U. S. NRC SAFETY EVALUATION REPORT ON

WESTINGHOUSE AMENDMENT REQUEST FOR APPROVAL OF HEMATITE

DECOMMISSIONING PLAN AND ASSOCIATED

SUPPORTING DOCUMENTS

October 2011

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1.0 Introduction

This Safety Evaluation Report (SER) covers the U.S. Nuclear Regulatory Commission (NRC) staff's review of the Westinghouse Electric Company, LLC (WEC) request to amend the former Hematite Fuel Cycle Facility license, SNM-33. Specifically, WEC requested approval of the Hematite Decommissioning Plan (DP) and associated supporting documents.

1.1 Background

On August 12, 2009, WEC submitted a two volume DP (ML092330136) for the former Hematite Fuel Cycle Facility located near Hematite, Missouri in Jefferson County. WEC also submitted the following documents in support of the DP:

- Decommissioning Funding Plan[1]
- Fundamental Nuclear Material Control Plan[1]
- Physical Security Plan[1]
- Environmental Report (ML092870403, ML092870405)
- Radiological Characterization Report (ML092870496, ML092870506)
- Supplemental Characterization Report (ML093430818, ML093430819, ML093430821, ML093430822)
- Sensitivity Analysis of RESRAD and RESRAD-Build Parameters for Hematite Decommissioning Project DCGL Calculations (ML093430913)
- Derivation of Surrogates and Scaling Factors for Hard-to-Detect Radionuclides (ML092870492)
- Historical Site Assessment (ML092870417, ML092870418)
- Site Specific Soil Parameters (ML093430808)
- Determination of Distribution Coefficients for Radionuclides of Concern at the Westinghouse Hematite Facility (ML093430811)
- Supplemental Analysis of Hydrogeologic Conditions in Overburden at Westinghouse Hematite Facility, Hematite, Missouri (ML093430807)
- Effluent and Environmental Monitoring Plan (ML110330371)

WEC submitted a DP in accordance with 10 CFR 70.38(g)(1). The staff reviewed the DP to determine that the DP met the requirements of 10 CFR 70.38(g)(4), 10 CFR 70.38(g)(5) and Subpart E of 10 CFR Part 20. The staff used the guidance in NUREG-1757, "Consolidated Decommissioning Guidance, Decommissioning Process for Materials Licensees." to assess whether WEC had met these regulatory requirements. Adherence to this guidance is not required to meet the regulations, but such adherence is one means of demonstrating that the regulatory requirements have been met.

As a result of the review of the DP and the various documents in support of the DP, the staff identified additional information that was required from WEC to assist the staff in assessing the adequacy of aspects of the DP. Table 1-1 presents a listing, by DP Chapter and/or Plan, of the staff's Requests for Additional Information (RAIs) which were transmitted to WEC.

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[1] This document contains either proprietary (financial) or safeguards information and is not publically available.

Table 1-2 presents a listing of WEC's responses to those RAIs. Also presented in Tables 1-1 and 1-2 are the numbers assigned to the documents as recorded in the NRC's Agencywide Documents Access and Management System (ADAMS). In some cases, due to either the magnitude of the submittal or WEC's staged responses, there may be multiple numbers assigned to the submittal.

During the staff's review of WEC's RAI responses, some responses were found to be sufficient and no additional details were required. In other cases, the responses remained insufficient or the responses raised additional staff questions and/or concerns. These additional staff questions/concerns and WEC's draft responses thereto were summarized in draft RAI Resolution Tables, which were transmitted to NRC staff on June 20, 2011 (ML111720018), and June 21, 2011 (ML111730489 and ML111730494). These Resolution Tables became the subject of publicly noticed conference calls on June 24, 2011, and June 27, 2011. The purpose of these publicly noticed calls was to provide the staff an opportunity to describe the remaining outstanding issue(s) with the RAIs and to address whether WEC's proposed resolution to the remaining issue was satisfactory. Following the completion of the June 24, 2011, and June 27, 2011, conference calls, WEC finalized the RAI Resolution Tables, which were subsequently submitted to NRC staff on July 5, 2011 (ML111880290).

This SER consists of 15 Chapters. The topic of each is noted in the Table of Contents. Major parts of this SER include: (a) the radiological characterization of the site to identify what requires remediation and the extent of the remediation; (b) the description of the dose model which demonstrates how the licensee will meet the dose criteria of 10 CFR 20.1402; and (c) the manner in which the licensee will conduct the Final Status Survey (FSS) to demonstrate that the site can be released for unrestricted use and the license terminated. These topics are covered in Chapters 4, 5 and 14, respectively, of this SER.

NUREG-1757 covers the typical review areas for decommissioning a facility. Two aspects which are not covered are those decommissioning activities involving physical security or material control and accountability. WEC has submitted revisions to their Physical Security (PSP) and their Fundamental Nuclear Material Control Plans (FNMCP). These revisions remain under staff review. Because during decommissioning a potential exists for exhuming Category I or Category II amounts of special nuclear material and because the existing Hematite PSP and FNMCP do not address Category I or Category II situations, WEC is prohibited from exhuming material in the documented burial pit areas and in the areas where undocumented burial pits are suspected. The staff's assessment of the PSP and the FNMCP will be the subject of a later SER.

1.2 State Consultation

The State of Missouri provided technical comments on the Hematite DP in a September 9, 2010, letter (ML110190083). These comments were provided by the Missouri Department of Natural Resources (MDNR) and the Missouri Department of Health and Senior Services (DHSS), and were discussed in conference calls with MDNR and DHSS and during a July 11, 2011, meeting in Missouri. The staff believes that this SER adequately addresses the MDNR and DHSS comments. In addition, NRC provided on April 14, 2011, draft copies of the Environmental Assessment (EA) to MDNR for review and comment (ML111020461). MDNR provided comments on the draft EA on May 13, 2011 (ML111580572). The final version of the

EA addressed MDNR's comments as indicated in a letter from NRC staff to the MDNR dated August 30, 2011 (ML112160406).

Table 1-1 Dates of NRC RAIs and Associated ADAMS Numbers

Hematite DP Chapter or Plan	NRC RAI Date	ADAMS No.
1	October 14, 2010	ML102810455
2	None	N/A
3	February 9, 2011	ML110210533
4	October 14, 2010	ML102810455
5	July 12, 2010	ML101760058
6	October 14, 2010	ML102810455
7	October 14, 2010	ML102810455
8	December 3, 2010	ML103300204
9	December 3, 2010	ML103300204
10	December 1, 2010	ML103260399
11	July 2, 2010	ML101740507
12	December 1, 2010	ML103260399
13	December 13, 2010	ML103430214
14	July 1, 2010	ML101740133
15	None	N/A
Physical Security Plan[1]	February 3, 2011 July 6, 2011	ML110460471 ML111860024
Decommissioning Funding Plan[1]	November 5, 2010-	ML102980081
Fundamental Nuclear Material Control Plan[1]	December 9, 2009 January 18, 2011	ML093370420 ML110130207
Environmental Report	None	N/A
Radiological Characterization Report	July 1, 2010	ML101740167
1 - This document contains either proprietary (financial) or safeguards information and is not publically available.		

Table 1-2 Dates of WEC RAI Responses and Associated ADAMS Numbers

Hematite DP Chapter or Plan	WEC RAI Response Date	ADAMS No.
1	December 10, 2010 December 21, 2010	ML103490100 ML103560708
2	N/A	N/A
3	March 10, 2011	ML110730287
4	December 10, 2010 December 21, 2010	ML103490100 ML103560708
5	August 11, 2010 September 15, 2010 October 7, 2010	ML102290015 ML102740175 ML102850223
6	December 10, 2010 December 21, 2010	ML103490100 ML103560708
7	December 10, 2010 December 21, 2010	ML103490100 ML103560708
8	January 24, 2011	ML110270200
9	January 24, 2011 March 21, 2011	ML110270200 ML110810978
10	January 28, 2011	ML110330366
11	August 10, 2010 June 20, 2011	ML102250089 ML111720018
12	January 28, 2011	ML110330366
13	January 19, 2011	ML110200410
14	July 30, 2010	ML102140158
15	N/A	N/A
Physical Security Plan[1]	June 10, 2011 July 28, 2011	ML11171A407 ML11214A106
Decommissioning Funding Plan[1]	December 21, 2010- June 30, 2011	ML110120334- ML111890034
Fundamental Nuclear Material Control Plan[1]	January 6,2010 February 18,2011	ML100110203 ML110530134[1]
Environmental Report	N/A	N/A
Radiological Characterization Report	July 30, 2010	ML102140158
Supplemental Draft Response on all chapters, excluding 11	June 21, 2011	ML111730497
Final Supplemental Response to RAIs	July 7, 2011	ML111880293
1 - This document contains either proprietary (financial) or safeguards information and is not publically available.		

2.0 Facility Operating History

The staff has reviewed the information in the “Facility Operating History” section of the Decommissioning Plan for the Hematite Fuel Cycle Facility license number SNM-33 located near Hematite, Missouri according to NUREG-1757, Volume 1, Section 16.2. Based on this review, NRC staff has determined that the licensee, WEC, has provided the information required under 10 CFR 70.38(g)(4), and that information is sufficient to aid NRC staff in evaluating the licensee’s determination of the radiological status of the facility and the licensee’s planned decommissioning activities, to ensure that the decommissioning can be conducted in accordance with NRC requirements. This finding incorporates the results of the staff’s assessment under Sections 2.2, 2.3, 2.4, and 2.5, below.

2.1 Site History

The Hematite site was originally farmland before it was purchased by Mallinckrodt Chemical Works (MCW) for industrial purposes. The original special nuclear material license for the Hematite facility was issued to MCW on June 18, 1956, by the Atomic Energy Commission (AEC), the predecessor agency to the NRC.

From 1956 through 1974, the facility primarily produced highly enriched uranium for the U.S. government under a number of contracts. During the government contract phase, there were a number of owners. Besides MCW, owners included United Nuclear Corporation (UNC), Gulf United Nuclear Fuels Corporation and the General Atomics Company (GAC). During this period, operations were focused on the production of reactor fuels for research and the production of enriched uranium fuel for the United States Navy and Army reactor programs. Operations involved the conversion of uranium hexafluoride (UF_6), into a variety of solid compounds including nuclear fuel for the Navy’s nuclear powered ships and the Army’s power reactors. Feed material for the operations came from AEC regulated or DOE controlled facilities and included spent nuclear fuel that had been recycled through DOE facilities. All recycled fuel feed material used at the facility contained fission byproducts such as Technetium-99 and various transuranics such as Neptunium-237.

From 1975 until 2001, the facility was licensed by the NRC to produce low enriched (< 5%) commercial nuclear fuel. Combustion Engineering (CE) was the initial commercial nuclear fuel licensee. CE was subsequently acquired by Asea Brown Bovier (ABB). In April 2000, the site was purchased by British Nuclear Fuels Limited (BNFL). At the time of the purchase, BNFL was the parent corporation to Westinghouse and the Hematite operations were consolidated into the Westinghouse nuclear operations. Production operations at the Hematite facility were permanently ceased in June 2001. On April 11, 2002, the facility was placed in a standby mode prior to decommissioning.

2.2 License History

Activities at the Hematite Site involving possession and use of radiological material are authorized under NRC License No. SNM-33. This license is maintained under and is based on the NRC requirements of 10CFR Part 70, "Domestic Licensing of Special Nuclear Material." The current authorized principal licensed activity is to decommission the site by removing the facility’s building systems, equipment, and process materials safely from service and reducing residual radioactivity to a level that permits termination of the license. The present license authorizes the radionuclides, maximum activities, quantities, and chemical forms permitted at the site. In addition, the current license provides specific conditions for decommissioning including those activities pertaining to:

1. reduction of license material through decontamination, waste preparation;
2. packaging and shipment;
3. decommissioning planning activities such as site characterization;
4. maintenance of existing facilities;
5. decommissioning and decontamination of building and equipment; and
6. demolition of buildings.

