of the waste to be disposed of, including the physical and chemical properties important to risk evaluation, and the proposed manner and conditions of waste disposal.

The NRC staff has determined that WEC's proposed statistical evaluation, sampling plan, quality assurance/quality control program, and contingency plans are acceptable, and demonstrate that its proposed disposal will not result in a dose to individual members of the public exceeding "a few millirem" per year.

Similarly, independent review of the post-closure and intruder scenarios using RESRAD estimated that the maximum projected dose per year over a period of 1,000 years is within "a few millirem." A conservative bounding analysis conducted by the NRC staff yielded doses less than the 10 CFR Part 20 annual dose limit of 1.0 mSv/yr (100 mrem/yr) to members of the public (10 CFR 20.1301). The projected doses to individual USEI workers have been conservatively estimated and demonstrate that the proposed 10 CFR 20.2002 disposal will not result in a dose to an individual USEI worker that exceeds "a few millirem" per year.

In addition, because this 10 CFR 20.2002 application involves SNM, the NRC staff performed nuclear criticality safety, material control and accounting, and physical security assessments. The NRC staff finds that this proposed action will not significantly impact the annual cumulative dose from all exempted and naturally occurring radioactive material at the USEI disposal facility. This finding is based upon the dose evaluations discussed in Section 3 above.

Further, in accordance with the provisions of 10 CFR 30.11 and 10 CFR 70.17, the NRC may, upon application by an interested person or upon its own initiative, grant such exemptions from the requirements of the regulations in those parts of Title 10, Chapter 1 of the Code of Federal Regulations as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest. Based on the above analyses, the NRC staff concludes that: (1) the material proposed for disposal poses no danger to public health and safety; (2) the proposed disposal does not involve activities that could potentially impact the common defense and security of the United States; and (3) it is in the public interest to dispose of wastes in a controlled environment, such as that provided by the USEI facility located in Grand View, ID. Therefore, to the extent that the waste proposed for disposal contains byproduct material and SNM that would otherwise be subject to NRC licensing, the NRC staff concludes that the receipt and possession of this material by USEI may be exempted from NRC licensing requirements in 10 CFR 30.3 and 10 CFR 70.3, respectively.

## 11. REFERENCES

For convenience, the references have been organized according to their WEC, LLC identification number.

HDP-TBD-WM-906. “Characterization Data Summary in Support of Additional USEI Alternate Disposal Request, Revision 0, Westinghouse Electric Company LLC, Hematite Decommissioning Project. January 19, 2012. (ADAMS Accession No. ML12017A188)

HDP-TBD-WM-906. “Characterization Data Summary in Support of Additional USEI Alternate Disposal Request, Revision 1, Westinghouse Electric Company LLC, Hematite Decommissioning Project. July 24, 2012. (ADAMS Accession No. ML12209A201)

HDP-TBD-WM-909. “Safety Assessment for Additional Hematite Project Waste at USEI, Revision 1”. August 2013, (ADAMS Accession No. ML13310A625)

HEM-09-52. “Westinghouse Electric Company, LLC - Request for Alternate Disposal Approval and Exemptions for Specific Hematite Decommissioning Project Waste,” Westinghouse Electric Company LLC, Hematite Decommissioning Project, May 21, 2009. (ADAMS Accession No. ML091480071)

HEM-09-94. “Decommissioning Plan and Revision to License Application,” Westinghouse Electric Company LLC, Hematite Decommissioning Project. August 12, 2009. (ADAMS Accession No. ML092330136)

HEM-09-94. Hematite Decommissioning Project Report DO-08-005, Rev. 0, “Historical Site Assessment.,” Westinghouse Electric Company LLC, Hematite Decommissioning Project. July 2009. (ADAMS Accession Nos. ML092870417 and ML092870418)

HEM-09-146. “WEC Response to Request for Additional Information - Alternate Waste Disposal,” Westinghouse Electric Company LLC, Hematite Decommissioning Project, December 29, 2009. (ADAMS Accession No. ML100320540)

HEM-I0-38. “Additional Information for Alternate Waste Disposal Authorization and Exemption,” Westinghouse Electric Company LLC, Hematite Decommissioning Project, March 31, 2010 (ADAMS Accession No. ML100950397)

HEM-10-46. Westinghouse (Hackmann) letter to NRC (Document Control Desk), dated May 24, 2010, "Additional Information and Clarifications Concerning 10 CFR 20.2002 Alternate Waste Disposal Authorization and Exemption for Specific Hematite Decommissioning Project Waste" (ADAMS Accession No. ML101450240).

HEM-10-126. Westinghouse (Hackmann) Letter HEM-10-126 to NRC (Document Control Desk), dated December 10, 2010, "Partial Responses to Requests for Additional Information on Decommissioning Plan Chapters 1, 4, 6 and 7" (ADAMS Accession No. ML103490100).