Under the current license, prior to approval of this DP, WEC is not authorized to conduct activities at the Hematite facility related to: (1) soil and groundwater remediation; (2) final status surveys for NRC approval; (3) subsurface disturbance to include trenching; (4) on-site waste treatment; or (5) staging of material, equipment, or waste in the Burial Pit Area except at existing pads and roadways. The decommissioning activities described in the DP and associated documents are intended to provide the basis for completing work activities in support of license termination and subsequent release of the site for unrestricted use pursuant to 10 CFR 20, Subpart E, "Radiological Criteria for License Termination" (Reference 2-5).

2.3 Previous Decommissioning Activities

Historical decommissioning activities conducted at the Hematite Site have included specific areas where work activities or events resulted in contamination. The Red Room (Building 240), Item Plant (Building 255), and related areas were used for high-enriched fuel production processes from 1956 until the early 1970s. During the CE purchase of the facility in 1974, these areas were identified as contaminated and partial decontamination efforts were undertaken in both building areas. Specifically, process equipment, duct work, and exhaust fans were removed; the floors were scarified; and the Red Room and Item Plant areas were vacuumed, steam cleaned, and painted. In the Red Room, three inches of concrete was added to the floor. Contamination in the Red Room Roof Burial Area was discovered in 1993 and reportedly removed to below 30 pCi/g. However, a subsequent investigation has shown contamination levels above 30 pCi/g in this area.

The Hematite facility has two evaporation ponds that were used for the retention of process filtrates, low-level liquid wastes, and high- and low-enriched uranium-containing materials. The ponds were originally designed to receive filtrates from the low-enriched ammonium diuranate (ADU) conversion facility. The evaporation ponds consisted of a primary pond (EP-1) and a secondary, larger overflow pond (EP-2) with a 1.5 foot berm around each pond. The ponds were originally lined with approximately 10 inches of rock (nominal diameter of 0.5 to 3 inches). The size of the primary pond was approximately 30 ft by 40 ft, and the secondary pond was 30 ft by 85 ft.

While the evaporation ponds were designed and built to receive filtrates from the low enrichment processes, they were also used for the retention of both high- and low-enrichment recovery waste liquids. WEC has indicated that historical documentation identifies retention of other liquid waste solutions in the evaporation ponds. Examples of these waste liquids include acidic cleanup solutions, organic solvent solutions (perchloroethylene and trichloroethylene), oils, building sump contents, and mop water. Use of the evaporation ponds was discontinued in 1978 by CE. In 1979, approximately 700 ft^3 of sludge was pumped out of the primary evaporation pond and sent for offsite disposal at a NRC licensed disposal facility.

Additional decommissioning efforts for the evaporation ponds were undertaken by CE in 1984 in response to NRC directives. As a result, CE removed approximately 2,800 ft^3 of sludge, rock and soil from the primary evaporation pond in 1985. Detailed sampling following the remediation effort determined the average total uranium contamination of the soil in the pond was below the 250 pCi/g total uranium decontamination limit set by the NRC; however, spot contamination levels in excess of the limit remained. Approximately 1,200 ft^3 of soil and rock were also removed from the secondary evaporation pond in 1987. Subsequent soil/sediment samples collected from the evaporation ponds following these remediation efforts revealed an average concentration of uranium in the evaporation ponds below the 250 pCi/g limit; however, individual sample results showed soil/sediment contamination levels in excess of the limit remained.

On May 4, 1995, a DP for the evaporation ponds (Evaporation Pond DP) was incorporated by amendment into the site license. Following additional characterization, the Evaporation Pond DP was revised based on more extensive characterization results. The Evaporation Pond DP was implemented over the next four years and resulted in the removal of approximately 6,000 ft^3 of additional soil/sediment for disposal. Surveys and sampling of the pond area conducted in 1999 indicated an average concentration of 170 pCi/g uranium-235 (U-235), with several samples yielding higher concentrations (the highest being 745 pCi/g U-235). In addition, uranium concentrations of approximately 100 pCi/g were detected at depths of 10 ft below grade. Remediation efforts associated with the evaporation ponds were suspended in 1999 to evaluate additional remediation techniques and options.

During construction of Building 253 in 1988 and 1989, an area of soil contamination was identified adjacent to Building 240. Contaminated soil was removed from this area until concerns developed about undermining the remaining building foundation. Prior to soil removal, technetium concentrations up to 680 pCi/g were found. Following soil removal from this area, residual technetium contamination averaged 17 pCi/g with a maximum value of 82 pCi/g. CE requested the NRC allow spent limestone stored onsite, to be used as fill material for this area. The NRC allowed spent limestone, meeting a 30 pCi/g limit, to be used as fill below Building 253 with the understanding that the fill may have to be removed upon facility decommissioning.

In 1995 it was identified that occasional malfunctions in the operation of the Sanitary Wastewater Treatment Plant (SWTP) over a period of time had resulted in contamination collecting in the Site Creek sediments. The effluent from the SWTP enters the Site Creek at Outfall #001, directly below the dam for the Site Pond, which is a small concrete dam impoundment southwest of the site which receives flow from the Site Spring. The contaminated sediment had settled between the dam and the point where the Site Creek passes beneath the railroad tracks. Prior to remediation, sediment samples showed total uranium concentrations within the range of 40pCi/g to 800 pCi/g. Remediation was accomplished by diverting the Creek and then removing the sediment with a backhoe to a depth of approximately 0.5 ft to 3 ft between the site dam and the railroad tracks. The removed material was dried and shipped to an offsite licensed disposal facility. Sediment was removed until the average remaining contamination was less than 30 pCi/g, with no single sample above 90 pCi/g. Remaining residual radioactivity after remediation of the Site Creek averaged 22 pCi/g, with a maximum concentration of 85 pCi/g.

Removal of systems, components and wastes from inside facility buildings has been performed in two phases since the facility ceased operations in 2001. The first phase involved uranium removal for reuse or disposal, and general removal of stored waste materials. This phase was conducted from 2001 to 2003. The second phase was conducted between 2003 and 2006 and included removal of uranium for re-use; and removal of building systems, equipment, and process materials for disposal or reuse in preparation for future building demolition. Demolition of buildings and structures was approved in SNM-33 License Amendment No. 52. However, because of characterization issues, building demolition could not occur until additional characterization efforts were conducted. Following the additional characterization, the NRC issued an SER reaffirming Amendment 52 (ML 102990346). WEC completed building demolition of all but six onsite buildings in June 2011.

In 1989, during construction of a truck bay for Building 256 (1989), a large area of contaminated soil was excavated and stored along the southeast comer of the Central Tract. This soil pile became known as "Deul's Mountain," using the last name of the employee who planned the construction and soil removal. The volume of the soil pile was approximately 1,100 cubic yards, and included building debris (cement and asphalt) in addition to native soils. The soil and debris in the pile were removed to original grade level and shipped off-site for disposal at an NRC licensed facility. A characterization study for this area concluded that U-234, U-235 and U-238 were the only radiological isotopes of concern in this area. Uranium concentrations in the excavated soil ranged from 0.3 pCi/g to 22.8 pCi/g U-235, and from 1.4 pCi/g to 33.5 pCi/g U-238.

2.4 Spills

The DP indicated that the original sanitary wastewater treatment plant involved a septic tank and a leach field. These components were abandoned in place in the period 1977-1978 and the modified sanitary wastewater treatment facility was connected to new wastewater equipment which discharges to the Site Creek. Degradation of the sanitary wastewater treatment system buried piping was identified in 2007. WEC identified the presence of subsurface soil contamination in the area of this piping.

WEC indicated in the DP that due to incomplete underground piping information during the early periods of operation, it is possible that building drains and storm water drains were interconnected at unknown points below grade. This possibility, in conjunction with known spills and leaks, results in the potential for residual radioactivity to have entered and potentially leaked to soil surrounding these buried piping systems. Thus, WEC considered areas containing building floor drains or storm water piping to be impacted by site operations.

WEC determined from interviews with former site employees and remaining physical evidence (e.g., abandoned manhole covers and photographs), that there was a former storm drain extending from the process building area to the Site Pond. The portion of the storm drain piping from the Building 230 area to the Site Pond was removed prior to the construction of Building 230. Some of this piping was shipped offsite for disposal as low-level radioactive waste. Subsequently, a replacement storm drain was installed adjacent to Building 230. WEC could not locate records of radiological surveys of the soil or of the disposition of the soil surrounding this former storm drain. Therefore, WEC considers the subsurface soil along the estimated former path of the drain piping to be potentially impacted by site operations.

Spills which would have occurred inside process buildings may have entered floor drains and connected building sumps. These spills would have been absorbed into the underlying soil through joints in the concrete slab. Small liquid spills also occurred outside of the facility structures. In 1984, an unknown quantity of acid insolubles from the wet recovery system was spilled onto the ground outside of Building 240. WEC indicated that a description of the event stated that the residues were vacuumed off the ground and transferred to an empty drum. Barrels of spill material were staged south of Building 240.

In addition, prior to construction of Building 253, the wet uranium recovery process was conducted outside in the area where Building 253 was eventually constructed. Therefore, spills in this area were possible from the uranium recovery operation.

An off-site low level radioactive liquid spill may have occurred around 1962. The spill is thought to have occurred as a result of a truck hauling low level contaminated filtrate to an offsite facility, overturning at a road curve and spilling filtrate offsite. According to the interviews conducted by WEC, the filtrate liquid would have been authorized for release only if the liquid met the effluent release standards in existence at the time. Research of early site records provided no additional information on this incident.

WEC also identified several events in the past few years where surface contamination was present on items and equipment located outside of the site restricted areas. Soil residual activity outside of the site restricted area was also identified. WEC evaluations of these events indicated that the contamination and activity posed no significant risk to the health and safety of the workers or members of the general public. NRC Region III assessments of these incidents reached similar conclusions.

2.5 Prior Onsite Burials

On-site burial was used as a disposal method for contaminated materials and wastes at Hematite from 1965 until 1970. Detailed logbooks of waste burial describe the presence of 40 unlined pits east of the process buildings. These Burial Pits were for the disposal of waste materials generated by the fuel fabrication processes. These on-site burials were created under the governance of AEC regulations contained in 10 CFR 20.304 (1964). These regulations described the spacing of the pits, the thickness of the cover and the quantity of radioactive material that could be buried in each pit. Nominal dimensions of each Burial Pit were 20 ft wide by 40 ft long by 12 ft deep. The regulations provided that the pits were to include a cover depth of approximately 4 ft. Both UNC and GUNC maintained detailed logs of waste burials occurring between July 1965 and November 1970. Each entry contains a date, a description of the waste buried, the weight of the uranium measured or estimated for that waste and a cumulative total of the uranium buried in that particular pit. The weight of the contaminated item measured or estimated was determined to the nominal value of 1 gram. Some entries also list percent enrichment for the uranium. The Burial Pit logs show a wide variety of wastes being buried in the pits; the majority of the listed waste is non-special nuclear material (SNM) waste, such as, contaminated trash, drums, pails, bottles, rags, etc. Additional waste materials that are listed include uranium process metals of various enrichments, metal wastes, liquid and solid chemical wastes, and High-Efficiency Particulate Air (HEPA) filters.

On-site burial of radioactive waste materials was terminated in November 1970 as a result of an AEC violation issued to the Hematite facility for failure to adhere to revised AEC regulations concerning the quantity of material which could be buried onsite. A revision to 10 CFR Part 20 enacted in June of 1970 reduced the burial limits for enriched uranium. The licensee at the time had continued burying material based upon the limits prior to June of 1970, resulting in the AEC violation.

Review of Burial Pit logbook records, former employee interviews, and the operational uranium recovery process used during this time period, led WEC to conclude that there were efforts to maximize recovery and utilization of uranium material whenever possible. This led WEC to conclude that there is little likelihood the Burial Pits contain significant quantities of recoverable SNM.

Interviews with former employees indicated that undocumented, on-site burials (in addition to the burial practices under 10 CFR 20.304 (1964)) may have occurred as early as 1958 or 1959. Available employee interview records indicate that three or four burials may have been performed each year, prior to 1965, for disposal of general trash and items that may have been slightly contaminated relative to the current radiological free release standards of that period. WEC estimated that 20-25 burials may exist for which there are no records. Burials prior to 1965 were not documented (logged), as they were not considered to contain significant quantities of SNM, and were not known to contain radioactive wastes. WEC has not located any information to indicate the specific nature of the waste material buried in these undocumented pits. Additionally, no evidence has been found to indicate that burial of known uranium-bearing materials (i.e., above free release criteria) occurred during this time period. WEC believes that these burials are in the area between the documented Burial Pits and the site buildings, under roadways.

In 1967, five dry scrubber columns were installed in Building 260 for removal of hydrogen fluoride from the off-gas associated with the conversion of UF_6 to $U0_2$. These dry scrubber columns used limestone rock chips as the off-gas scrubber media. The limestone media was periodically replaced; and, the waste limestone was stored outside Building 260, sometimes being utilized as onsite fill material. The areas where "spent" limestone was known to be placed included fill under the floor slab during construction of Building 253 if the limestone met a release criterion of 30 pCi/g. During Hematite operations, the limestone scrubber media became contaminated with Tc-99. The only identified source of the Tc-99 is as a contaminant of the DOE supplied UF_6 originating from reprocessed/recycled spent nuclear fuels.

Sections of the Building 240 roof were buried in an area south of the Tile Barn (Building 101). The Red Room area of Building 240 was used for UF_6 conversion of highly-enriched uranium. Soil contamination was discovered in 1993 during renovations to the Tile Barn. The Cistern Burn Pit Area, southwest of Building 101 (Tile Barn) and adjacent to the Red Room Roof Burial Area, was used to burn wood pallets that may have been contaminated. This general area was also known to have been used for temporary storage of scrap materials. These actions may have resulted in the inadvertent burial of radioactive materials.

2.6 Prior Partial Site Releases

There were no prior partial site releases.

3.0 Facility Description

Chapter 3 of the Hematite DP provides detailed descriptions of the site location; the population distribution surrounding the site; current and future land use of the site; and the physical characteristics of the site including meteorology, climatology, geology, seismology, hydrology, and natural resources. The Hematite Environmental Report (ER) also presents details about the facility description. Summaries of these topics are provided below.

3.1 Site Location and Description

The 228-acre Hematite facility is in Jefferson County, Missouri. Jefferson County is roughly bounded by three large rivers: the Mississippi River on the east, the Meramec River on the north, and the Big River in the west. A high ridge runs north and south through the center of the county that forms a watershed that empties into the Big River and the Mississippi River. Narrow ridges and deep ravines are common throughout the northern portion of the county while the southern half is characterized by rolling hills. Bottomlands are found along the main river ways and bluffs rising up to 170 feet can be found along the Mississippi River.

The Hematite facility is located approximately 0.75 miles northeast of the unincorporated town of Hematite and approximately 35 miles south of the City of St. Louis, Missouri. Licensed activities are restricted to a central tract of land of about 10 acres. Land near the Hematite facility is primarily forest, farms and residences.

Three private residences are located on the site property. The nearest resident is approximately 1,000 feet from the site central tract. Other residences are located within 0.25 mile of the site. At the Hematite facility, there are several transportation corridors in the immediate vicinity of the site. The Union Pacific railroad crosses the property from the southwest to the northeast. State Road P also crosses the site from the southwest to the northeast.

There are no public lands in the immediate vicinity of the site. Primary natural resources at or near the site include farms, ponds, streams and groundwater. Wooded areas on and surrounding the site produce low quality timber that is not likely suitable for harvesting. A limestone quarry of less than two acres in size is operated approximately 1 mile southwest of the Hematite facility.

3.2 Population Distribution

State Highway P is a census tract boundary; consequently, the Hematite facility is within two census tracts, Tract 7009 and Tract 7010. Part of the town of Festus falls within Tract 7009 but Tract 7010 is entirely rural. Historically, Jefferson County has been a rural county, but its close proximity to St. Louis has created a large influx of population in the last fifty years. A comparison of 1990 and 2000 census data for Jefferson County, the State of Missouri, and the two census tracts indicates a 16 percent increase in population during the 10-year census period. The 2000 U.S. Census indicated that the population of Jefferson County is predominantly white (98 percent).

The nearest populated settlement to the Hematite facility is the community of Hematite, Missouri. During the 1990 census, Hematite had a population of 125 people. Hematite is a residential community with no businesses, industries, or commercial activities. The closest community of significant size, located 3.5 miles east-northeast of the site consists of the combined cities of Festus and Crystal City. The 2000 census combined population of the Festus and Crystal City communities was 13,900 people.

The 2009 population estimate for Jefferson County is 219,046 people with a 10.6% increase from 2000 to 2009. The state of Missouri projects that the population of Jefferson County will increase by approximately 31% between 2000 and 2025.

3.3 Current and Future Land Use

The primary land use within a five-mile radius of the Hematite facility consists of deciduous forest, pasture (agriculture), soy beans and low-density, single family, urban/residential. There are several businesses, hotels/motels and shopping centers in the residential communities of Festus and Crystal City to the east, between the three and five mile radii from the site. Other residential communities in or near the boundary of the five-mile radius of the facility include Hematite to the south; Mapaville to the north; Horine, Munsons and Silica to the northeast; and Hillsboro to the northwest. The closest commercial or industrial facilities are the National Guard Armory, a Missouri Natural Gas Company Service Center (a subsidiary of Laclede Gas Company), and an Ameren Company utility staging area, which are all approximately a mile and a half northeast of the site, near the intersection of State Roads A and P. Other commercial and industrial facilities are located in Festus and Crystal City.

Interstate 55 is a major transportation corridor located approximately 3.5 miles east of the site and provides access to the site via State Roads A and P. The Union Pacific railroad maintains an active rail corridor in the area, which crosses the Hematite facility from the southwest to the northeast.

The nearest significant public land is the Victoria Glades Conservation Area (VGCA) located approximately four miles west of the Hematite Site on the Victoria to Hillsboro county road. VGCA is an undeveloped, wild recreational area with hiking trails but no structures and facilities other than a parking lot. No other significant public lands are located within a five-mile radius of the site.

It is anticipated that future uses of the land within and around the Hematite facility will remain generally consistent with current land use in the area, i.e., agriculture/pasture and low-density residential. No definite plans had been made for specific future uses of the site. Because of the remote location, there is little interest in industrial or commercial development of the land.

3.4 Meteorology and Climatology

The area of the Hematite facility receives an average of 38 in. of precipitation annually, with 12 in. of annual runoff. Approximately 45 percent of the total yearly precipitation falls from April through September. The maximum 10-day precipitation event would yield 9 in. of precipitation in a given 25-year span. Snowfall has averaged less than 20 in. per winter season since 1930. December, January and February are the driest months, while April and May are normally the wettest. It is not unusual to have extended periods (1 to 2 weeks or more) without appreciable rainfall from the middle of the summer into the fall. Thunderstorms occur on average between 40 and 50 days per year, mostly between May and August. The U.S. Department of Commerce reports a mean annual frequency of about 8 tornadoes per year based on data for a 30-year period.

General climatological characteristics of the site area can be inferred from those of St. Louis, the location of the nearest U.S. Weather Bureau recording station. The region experiences a modified continental climate without prolonged periods of extreme cold, extreme heat, or high humidity. Generally, air masses moving northward from the Gulf of Mexico bring warm, moist air, while colder, drier air masses typically approach from the north. Invasion of the region by these air masses, along with local weather phenomena, produce a variety of weather conditions. Winters are brisk but seldom severe. Minimum temperatures remain as cold as 32°F or lower for fewer than 20 to 25 days in most years. Summers are warm with a maximum temperature of 90°F or higher for an average of 35 days per year to 40 days per year. Prevailing winds are generally from the south (8 miles per hour [mph] to 9 mph average) from May to October, and from the west-northwest (10 mph to 11 mph average) from November to April.

3.5 Geology and Seismology

The Hematite facility is in the overall Ozarks Plateaus Physiographic Province. The Ozark Plateaus province is a geologic uplift, covering approximately 50,000 square miles and is bounded to the north by the Missouri River, to the east by the Mississippi River, to the south by the Arkansas River, and to the west by the Grand and Neosho Rivers. Precambrian igneous and metamorphic rocks that outcrop at the Saint Francois Mountains form the basal crust of the entire region and are overlain by Paleozoic sedimentary rocks that range in thickness from 0 around the periphery of the Saint Francois Mountains to 6,000 ft.

The Ozark Plateaus consist of three sections: the Springfield Plateau, the Salem Plateau and the Boston Mountains. Topography is mostly gently rolling except in the Boston Mountains, along the escarpments separating the Springfield and Salem Plateaus and the Saint Francois Range where it is rugged. Karst features, such as springs, sinkholes and caves, are common in the limestone of the Springfield Plateau and abundant in the dolomite bedrock of the Salem Plateau and Boston Mountains. However, there are not a significant number of Karst features in the vicinity of the Hematite Site.

The Hematite facility lies within the Salem Plateau, which is underlain by flat-lying to gentle northeasterly dipping Cambrian to Lower Ordovician strata that are mostly dolomite. The Paleozoic rocks are overlain by unconsolidated surface deposits of Tertiary to Quaternary age. Within the Festus quadrangle where Hematite and the Hematite facility are located, Ordovician-age Cotter Dolomite outcrops are present almost entirely throughout the region. The Ordovician- and Cambrian-age stratigraphic units underlying the Salem Plateau in the vicinity of the Hematite facility include, from youngest to oldest:

- The Cotter Dolomite, the Jefferson City Dolomite, the Roubidoux Formation, the Gasconade Dolomite, which contains a well-defined basal sandstone member called the Gunter Sandstone member, the Eminence Dolomite and the Potosi Dolomite;

- The Doe Run Dolomite, the Derby Dolomite, the Davis Formation, the Bonneterre Dolomite, the Reagan Sandstone and the Lamotte Sandstone (these units make up the St. Francois confining unit and the St. Francois aquifer).

Regarding seismology, although there are no major mapped or suspected faults within several miles of the site, the southeastern area of Missouri is quite active seismically. The southeastern part of Missouri contains a portion of the New Madrid Fault that caused the earthquakes of 1811 and 1812. There were three quakes of Epicenter Intensity XII, based on the Modified Mercalli scale (M.M.), which took place on December 16, 1811, and January 23 and February 7, 1812, near New Madrid. The 1811-1812 New Madrid earthquakes were an intense intraplate earthquake series with an initial pair of very large earthquakes on December 16, 1811. These earthquakes remain the most powerful earthquake events to hit the eastern United States. There are estimates that the earthquakes were felt strongly over 50,000 square miles, 10 times stronger than the 1906 San Francisco earthquake.

In 1962, an Intensity V quake (M.M.) was recorded in the New Madrid area. A quake with a magnitude of 4.5 was recorded in the New Madrid area in 1963. The closest earthquake to the Hematite Site of 3.0 magnitude or greater was centered roughly 10 miles south-southeast of the facility.