HEM-11-16. “Revised Technical Basis for Characterization of Decommissioning Soils Waste that is Subject to the Alternate Disposal Request for U.S. Ecology Idaho, Inc.” February 18, 2011. (ADAMS Accession No. ML110530155)

HEM-12-2. “Request for Additional Alternate Disposal Approval and Exemptions for Specific Hematite Decommissioning Project Waste at US Ecology Idaho,” Westinghouse Electric Company LLC, Hematite Decommissioning Project, January 16, 2012. (ADAMS Accession Nos. ML12017A188, ML12017A189, ML12017A190)

HEM-12-67. “Partial Response to NRC Requests for Additional Information Dated May 1, 2012 on the January 16, 2012 Hematite 20.2002 Alternate Disposal Request. Westinghouse Electric Company LLC, Hematite Decommissioning Project. June 19, 2012. (ADAMS Accession No. ML121740265)

HEM-12-88. “Final Responses to NRC Requests for Additional Information Dated May 1, 2012 on the January 16, 2012 Hematite 20.2002 Alternate Disposal Request.” Westinghouse Electric Company LLC, Hematite Decommissioning Project. July 24, 2012. (ADAMS Accession Nos. ML12209A200 and ML12209A201)

HEM-13-71. “Westinghouse Hematite Decommissioning Project: Request for Third Alternate Disposal Approval and Exemptions for Waste Transferred to US Ecology Idaho”. May 28, 2013. (ADAMS Accession No. ML13149A291)

HEM-13-101. "Westinghouse Hematite Decommissioning Project: Response to N RC Request for Additional Information dated July 10, 2013, on the May 28, 2013, HOP 20.2002 Alternate Disposal Request". August 13, 2013, (ADAMS Accession No. ML13226A385)

HEM-13-127. “Westinghouse Hematite Decommissioning Project: Second Response to NRC Request for Additional Information dated July 10, 2013, on the May 28, 2013, HDP 20.2002 Alternate Disposal Request”. November 5, 2013. (ADAMS Accession No. ML13310A625)

HEM-14-60. “Westinghouse Hematite Decommissioning Project: Request for Waste Volume Increase to Alternate Disposal Approvals and Exemptions for Waste Transferred to US Ecology Idaho,” July 11, 2014, (ADAMS Accession No. ML14193A008)

HEM-14-74. “Westinghouse Hematite Decommissioning Project - Supplemental Information for July 11, 2014, Request for Waste Volume Increase to Alternate Disposal Approvals and Exemptions for Waste Transferred to US Ecology Idaho,” September 25, 2014. (ADAMS Accession No. ML14293A614)

HEM-14-99. “Final Responses to NRC Requests for Additional Information dated May 1, 2012 on the January 16, 2012, Hematite 20.2002 Alternate Disposal Request” December 19, 2014. (ADAMS Accession No. ML15009A166)

HEM-15-10. “Hematite Decommissioning Project - Additional Information Resulting from Teleconferences Regarding the July 11, 2014, Request for Waste Volume Increase to Alternate Disposal Approvals and Exemptions for Waste Transferred to US Ecology Idaho,” February 18, 2014. (ADAMS Accession No. ML15063A024)

Nuclear Criticality Safety Associates, NSA-TR-HDP-11-11, Rev. 1, “Nuclear Criticality Safety Assessment of the US Ecology Idaho (USEI) Site for the Land Fill Disposal of Additional Decommissioning Waste from the Hematite Site”, July 2012. (ADAMS Accession No. ML12209A200)

U. S. Environmental Protection Agency, Federal Guidance Report No. 11, “Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion and Ingestion,” September 1988.

U.S. Nuclear Regulatory Commission, NUREG/CR-6505, Vol. 1, “The Potential for Criticality Following Disposal of Uranium at Low Level Waste Facilities.” June 1997.

U.S. Nuclear Regulatory Commission, NUREG/CR-0782, Volume 4, “Draft Environmental Impact Statement on 10 CFR Part 61 Licensing Requirements for Land Disposal of Radioactive Waste: Appendices G-Q,” September 1981. (ADAMS Accession No. ML052590354)

U.S. Nuclear Regulatory Commission, NUREG/CR-4370, “Update of Part 61 Impacts Analysis Methodology, Vol. 2”. January 1986. (ADAMS Accession No. ML100250917)

U.S. Nuclear Regulatory Commission, Hematite Amendment No. 58. “US NRC Safety Evaluation Report Request for Alternate Disposal Approval and Exemptions for Specific Hematite Decommissioning Project Waste at US Ecology’s Idaho Facility,” October 27, 2011. (ADAMS Accession No. ML111441087)

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