Numerous fault and fracture zones that exhibit preferential orientations to the northwest-southeast and northeast-southwest have been mapped in the Ozark Plateaus. The northwest-southeast-trending Eureka-House Springs Fault Complex and the St. Genevieve fault zones intersect the northeast and southwest tips of Jefferson County, respectively. However, these fault zones are several miles away from the Hematite facility and do not appear to have any influence on the geology or hydrogeology of the area.

Several north-northwesterly trending monoclines are mapped on the Festus and DeSoto quadrangles but nothing in the immediate vicinity of the Hematite facility. The first geologic map prepared for the Crystal City 15' quadrangle identified a northeast-southwest-trending structural feature parallel to Joachim Creek (offset slightly to the south of the creek) that was termed the Crystal City Anticline.

3.6 Surface Water Hydrology

Joachim Creek, located along the southeast site boundary, is a permanent flowing stream. There are several other surface water features present on or near the site, including a spring, intermittent perennial and ephemeral streams, a lake, and ponds. Joachim Creek is a gaining stream, and therefore, a recipient of shallow groundwater discharge. This indicates that groundwater in the overburden at the Hematite facility migrates from the vicinity of the Hematite facility toward Joachim Creek where it discharges.

There are no public water supply intakes on Joachim Creek. Most of the residents in the community of Hematite receive their drinking water from a public water supply well located approximately 2.5 miles south-southeast of the town (near the intersection of Sunnyside and Carron roads). However, there are no physical or administrative restrictions preventing public use of surface water downstream of the site for commercial or recreational purposes. Thus, it is possible that local residents may use water bodies such as Joachim Creek for recreational fishing, swimming and/or boating.

Floods that might occur at the site will produce different flood levels depending upon the flow rate of Joachim Creek. While historical records (maximum observed level of 431 ft above mean sea level) and analysis by the Federal Emergency Management Agency show that a site flood is not likely, it is still considered remotely possible. If a flood of larger magnitude (greater than 432 ft above mean sea level) were to occur, water at the site would rise, but there is not expected to be any significant water velocity associated with the flooding. The reason for the minimal water velocity is that the railroad track, which is located between Joachim Creek and the plant, would serve to isolate the plant area from the main stream flow.

At the Hematite facility, a small concrete dam impoundment (Site Pond) is located in the southwestern portion of the site. The Site Pond is fed by a spring located northwest of the site. This spring likely originates in the Jefferson City-Cotter Formation and produces an estimated 1 to 10 gallons per minute most of the year. The Site Pond also receives sanitary discharge and store water runoff from the Hematite facility area. The flow from below the dam of the Site Pond becomes the Site Creek.

The Northeast Site Creek, located just east of the Hematite facility flows southeast to the east of the Burial Pit area and then east to its confluence with the flow of East Lake tributary before discharging to the Joachim Creek. East Lake, located further upstream to the east of the facility is an earth impoundment lake that has been used as a water supply for cattle.

Joachim Creek is perennial stream, with annual mean flow of approximately 130 cubic feet per second (CFS). It flows into the Mississippi River near Herculaneum, Missouri.

3.7 Groundwater Hydrology

3.7.1 Regional

The Salem Plateau groundwater province surrounds the St. Francois Mountains and includes all or parts of 49 Missouri counties, an area of about 24,760 square miles. The province is most extensive to the north, west and south of the St. Francois Mountains, and relatively small on the east side. Groundwater resources in the Salem Plateau groundwater province are the most extensive in the state. About 46.6 percent of Missouri's potable groundwater is in this region, a volume of about 233 trillion gallons. All but a very few communities and essentially all of the rural residents in this province rely on groundwater.

There are two major aquifers that underlie this region, the St. Francois aquifer and the Ozark aquifer. As in the St. Francois Mountains groundwater province, the St. Francois aquifer also consists of the Lamotte Sandstone and the overlying Bonneterre Formation. The aquifer ranges in thickness from less than 200 feet to locally more than 700 feet thick, and averages about 500 feet in thickness. Depth to the top of the aquifer ranges from less than 500 feet near the St. Francois Mountains to more than 5,000 feet in extreme eastern Missouri.

Overlying the St. Francois aquifer is 100 to 500 feet of low-permeability carbonate rock and shale including the Derby-Doerun dolomites and Davis Formation. Together, they form the St. Francois confining unit. Though these units can yield small quantities of water, they are not considered a significant aquifer. Instead, they greatly limit the interchange of water between the two aquifers. The movement of water between the Ozark and St. Francois aquifers is controlled by the thickness and hydraulic conductivity of the St. Francois confining unit, and the water-level difference between the two aquifers.

Thick Ordovician- and Cambrian-age dolomite and sandstone units comprising the Ozark aquifer overlie the St. Francois confining unit. The Ozark aquifer consists of bedrock units from the top of the Kimmswick Limestone to the base of the Potosi Dolomite. Throughout much of the province, the Ozark aquifer is generally 800 to 1,000 feet thick, but it reaches thickness exceeding 2,000 feet locally. It is considered an unconfined aquifer in most of this region.

The geologic units comprising the Ozark aquifer do not have uniform water-yielding characteristics. Generally, the younger formations have lower hydraulic conductivities than the older units. The major exception is the St. Peter Sandstone. The St. Peter underlies much of the extreme northeastern and eastern parts of the province. It can range in thickness from a few feet to more than 100 feet. Where it is sufficiently thick and deep enough to be saturated with water, it generally yields from 10 to about 40 gallons per minute. It is most widely used in this province in southwestern St. Louis County and parts of Jefferson, Perry and Cape Girardeau counties. There are several limestone and dolomite units overlying the St. Peter Sandstone that are considered part of the Ozark aquifer, but are not generally major water yielding formations. These include the Kimmswick Limestone, Plattin Formation, and Joachim Dolomite. The units between the St. Peter and the deeper high-yielding zones, including the Everton, Powell, Smithville formations and the Cotter and Jefferson City dolomites, can supply enough water for private domestic wells. Higher yields are available from these units in the southeastern part of the province, particularly in Cape Girardeau County.

Groundwater quality in this region is generally very good. The water is generally a moderately mineralized calcium-magnesium-bicarbonate type, which reflects the dolomitic bedrock in the area. Many residents use a water softener to reduce the hardness caused by calcium and magnesium levels, but the water generally requires no treatment.

3.7.2 Site-Specific

The components of the hydrogeologic system at the Hematite facility that are relevant include the unconsolidated overburden sediments, the Jefferson City-Cotter Formation, and the Roubidoux Formation.

In the unconsolidated overburden sediments, the hydrostratigraphic units consist of: (i) a relatively thick silty clay layer; and (ii) a thin sand/gravel unit underlying the overburden silty clay. The silty clay unit generally extends approximately 8 m below land surface at the Hematite site. This unit's thickness varies from 1.2 m near the banks of Joachim Creek to 11.4 m north of the Hematite facility. It generally acts as an aquitard, with a calculated mean hydraulic conductivity of 2.85E-5 cm/sec. The silty clay unit exhibits a strong downward hydraulic gradient toward the underlying sand and gravel aquifer. Some lateral groundwater movement likely occurs in silt-rich lenses within the aquitard. The preferential accumulation of water in the backfilled excavations in the silty clay unit has resulted in abnormally high water levels (mounding) around the burial pits. However, hydraulic data from the silty clay unit does not indicate the presence of perched conditions

The thickness of the sand/gravel unit in the vicinity of the Hematite facility varies from about 1.5 m in the terrace deposits at the northern facility boundary to approximately 6.1 m in the vicinity of Joachim Creek. The hydraulic gradient (0.0109 feet/foot on average) in the sand/gravel unit has a large horizontal component in the southeast direction. Permeability testing (slug tests) in the sand/gravel unit indicate a hydraulic conductivity ranging from 3.38E-4 cm/sec to 6.91E-2 cm/sec (i.e., significantly greater than the overlying silty clay unit). The estimated groundwater flow velocity is between 20 and 300 ft/year (SAIC and Geo Consultants, LLC., 2007). Ground water flow in the sand/gravel unit ultimately discharges into the Joachim Creek. Water levels in sand/gravel unit were above the silty clay aquitard and sand/gravel interface, indicating that the sand/gravel unit is under confined conditions.

Underlying the unconsolidated overburden sediments is the dolomitic Jefferson City-Cotter bedrock aquifer. The Jefferson City-Cotter bedrock unit has a mean hydraulic conductivity of 1.29E-3 cm/sec., with a southeastern groundwater flow. The temporal changes in the hydraulic heads measured in Jefferson City-Cotter appear to be correlated with those measured in the overburden hydrostratigraphic unit (HSU). In addition, volatile organic compounds that originated at the Hematite facility appear to have migrated downward and have been detected in parts of the Jefferson City-Cotter aquifer (SAIC and Geo Consultants, LLC, 2007). Based on these observations, the overburden HSU and the shallow bedrock Jefferson City-Cotter HSU appear to be hydraulically connected.

Underlying the Jefferson City-Cotter bedrock aquifer is the sandstone Roubidoux aquifer. The factures, joints, and bedding planes in the Roubidoux are observed in core to be widened by dissolution, whereas it is less apparent in the Jefferson City-Cotter core material. The Roubidoux aquifer has a mean hydraulic conductivity of 7.55E-5 cm/sec. (SAIC and Geo Consultants, LLC, 2007, Section 3.3.3). The potentiometric surfaces for the Roubidoux HSU differ significantly from that for the shallow overburden and Jefferson City-Cotter HSU, with groundwater in the Roubidoux moving predominantly northeast. It appears that Roubidoux HSU is likely a part of the intermediate regional groundwater flow system.

3.8 Natural Resources

The primary natural resources occurring at or near the Hematite facility are agricultural lands, surface water ponds and streams, and groundwater. There are some wooded areas on and surrounding the site, but the low quality of the timber makes any major harvesting unlikely.

The surface water features on and near the Hematite facility are described in Section 6 above. These surface water features are not used for drinking water, but some are used for watering livestock. Groundwater is widely used as the primary source of household water.

There are 33 surface mines within 5 miles of the Hematite facility. The closest are two limestone quarries, less than two acres in size, that are approximately 1 mile southwest of the site. The other mines consist of 1 copper, 11 lead, 2 other limestone, and 17 sandstone quarries. Most of these lie outside of a 2-mile radius from the site.

4.0 Radiological Status of Facility

The staff has reviewed the information in the "Facility Radiological Status" section of the Hematite DP according to the NUREG-1757, Volume 1, Section 16.4. Based on this review, the staff has determined that WEC has described the types and activity of radioactive material contamination at its facility sufficiently to allow the staff to evaluate: the potential safety issues associated with remediating the facility, whether the remediation activities and radiation control measures proposed by WEC are appropriate for the type of radioactive material present at the facility, whether WEC's waste management practices are appropriate, and whether WEC's cost estimates are plausible, given the amount of contaminated material that will need to be removed or remediated.

4.1 Contaminated Structures

Originally, the Hematite site contained 16 buildings that were impacted by licensed activities. On June 30, 2006, the NRC issued Amendment 52 to Hematite's License (ML061280324). This amendment authorized the WEC to dismantle and demolish Hematite's former process buildings. WEC had provided information in support of the license amendment which indicated that there was less than 250 grams of U-235 in the process buildings and that the U-235 was dispersed as surface contamination on the interior building walls and floors. Additionally, in documents supporting the demolition, WEC stated that all process equipment had been removed and there was no inventoried SNM mass in the process buildings.

On November 11, 2008, while performing surveys within the process buildings to re-verify previous characterizations of residual radiological contamination, WEC identified residual U-235 in former process pipes in excess of the 250 grams noted above. WEC's initial estimate was that 2,322 grams were present in the pipes, but additional surveys performed in early November 2008, increased that amount to an estimated 2,638 grams. As a result of these findings, WEC was required to re-characterize the buildings and the equipment within the process buildings.

The re-characterization for U-235 revealed an estimated 1,770 grams in equipment, main piping, and miscellaneous components. The re-characterization of the building surfaces identified approximately 6,730 grams on floors, walls and the roof of the process buildings.

In December 2009, WEC submitted a letter (ML093570277), which included an attachment that provided WEC's assessment of the current validation of Hematite License Amendment 52. Following WEC's submittal of two Hematite process building activities safety reports in January 2010 (ML100341241), and additional information provided in a March 22, 2010, transmittal (ML100830643), the staff issued WEC a letter and an SER on December 10, 2010 (ML102990298, ML102990346) which confirmed that WEC could proceed with the building demolition in accordance with Amendment 52.

Amendment 52 permitted the demolition of buildings down to the slab. A license condition associated with Amendment 52 stated that neither the slab nor the foundation of the demolished buildings could be removed. During the period of April – June 2011, WEC demolished all but six buildings.

WEC has not proposed to demolish the following buildings:

- Building 110 - Office Building and Security
- Building 230 - Rod Loading
- Building 231 - Warehouse

Instead, WEC intends to release the above buildings for unrestricted use prior to license termination. A description of their contamination follows.

Building 110 was constructed in 1972 and provides the facilities necessary for implementing Site Security measures, and is the primary ingress/egress location for the Hematite facility. Portions of building are also used as an office for the NRC, the MDNR, and for administrative functions required to support decommissioning activities. The historical information that was compiled and documented in the Historical Site Assessment Report by WEC did not indicate that radioactive material was used in this building. However, survey results indicate that Building 110 is impacted and contains slightly elevated levels of radioactivity in excess of background levels on the interior and exterior horizontal surfaces, as well as the ventilation ducts. The building drain system also contains elevated levels of radioactivity based on gamma radiation measurements obtained within the piping. The highest contact exposure rate for the drains was 10 microRoentgen per hour (μR/hr) and was obtained from within Drain 1 located in the restroom adjacent to the security monitoring station. All other general area radiation levels ranged from 4 μR/hr to 6 μR/hr. The floor surface adjacent to Drain 1 showed a slightly elevated alpha-plus-beta concentration of 1,467 disintegrations per minute per 100 square centimeters (dpm/100 cm^2). The floor surface adjacent to Drain 3 also showed a slightly elevated alpha-plus-beta concentration of 3,192 dpm/100 cm^2. WEC plans to make additional measurements of these drains during site remediation, and based upon that data and the cost of removal versus decontamination and/or in-situ survey, select an appropriate course of remediation action.

Building 230 is a split level mezzanine building constructed in 1992 and housed the equipment used for the final assembly of fuel rods for commercial nuclear power operations. The building currently houses offices and material storage areas needed for the decommissioning. The survey results identified that a portion of the floor surface and portions of the ventilation system, the utility trenches, and the floor drains have been impacted by the former licensed production activities. Elevated activity was identified primarily on floor surfaces in the Kardex Room and the bathroom floors located on the first floor. A limited number of isolated spots were also identified within the seams and joints on the concrete floor in various locations throughout the building and an isolated location in a utility trench. The highest alpha-plus-beta surface activity concentration for floors was identified in the men's bathroom at a concentration of 126,049 dpm/100 cm^2. Based upon WEC's initial review of the measurement results of surface contamination in the men's bathroom, the benches and several floor tiles were removed and the exposed surfaces were decontaminated. Post-remediation surveys of these areas were slightly higher than background levels. The general area radiation levels ranged from 3 to 8 μR/hr. The highest elevated alpha-plus-beta concentration for drains was obtained from the opening of Drain 15 (hallway closet drain) at 35,487 dpm/100 cm^2. For this building, WEC determined and identified the storm and sanitary drains that will potentially undergo FSSs and remain in place post-decommissioning along with their associated DCGLs. WEC plans for additional surveys of drains throughout the building during site remediation. This will aid WEC in confirming whether FSSs or removal is the appropriate course of action.

Building 231 was erected in 1996 and used to store radioactive material shipping containers. Additionally, some shipping container refurbishment was performed in this building and it was also used as a temporary storage facility for contaminated items. Building 231 is an open rectangular warehouse. Characterization surveys of Building 231 indicated that surface activity and the general area radiation levels are at or near background levels. The general area radiation levels ranged from 3 μR/hr to 6 μR/hr. Nevertheless, WEC considered Building 231 to be an impacted structure due to location on the site.

WEC identified three structures, Building 115, the Sanitary Wastewater Treatment Plant (SWTP) Shed and Building 235, which may be demolished at some point after DP approval or, if deemed economically advantageous, remain intact after license termination. WEC considered each of these structures to be impacted with contamination levels in excess of background. If the decision is made that these buildings are to remain and be subjected to FSSs, then WEC will perform additional characterization surveys to support the new Data Quality Objectives (DQOs) for these structures. WEC indicated that the final decision to demolish or decontaminate these three buildings will be made based on a consideration of cost. A description of the contamination associated with each of these buildings follows.

Building 115, the Fire Pump House, has no history of radioactive material use. Based on the previous WEC characterization work, it does not appear that the placement of waste in nearby burials impacted the subsurface of the building. WEC plans to use this building to support decommissioning such as sorting/measuring trash or other objects. Consequently, it may be exposed to radioactive materials.

The SWTP Shed, which houses equipment and instrumentation associated with water treatment, will be subjected to an FSS prior to license termination. The final radiological status of the system process components will be determined when the system is taken out of service and the tanks and piping made available for sampling and surveys. WEC also plans to use this building to support decommissioning so it may be exposed to radioactive materials. The SWTP Shed may also be used for sorting/measuring trash or other objects.

The West Storage Building was constructed as part of the original facility in 1956 and was used as a uranium storage building. Operational survey results indicate that residual radioactive material exists on the surfaces in excess of background levels. Based on the operational use of the building, which only involved storage of dry material, and due to the absence of floor drains, WEC believes it is unlikely that the subsurface has been impacted. WEC plans to leave this building in place during most of the decommissioning process for temporary storage of contaminated materials.

WEC considered the surfaces of the slab and/or foundations of the buildings discussed above to have residual contamination in excess of background and therefore, were considered to be impacted. WEC indicated that the final disposition of the slabs in each of these buildings will be based on the relative cost for demolition, and the cost for decontamination and subsequent final survey.

The staff has reviewed the information in Section 4.1 (Contaminated Structures) of the WEC Hematite DP and associated RAI responses according to 10 CFR 70.38(g)(4) and the NRC staff guidance in NUREG-1757, Volume 1, Section 16.4.1 and Appendix D, Section IV.a. Based on this review, the staff has determined that WEC has provided sufficient information on the contaminated structures to allow the staff to evaluate WEC's planned decommissioning activities to ensure that the decommissioning can be conducted in accordance with the NRC's applicable regulatory requirements.

4.2 Contaminated Systems and Equipment

WEC removed above ground contaminated systems and equipment from the process buildings prior to their demolition. Those systems that will remain at the time of DP approval are:

- Ventilation Systems in Buildings 110, 230, and 231 (Building 231 contains only local unit heaters);
- Equipment in the SWTP Shed; and
- Underground Storm Water Drain and SWTP piping system

WEC indicated that the radionuclides present and activity fractions in the systems and equipment are the same as those in the contaminated structures where the systems and equipment are located.

WEC measured contamination levels for the ventilation systems at the accessible ducts within Buildings 110 and 230. Measurements showed residual radioactivity levels to be far less than the proposed release criteria. WEC has indicated that additional measurements will be obtained throughout the ventilation systems at the time of the FSS to confirm suitability for unrestricted release.

The underground systems consist of the Storm Water Drain System (Buildings to Outfall #3) and the SWTP (Buildings to Outfall #1). Historically, the Storm Water Drain System and SWTP have both received discharges from multiple site structures during operation of the facility. Hematite facility operating history and radiological effluent monitoring indicate that these underground systems contain licensed material.

The underground Storm Water Drain System directs water from building roof areas and ground surface drains flows to the Site Pond. During the Hematite facility's former production operations, the Storm Water Drain System also received condensed steam from the Uranium Hexafluoride (UF_6) vaporizer steam jackets and cooling water from heat exchangers. Facility operating history, building and soil characterization surveys and effluent monitoring indicate the underground Storm Water Drain System is contaminated with radiological constituents in excess of background levels.

The underground SWTP historically received discharge from multiple site structures during operation of the facility. It receives water from sinks, toilets, showers and drinking fountains. The SWTP was also used to receive laundry water (after the water was filtered and held for sampling) and waste water from the process water demineralizer system and laboratory sinks. Facility operating history, building and soil characterization surveys and effluent monitoring indicate that the underground SWTP is contaminated with radiological constituents in excess of background levels.

The SWTP Shed consists of a series of settling and aeration tanks and an adjacent building that contains data logging and electronic instrumentation, floor drains, and an open work area. The portions of this system that have been impacted by licensed production activities are limited to the process components in contact with waste water, and that have the potential to collect solids that have settled out of the waste fluid.

The staff has reviewed the information in Section 4.2 (Contaminated Systems and Equipment) of the WEC Hematite DP and associated RAI responses according to 10 CFR 70.38(g)(4) and the NRC staff guidance in NUREG-1757, Volume 1, Section 16.4.2 and Appendix D, Section IV.b. Based on this review, the staff has determined that WEC has provided sufficient information on the contaminated systems and equipment to allow the staff to evaluate WEC's planned decommissioning activities to ensure that the decommissioning can be conducted in accordance with the NRC's applicable regulatory requirements.

4.3 Soil Contamination

The staff reviewed the results of WECs soil investigations provided in Section 4.3 of the DP and Section 4 of the Hematite Radiological Characterization Report (HRCR). The HRCR was submitted in July 2009, in support of the DP (ML092870496 and ML092870506). The soil was surveyed for the following radionuclides: Americium-241, Neptunium-237, Plutonium-239/240, Radium-226, Technetium-99, Thorium-232, Uranium-234, Uranium-235, and Uranium-238. Several surface and sub-surface soil sampling investigations were completed across the site, and non-impacted and impacted areas were defined accordingly. Results were compared to background soil samples taken at off-site locations considered to be representative of soil types which would be found on-site. WEC performed a statistical assessment of background data from the HRCR and background threshold values for total uranium (2.4 pCi/g), Thorium-232 (1.7 pCi/g), and Radium-226 (1.6 pCi/g) were developed. A threshold value of 1.2 pCi/g was also calculated for Technetium-99, based on the 99% nonparametric percentile of the population. The soil analytical data presented by WEC indicated the following elevated surface soil contamination locations and their constituents:

- Burial Pits Soil - Total Uranium, Technetium-99, and Thorium-232 (isolated);
- Site Pond, Site Creek and Surrounding Soil and Sediment - Total Uranium, Technetium-99, Thorium-232 (isolated);
- Soil Beneath and Surrounding the Process Buildings - Total Uranium and Technetium-99;
- Soil Southeast of the Process Buildings and Surrounding Areas - Total Uranium, Technetium-99, and Thorium-232 (isolated); and
- Soil Beneath and Surrounding the Barns, Cistern Burn Pit and Red Room Roof Burial - Total Uranium and Technetium-99.

WEC also conducted a gamma walkover survey (GWS) using a 2 x 2 NaI detector coupled to a GPS data logger. Elevated gamma readings were identified near the railroad tracks, which WEC has attributed to Rhyolite Porphyry, a natural material containing uranium and thorium, which was used under track beds.

For sub-surface soil existing below 15 cm, the elevated areas are listed as:

- Burial Pits Soil - Total Uranium, Technetium-99, and Radium-226 (isolated to the Radium-226 Impacted Area);
- Site Pond, Site Creek and Surrounding Soil - Total Uranium and Technetium-99 (isolated);
- Soil Beneath and Surrounding the Process Buildings - Total Uranium and Technetium-99;
- Soil Southeast of the Process Buildings and Surrounding Areas - Total Uranium and Technetium-99; and
- Soil Beneath and Surrounding the Barns, Cistern Burn Pit and Red Room Roof Burial - Total Uranium and Technetium-99.

During its review, staff identified several review areas related to soil contamination that required additional information. Staff's Chapter 4 RAIs requested information on the radiological status of subsurface soil and the soil underneath buildings which were to remain following license termination (RAI 4-Q1 - ML102810455). WEC provided their response in December 10, 2010, and December 21, 2010, RAI responses (ML103490100 and ML103560708). RAI response 4-Q1 included a cross reference table which indicated the site areas where soil characterization has been performed. Staff's Chapter 4 RAI 4-Q6 (ML102810455) requested additional details on how soil contours were developed to show radioactivity under buildings. The WEC response clarified how concrete coring was performed during site characterization and WEC provided new information on core boring activities completed in 2010. WEC performed this coring in order to further characterize the depth of penetration and the radionuclide contribution to contamination in concrete. WEC also took samples from the soil/gravel fill beneath the cores. WEC provided a table of data along with a figure showing the soil sample locations underlying the process building. A total of 21 samples were analyzed for Technetium-99, Uranium-234, Uranium-235, and Uranium-238. The results indicated that Uranium-234 and Uranium-238 activities above the proposed surface soil DCGL are present underneath Building 240 (Red Room).

WEC's RAI 4-Q6 response provided adequate characterization of surface soil underneath the process buildings, but there were still staff concerns that subsurface contamination may not be completely characterized. This concern was based in part on an elevated Technetium-99 (112 pCi/g) sample that was taken under Building 253. This location is in close proximity to Hematite monitoring wells (BD02 and BD04) which have also exhibited elevated Technetium-99 levels. Similar concerns regarding elevated subsurface contamination were raised in staff's Radiological Characterization Report RAIs, RCR 09-Q1 and RCR 09-Q2 (ML101740167). As a result of these concerns, WEC provided an "Evaluation of Technetium-99 Under the Process Buildings" on May 5, 2011(ML111260624). This evaluation provided additional details on the historical usage of former process buildings and on the various soil and subsurface water sampling regimes that have taken place. Additional details were also provided on planned excavation activities and post-excavation subsurface soil sampling. These activities are described in greater detail in Section 8.3 of this SER. The information provided in the “Evaluation of Technetium-99 Under the Process Buildings” also described historical subsurface sampling efforts from 2003 and 2007, along with future sampling that will take place underneath the Red Room and Erbia Room areas. WEC’s Technetium-99 evaluation provided more information on the characterization process undertaken by WEC at the site and WEC commitment to additional characterization as discussed in Section 5.2.1 of this SER addressed the concerns raised by staff in RAIs RCR-09-Q1 and RCR-09-Q2.

An apparent discrepancy between Erbia Room subsurface data provided in the 2006 Hematite DP (DO-04-004) and the 2009 DP was also identified by staff (RAI RCR-09-Q3). WEC provided additional clarification regarding this discrepancy in their July 30, 2010, response (ML102140158). In RAI RCR 09-03 (ML101740004) the staff requested WEC conduct an audit of sampling information provided in the HRCR and that, based on the review of the data, WEC provide corrections to the data table(s) and to any conclusions, as appropriate. In Attachment 8 of WEC’s July 30, 2010 , response to the Characterization Report RAIs (ML102140158), WEC provided a “Detailed Description of RCR Discrepancies Identified” and committed to add these results as an appendix to the DP. WEC’s response to RCR-09-Q3 contained limited and inconclusive details on the impacts of excluding the data. Accordingly, the staff independently reviewed the data provided in Attachment 8 and concluded that the exclusion did not impact the determination of survey units or initial area classifications.

The staff has reviewed the information in Section 4.3 (Soil Contamination) of the WEC Hematite DP and associated RAI responses according to 10 CFR 70.38(g)(4) and the NRC staff guidance in NUREG-1757, Volume 1, Sections 16.4.3 and 16.4.4 and Appendix D, Sections IV.c and IV.d. Based on this review, the staff has determined that WEC has provided sufficient information on contaminated soil to allow the staff to evaluate WEC’s planned decommissioning activities to ensure that the decommissioning can be conducted in accordance the NRC’s applicable regulatory requirements.

4.4 Surface Water

WEC sampled the surface water bodies at and in the vicinity of the Hematite facility to determine the potential impact of radionuclides resulting from historical and present site operations. Surface water features investigated by WEC included the Site Pond, Site Creek, Northeast Site Creek and Joachim Creek. WEC analyzed the surface water for the following radionuclides: Thorium-232, Technetium-99, Uranium-234, Uranium-235, Uranium-238, along with gross alpha and gross beta. In addition to the radionuclides analyzed in the surface water samples, groundwater was also monitored and analyzed for Americium-241, Neptunium-237, Plutonium-239, and Plutonium-240 on selected samples during the site-wide ground water monitoring.

The Site Pond, which is fed by a natural spring, also receives storm water runoff from the Hematite plant area. WEC’s investigation of the Site Pond water quality indicated the presence of total uranium at 32 pCi/L, gross alpha at 38.9+/-8.1 pCi/L, and gross beta at 34.7+/-7.0 pCi/L. The investigation found elevated uranium activity in the Site Pond relative to surface water samples from upstream of the Hematite facility. In addition, elevated Technetium-99 activity was also detected in the water samples collected from the Site Pond

The Site Creek, which flows out of the Site Pond, also receives discharge from the SWTS at Outfall 1 located directly below the Site Pond dam. WEC's investigation of the Site Creek water quality indicated the presence of total uranium at 2.0 pCi/L. Similar to the Site Pond, elevated Technetium-99 activity was also detected in the water samples collected from the Site Creek.

Relative to the Hematite facility, the Northeast Site Creek flows just east of the Burial Pits. As such, the Northeast Site Creek receives surface runoff from the Burial Pits area, paved and unpaved areas southwest of Building 252, and the east side of the central site tract of the Hematite facility at Outfall 4 and 6. Water quality analysis of the Northeast Site Creek indicated total uranium levels at 2.7 pCi/L, which was slightly above the background level.

As a perennial creek located along its southeast boundary, Joachim Creek is directly downgradient of the historical site operations conducted at the Hematite facility. As such, it receives surface water flow from the Site Creek and the Northeast Site Creek as well as shallow ground water discharge. WEC's investigation of the Joachim Creek water quality indicated no radiological impact (gross alpha, gross beta, and total uranium) above background levels.
The staff has reviewed the information in Section 4.4 (Surface Water) of the WEC Hematite DP and associated RAI responses according to 10 CFR 70.38(g)(4) and the NRC staff guidance in NUREG-1757, Volume 1, Section 16.4.5 and Appendix D, Section IV.e. Based on this review, the staff has determined that WEC has provided sufficient information on the surface water to allow the staff to evaluate WEC's planned decommissioning activities to ensure that the decommissioning can be conducted in accordance with the NRC's applicable regulatory requirements.

4.5 Groundwater

In the HRCR, the potential radionuclides of concern (ROC) for the site are uranium isotopes (Uranium-234, Uranium-235, and Uranium-238), Technetium-99, Thorium-232, Radium-226, Americium-241, Neptunium-237, and Plutonium-239. The chemical analyses of groundwater samples collected from the monitoring wells completed in various hydrostratigraphic units confirmed that only Uranium-234, Uranium-235, Uranium-238 and Technetium-99 are the primary radionuclides of concern in groundwater.

The sources of radioactivity which may contribute to groundwater contamination at Hematite include:

1) Wastes in the Burial Pits,
2) Contaminated soil beneath the main process buildings,
3) Spent limestone in the storage area, and
4) Contaminated soils associated with evaporation ponds

4.5.1 Overburden Clay and Silty Clay

Most occurrences of radiologic activity in the overburden groundwater are found beneath and immediately down gradient of the source areas indicated above. Based on the monitoring data collected in 2007 and 2008, total uranium concentrations were sporadic in the overburden monitoring wells, ranging from 39.23 to 268.8 pCi/L (BD-02, BD-03, BD-04, and BD-6) beneath the process building, from 143.5 to 244.8 pCi/L (DM-02) in the limestone storage area, and from 79.03 to 259.5 pCi/L (WS-24) near the northeastern end of the burial pit area. In November, 2006, a maximum total uranium of 8,480 pCi/L was detected in the groundwater (leachate) within the overburden located in the burial pit area (Table 4-28 in ML092330129). Within the Hematite site, the extent of total uranium activity exceeding 30 pCi/L in the overburden groundwater appears to be limited. Technetium-99 was found in the groundwater in the vicinity of the main process buildings, spent limestone storage area, and evaporation ponds. Technetium-99 activity levels ranged from 1.55 to 6,400 pCi/L. The highest Technetium-99 activity level was detected beneath Building 240 (BD-02) in June 2007, with the plume extending eastward from Building 255.

WEC's investigation of the overburden ground water quality included sampling and analysis of samples from hybrid wells (i.e., wells screened across both the silty clay and sand/gravel overburden units). Since samples from these wells likely contain a contribution from both overburden units, the data from these wells provides an incomplete picture with respect to the radiological status of the sand/gravel unit. The information provided from WEC (ML103560708) in response to the staff's RAIs 4-Q8 and 4-Q12 (ML102810455) included the fact that WEC installed eleven monitoring wells screened solely in the sand/gravel unit in 2009 and that additional groundwater monitoring data were collected from these sand/gravel wells during 2009-2010. Data from these wells (discussed in Section 4.5.2 of this SER) indicates that the radiologic impact on the sand/gravel unit appears limited and that the radiological contribution to the hybrid wells water samples appears to be primarily from the silty clay unit. Based on these data, it is highly likely that the hybrid well screens may have facilitated the transport of water/sediment impacted with radionuclides from the silty clay overburden into the water sample during well purging and sampling..

The additional monitoring data from 2009–2010 further defines the elevated Technetium-99 groundwater impact areas located within the overburden units at the east and southeast of Building 256 - spent limestone storage area, and around the evaporations ponds. The distribution of Technetium-99 in the groundwater associated with the limestone storage appears to extend between east/southeast of Building 255, across the storage area to just south of the railroad track, with Technetium-99 exceeding 500 pCi/L located around the former storage area. In the vicinity of the evaporation ponds, the Technetium-99 impacted groundwater in the clay overburden was investigated by a number of monitoring wells (e.g., EP-20, EP-16, EP-15, EP-14, and PL-6). The contamination is primarily located between the evaporation ponds and the railroad track to the south. The range of Technetium-99 activities in the groundwater varies from 92.3 to 2,280 pCi/L, with the highest activities observed just southeast of the ponds (Well EP-20). The Technetium-99 plume also extends to the west of the ponds near Building 231, with the magnitude of Technetium-99 deceasing significantly to approximately 90 pCi/L as observed in Well PL-6.

4.5.2 Sand/Gravel

WEC responses (ML103560708) to staff RAI 4-Q12 (ML102810455) provided further information on the radiological impact on the sand/gravel unit. Data from the eleven monitoring wells installed within the sand/gravel unit downgradient of the identified source areas in September 2009 indicated that the sand/gravel aquifer has only been minimally impacted by radionuclides. Total uranium activity of up to 8.6 pCi/L and Technetium-99 of up to 157 pCi/L were found in the sand/gravel aquifer. The highest Technetium-99 activities in the sand/gravel aquifer were detected in monitoring well GW-X. Activity levels varied between 96 and 157 pCi/L during the 3rd Quarter 2009 through the 3rd Quarter 2010. As GW-X is not located in the downgradient direction of identified Technetium-99 source areas, the detection of Technetium-99 in both the sand/gravel well (GW-X) and hybrid well (PL-6) with activity levels of similar magnitude may indicate that the groundwater contamination of sand/gravel aquifer in the vicinity GW-X/PL-6 is from an unknown source. Additional information provided by WEC (ML111880290) on July 5, 2011, following its response to RAI 4-Q8 suggests that the former leach field and leaking of a sewer treatment pipe could be the potential sources for the observed groundwater contamination. WEC further explained that the source of the Technetium-99 detected in hybrid well NB-31 could be the former ring storage area, which is located northwest (upgradient) of well pair GW-V/NB-31. A discrete silt or sand lens with higher permeability in the silty clay overburden may have contributed to the preferential migration of Technetium-99 from the former ring storage area to well NB-31.

The uranium and Technetium-99 levels observed in the sand/gravel aquifer in the vicinity of the Hematite facility are significantly below the respected EPA Maximum Contaminant Levels (MCLs) of 30 µg/L (or 20 pCi/L) for uranium and 4 millirem/year(or 900 pCi/L) for beta/photon emissions (ML103560708). The extent of groundwater impacted with Technetium-99 above the background level (1.5 pCi/L) in the sand/gravel aquifer is approximately 700 ft beyond the railroad tracks into the Joachim Creek flood plain.

4.5.3 Bedrock Aquifer

In RAI 4-Q14 (ML102810455), the staff requested information on the methodology used by WEC and the detailed statistical data in the determination of the radiological background threshold value (BTV) for the Jefferson City-Cotter and Roubidoux bedrock aquifers. WEC's response of December 21, 2010 (ML103560708), indicated that the statistics of isotopic data collected from wells BR12JC and BR12RB were calculated using ProUCL and were used in establishing the background levels. WEC determined a BTV for total uranium of 8.6 pCi/L for the bedrock aquifers. WEC committed in ML103560708 to revise DP Section 4.5.2. to include the updated background statistics, BTV, and a new summary statistics table.

Because the background levels for the maximum concentrations of gross alpha and gross beta shown in DP Table 4-28 exceeded EPA drinking water standards established for the bedrock aquifers, WEC treated this data as being outliers. In RAI 4-Q15 (ML102810455), the staff requested WEC evaluate the nature and extent of gross alpha and gross beta activity levels in the bedrock and their relationships to isotopic concentrations in the aquifers. Among the samples collected from 2004 through 2010 in the bedrock aquifers, about 2.3 percent were outliers or anomalies. The staff concluded that the anomalies in the results of samples collected in June 2007 from BR-01-JC and BR-04-JC were probably the result of sediment being in the samples. The identified outliers or anomalies in the sample results were either not supported by the isotopic concentrations, or/and the subsequent sampling results were found around the background levels. Based on the staff's understanding of the subsurface groundwater flow systems at Hematite, the staff concluded that it was unlikely that site operations would have negatively impacted the bedrock aquifers as there are only minimal levels of uranium and Technetium-99 detected in the sand/gravel HSU located above the bedrock aquifers.

The staff has reviewed the information in Section 4.5 (Groundwater) of the WEC Hematite DP and associated RAI responses according to 10 CFR 70.38(g)(4) and the NRC staff guidance in NUREG-1757, Volume 1, Section 16.4.6 and Appendix D, Section IV.f. Based on this review, the staff has determined that WEC has provided sufficient information on the groundwater to allow the staff to evaluate WEC's planned decommissioning activities to ensure that the decommissioning can be conducted in accordance with applicable NRC regulatory requirements.

5.0 Dose Analysis

Subpart E to 10 CFR Part 20, "Radiological Criteria for License Termination," establishes criteria for the release of sites for unrestricted use. Specifically, the residual radioactivity that is distinguishable from background level must result in a total effective dose equivalent (TEDE) to the average member of the critical group that does not exceed 25 mrem/yr, and the residual radioactivity must also be reduced to levels that are as low as reasonably achievable (ALARA).

WEC has chosen to develop derived concentration guideline levels (DCGLs) to demonstrate compliance with the dose based criteria. DCGLs are the levels of each radionuclides of concern (ROCs) that would result in a dose of 25 mrem/yr. When more than one radionuclide is present, the sum of fractions rule is applied to ensure that the total dose remains within the limit. The sum of the fractions methodology takes the radionuclide concentration for each radionuclide present and divides it by the DCGL of the same radionuclide for all of the ROCs and sums them. The sum of the ratios of all the ROCs must be less than or equal to one.

The DCGL approach assumes that the entire site is right at the concentration that results in 25 mrem/yr to the average member of the critical group. Because of the conservative assumption that the entire site is at the calculated DCGL, this compliance approach provides the NRC staff with reasonable assurance that the exposure will not exceed the regulatory-specified limit of 25 mrem/yr.

The DP establishes DCGLs to an average member of the critical population group for soil and buildings. This Chapter describes the staff's review of the development of the DCGLs for the Hematite Site.

The staff has reviewed the dose modeling analyses for the Hematite site as part of the review of the WEC's DP according to NUREG-1757, Volume 2, Section 5.2. The following provides a summary of that review.

5.1 Building Surfaces

5.1.1 Source Term

The ROCs in the buildings remaining on the Hematite site include Uranium-234, Uranium-235, Uranium-238, Technetium-99, Americium-241, Neptunium-237, Plutonium-239/240, and Thorium-232. Radium-226 was not included as a ROC in the buildings, even though it was identified as a ROC at two locations in the buried waste, because the operations in the buildings did not involve Radium-226 and it is, therefore, not expected to be present in the buildings.

5.1.2 Building Site Conceptual Model

WEC stated in the DP that the current plan is for three buildings to remain after license termination (Building 110, Building 230, and Building 231). WEC also stated that possibly three other structures, (the Fire Pump House (Building 115), the West Storage Area (Building 235) and the Sanitary Wastewater Treatment Shed), may also remain after closure.

WEC considered two room sizes in the dose assessment modeling calculations: a large open warehouse and a small office. The size of the warehouse was based on the smaller of the warehouse buildings expected to remain because the dose is expected to be higher in a smaller room since the receptor is located nearer to the walls. The calculations performed assumed that the contamination was limited to the building surfaces and that less than 10% of the residual radioactivity will be removable. WEC stated that they did not believe that volumetric contamination existed within the buildings expected to remain at the time of license termination. Additionally, WEC stated that in the event that volumetric contamination was identified, the material would be disposed of or appropriate DCGL values would be developed and provided to the NRC for approval at that time (ML111030152).

NRC staff finds that this conceptual model is reasonable for the residual contamination in the buildings that will remain following license termination because the conceptual model assumed is consistent with configuration of the contamination in these buildings. The rooms evaluated in this conceptual model (i.e., a small office and a large warehouse) are representative of the rooms in the buildings and the potential dose to a worker in these rooms bounds the potential dose in rooms of other sizes. Additionally, NRC staff finds that WEC's proposed approach for volumetric contamination is acceptable because it is unlikely that the buildings that will remain at the time of license termination will have significant amounts of volumetric contamination. Also the proposed approach ensures that if volumetric contamination is found, it will either be removed from the building or assessed using the appropriately calculated and NRC approved DCGLs.

5.1.3 Scenario

The industrial worker scenario was assumed by WEC in the calculation of DCGL values for the site buildings. This individual is assumed to perform light commercial work over the course of the year. The modeled pathways of exposure for this worker include: direct exposure from residual surface contamination, inhalation of airborne contamination, and ingestion of removable surface contamination. NRC staff finds that this scenario is reasonable and appropriate for the buildings remaining on the Hematite site because the expected future use of these buildings is industrial or commercial use.

5.1.4 Computer Code and Building Site Specific Parameters

RESRAD-BUILD code Version 3.4 was used by WEC to calculate the building DCGL values. The model was run deterministically for the calculation of the DCGL values, but a probabilistic uncertainty analysis was also performed to identify sensitive parameters. The dose was calculated over a 30 year evaluation period, but the peak dose was at the initial time.

The receptor was assumed to stand in the center of the room at a height of 1 m off the floor. The small office was assumed to have a length of 2.4 m, a width of 2.7 m, and a height of 2.4 m. The large warehouse was assumed to have a length of 17 m, a width of 30 m, and a height of 7.3 m.

The physical parameter values assumed by WEC in RESRAD-BUILD were based on the results of a sensitivity analysis, with the exception of the removable fraction and the air fraction. This sensitivity analysis is described in more detail in the next section. The parameters that were identified as sensitive were assigned the 25th or 75th percent of the parameter distribution, depending on which was more conservative. The mean or median of the distribution was used for the parameters that were not sensitive.

A building air exchange rate of 0.83 hr^{-1} was assumed by WEC based on the 25th percent of the Probability Density Function (PDF) for this parameter in NUREG/CR-6697, "Development of Probabilistic RESRAD 6.0 and RESRAD-BUILD 3.0 Computer Codes," dated December 2000, (ML010090252 and ML010090278). In staff RAI 5-Q15 (ML101760058), the staff asked how this parameter value compared to the exchange rates in the buildings that are expected to remain on site following decommissioning. In response to this question, WEC provided air exchange information for the buildings that may remain at the time of license termination (ML102740175). The current air exchange rates in Buildings 110 and 230 range from 0.9 to 35.5 hr^{-1}. Because the dose is inversely proportional to the air exchange rate, the value selected by WEC for the air exchange parameter in the model is conservative compared to the actual exchange rate in these buildings. Building 231 does not have a ventilation system, so WEC estimated the amount of natural circulation that occurs in this building using the PHPAIDA calculator. The result of this calculation was an air exchange rate of 0.28 hr^{-1} when the rollup door is open and an air exchange rate of 0.13 hr^{-1} when the door is closed. Since these values would result in a higher dose than the air exchange rate assumed in the model, WEC calculated Building-Specific DCGL values for Building 231 (assuming that the contamination is only present on the floor) to see how they compared to the DCGL values calculated for the small office. WEC found that the DCGL values calculated for the small office bound the Building-Specific DCGL values for Building 231 even though this building has a lower air exchange rate than was assumed.

A value of 17,918 days was assumed by WEC for the source lifetime parameter in RESRAD. This value was based on the 25th percentile of the distribution for this parameter in NUREG/CR-6697. In RAI 5-Q14 (ML101760058), the staff noted that this distribution is a triangular distribution with a most likely value of 10,000 days. Since the dose is inversely correlated with this parameter, the staff did not believe that it was conservative to use a value that is more than the most likely value. In the response (ML102290015) to this RAI, WEC noted that the most likely value in this distribution was based on the release of solid powders that are covered with a substantial layer of debris or are constrained by indoor static conditions. Further, WEC stated that they did not believe that these conditions were applicable to Hematite. However, it was not clear to the staff that these conditions are really different than the conditions at the Hematite site because the source lifetime parameter applies to the removable fraction of the contamination. This loose contamination might behave in a similar manner as the constrained solids that were the basis for the 10,000 day parameter value. To determine if this issue was significant, the staff performed a sensitivity analysis on this parameter and found that the dose did not change significantly based on the variability of this parameter. Therefore, because the value assumed for the source lifetime parameter is not risk significant for this site, the staff finds that the value selected by WEC is acceptable.

WEC assumed a value of 8.07E-05 m/s for the deposition velocity and a value of 5.73e-8 s^{-1} for the re-suspension rate based on the median of the PDFs in NUREG/CR-6697. The removable fraction assumed was 0.1 based on NUREG/CR-5512, Vol. 3, "Residual Radioactive Contamination From Decommissioning – Parameter Analysis," Draft Report for Comment dated October 1999 (ML082460902). The air fraction was assumed to be 0.07 since this is the most likely value in NUREG/CR-6697and this is reported as being the bounding value for contaminated non-combustible solids.

WEC selected values for the behavioral and metabolic parameters based on the mean of the PDF for the parameter in NUREG/CR-5512, Vol. 3. Using this methodology, the assumed value for the fraction of time the receptor spends indoors was 0.27, the assumed breathing rate was 33.6 m^3/d, and the assumed ingestion rate was 1.1E-04 m^2/hr. A value of 2.94E-06 hr^{-1} was assumed for the direct ingestion in the small office and a value of 6.14e-8 hr^{-1} was assumed for the direct ingestion in the warehouse. These values were calculated from the 1.1E-04 m^2/hr ingestion rate described above and the surface areas of the rooms. As noted in RAI C5-Q12 (ML101760058), the staff proposed that the values used for direct ingestion in WEC's analysis were for indirect ingestion rather than for direct ingestion. However, because the amount of direct ingestion (i.e., direct eating of the source) is expected to be zero in this scenario, the values used by WEC in their calculation are conservative and, are therefore, acceptable.

For the reasons described above, the staff concludes that the parameter values selected for determination of building surface DCGL values are appropriate and reasonable for the scenario selected for Hematite. WEC selected conservative values for sensitive parameters and mean literature values for non-sensitive parameters.

5.1.5 Sensitivity and Uncertainty Analysis

WEC performed a sensitivity analysis for the dose from residual contamination in the buildings using the Uncertainty Analysis module in RESRAD-BUILD. This analysis assumed relative ratios of radionuclides based on a limited number of samples from the buildings. Any parameter for which the partial rank correlation coefficient (PRCC) value was above 0.1 was identified as being sensitive. As described above, the physical parameters that were sensitive were assigned the 25th or 75th percent of the parameter distribution, depending on which was more conservative.

In RAI 5-Q16 (ML101760058), the staff questioned whether WEC's sensitivity analysis reflected the range of relative ratios of radionuclides that could be present. In particular, the staff was concerned that the ratios were based on a small number of samples and that many of these samples came from the floor drains which might have different relative ratios of radionuclides than the other building surfaces. In response (ML102290015) to this RAI, WEC stated that the limited population of samples outside of the drains was due to the absence of any significant amount of contamination on the surfaces. WEC had also assessed the dose contributions from the individual radionuclides under a range of assumed ratios and found that in all cases the majority of the dose was due to the uranium isotopes. The staff performed their own independent sensitivity analysis of the dose calculations to the various parameters for each radionuclide and found that there was not a significant difference in the sensitive parameters for the different radionuclides. Therefore, the staff concluded that the sensitivity analysis performed by WEC adequately identified the sensitive parameters.

5.1.6 Calculated DCGL values

The RESRAD-BUILD code was run using the parameters described above to calculate the dose for a concentration of 1 dpm/ 100 cm^2 for each radionuclide. The 0.25 mSv/yr (25 mrem/yr) limit was divided by this dose to source ratio to determine the DCGL for each radionuclide. The DCGL values calculated for the small office were limiting, so these values are the appropriate ones for the building surface DCGLs. The DCGL values for the building surfaces generated by WEC are provided in the following table. As described in Section 14.1.1.2 of this SER, WEC used these individual radionuclide DCGL values and the relative ratios of the radionuclides to generate a gross DCGL value.

Table 5-1 DCGL Values for Building Surfaces

Radionuclide	DCGL dpm/100 cm^2 (Bq/100 cm^2)
Uranium-234	20,000 (333)
Uranium-235 +D	19,000 (317)
Uranium-238+D	21,000 (350)
Technetium-99	13,000,000 (217,000)
Thorium-232 +C	1,200 (20)
Neptunium-237 +D	2,700 (45)
Plutonium-239/ Plutonium-240	3,500 (58)
Americium-241	3,400 (57)

5.1.7 Area Factors

Area factors were calculated for small areas of surface contamination in the buildings using the small office scenario. These calculations used the same parameter values as the DCGL calculations except that the contamination was assumed to be located only on the floor. The areas that the area factors were calculated for ranged from 1 m^2 to 6.5 m^2. The area factors generated by WEC are provided in the table below.

Table 5-2 Area Factors for Building Surfaces

Radionuclide	Elevated Measurement Area		
	6.5 m^2	4 m^2	1 m^2
Uranium-234	1	1.6	6.5
Uranium-235 +D	1	1.6	6.1
Uranium-238+D	1	1.6	6.4
Technetium-99	1	1.6	6.4
Thorium-232 +C	1	1.6	6.1
Neptunium-237 +D	1	1.6	6.4
Plutonium-239/ Plutonium-240	1	1.6	6.5
Americium-241	1	1.6	6.5

5.1.8 NRC Independent Analysis

The staff performed independent analyses using RESRAD-BUILD to confirm the building surface DCGL values and area factors. In this analysis, NRC staff obtained comparable results to WEC, so the staff confirmed that WEC's calculations yield appropriate results. Additionally, NRC staff concludes that the proposed DCGL values and area factors calculated for building surfaces are acceptable as long as the assumptions used in WEC's analysis (i.e., that the removable fraction is less than 10% and that the contamination is not volumetric) are found to be true.

5.1.9 Ducts

WEC proposed to use the criteria in Table 1, Acceptable Surface Contamination Levels, in the NRC document "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," dated April 1993 (ML103620647) as the criteria for contamination remaining inside on the interior surfaces of the ventilation system. These criteria are more restrictive than the criteria that have been established for the building surfaces.

WEC also intends to perform air sampling at the outlets of ventilation ducting to assess the dose contribution from the ventilation system to an occupant of the building. The average dose contribution from the air samples will be added to the dose from the surface contamination to ensure that the 25 mrem/yr standard is met at the time of license termination.

The staff finds that WEC's proposed approach is acceptable because the criteria WEC proposed for ducts are more conservative than the criteria established for building surfaces, and WEC demonstrated that the building surface criteria were consistent with the 25 mrem/year standard for unrestricted release.

5.2 Soil Surfaces

5.2.1 Soil Source Term

WEC determined the ROCs based on historical studies in the Hematite Historical Site Assessment and the facility operating history as discussed in Chapter 2 of the DP, as well as the characterization data summarized in Chapter 4 of the DP.

The radionuclides for which soil DCGLs were developed include Uranium-234, Uranium-235, Uranium-238, Techneticum-99, Americium-241, Neptunium-237, Plutonium-239/240, Thorium-232, and Radium-226. Thorium-232 and Radium-226 were identified as ROCs in limited areas at the site.

WEC characterized the extent and depth of contamination by reviewing the historical site data, taking soil samples, and conducting a gamma walkover survey.

The areas of elevated surface contamination identified by WEC, described in terms of their physical location within the site boundary and identified ROCs, are as follows:

- Burial Pits Soil - Total Uranium, Technetium-99 and Thorium-232 (isolated);
- Site Pond, Site Creek and Surrounding Soil and Sediment - Total Uranium, Technetium-99, Thorium-232 (isolated);
- Soil Beneath and Surrounding the Process Buildings - Total Uranium and Technetium-99;
- Soil Southeast of the Process Buildings and Surrounding Areas - Total Uranium, Technetium-99 and Thorium-232 (isolated); and
- Soil Beneath and Surrounding the Barns, Cistern Burn Pit and Red Room Roof Burial - Total Uranium and Technetium-99.

For sub-surface soil existing below 15 cm, the elevated areas are listed as:

- Burial Pits Soil - Total Uranium, Technetium-99, and Radium-226 (isolated to the Radium-226 Impacted Area);
- Site Pond, Site Creek and Surrounding Soil - Total Uranium and Technetium-99 (isolated);
- Soil Beneath and Surrounding the Process Buildings - Total Uranium and Technetium-99;
- Soil Southeast of the Process Buildings and Surrounding Areas - Total Uranium and Technetium-99; and
- Soil Beneath and Surrounding the Barns, Cistern Burn Pit and Red Room Roof Burial - Total Uranium and Technetium-99.

The area of contamination is assumed to be approximately 153,400 m^2 for all radionuclides. The DP states that Radium-226 and Thorium-232 are only found in certain locations of the site. The location and extent of contamination are further illustrated in WEC response (ML102290015) to RAI 5-Q1. Even though WEC claims these radionuclides are only found in certain locations, WEC committed to measure for Thorium-232 and Radium-226 throughout the entire site, and to include the results in the overall dose calculations as a result of RAI 5 Q1.

With the exception of the lack of Technetium-99 characterization data at depths below 1.5 m beneath the process buildings and surrounding areas, WEC has provided an adequate description of the types, levels, and extent of radioactive material present at the site. Where there is currently a lack of adequate characterization data, WEC has committed to performing extensive excavation, and additional characterization throughout the excavation. In “Evaluation of Technetium-99 Under the Process Buildings” (ML111260624), WEC has committed to the following:

- All of the previous soil sample results with Tc-99 exceeding the adjusted uniform DCGL for Tc-99 are within areas planned for excavation to depths that will remove the contaminated soil.
- Excavation will continue until all soil that exceeds either the RGs or DCGLs, buried debris, and/or spent limestone is removed.
- Following excavation, the subsurface investigation will consist of biased sampling of deeper soil in selected areas.
- WEC has defined an investigation area beneath the Process Buildings in which unexcavated subsurface soil will be sampled and analyzed for Tc-99 and uranium at

depths extending downward from the surface of the completed excavation to the top of the sand/gravel layer.
- WEC will sample abandoned site hybrid wells following an investigation protocol described in response to RAI 3 Q9.

The source term description has covered residual radioactivity that will remain after license termination in the surface and subsurface soil. With WEC's commitment to perform extensive excavation in conjunction with WEC's description of the types, levels and extent of radioactive material present at the site, the staff finds WEC's approach to determine the soil source term acceptable in that the actual measurements, facility history, and planned remedial actions support the source term configuration WEC assumed in the modeling to derive the DCGLs.

5.2.2 Groundwater Source Term

The guidance in NUREG-1757 suggests a manner for demonstrating that 10 CFR Part 20, Subpart E is met. One aspect of that demonstration is for NRC licensees to account for the potential radiation dose that could result from groundwater contamination. The DP establishes dose to source ratios (DSRs) for groundwater contamination. The dose to source ratio defines the annual dose that would result per unit of contamination in the groundwater, should contamination be found in the sand/gravel aquifer during decommissioning. The ratios are based on the Deep Conceptual Site Model (CSM), with the external gamma, inhalation, and soil ingestion pathways turned off.

The source term assumed in the RESRAD model is solely from soil modeled as within the contaminated zone (CZ). However, contamination has been found in the upper aquitard as stated in the DP in Table 4-28. This contamination would serve as an additional source term if it reaches the lower aquifer. The cumulative impact of both source terms on the soil DCGLs should be considered, or the source term in the upper aquitard should be removed. The latter is accomplished by removing the contaminated soil that is causing higher concentrations in the upper aquitard and by removing the contaminated water in the aquitard.

WEC's September 15, 2010, response (ML102740175) to RAI 5-Q11, stated that the water contamination in the upper aquitard is pore space water of the clay overburden and that there is no vertical flow in the overburden towards the sand/gravel aquifer. WEC also stated that this source term will be removed during remediation. However, WEC did not commit to removing pore space water that exists below the remediation depths.

In the resolution of RAI 5-Q11, WEC committed to performing analysis of samples, as appropriate, of unexcavated soil below the contamination zone associated with monitoring wells to verify DCGLs are met. (ML111030152) The specifics of this sampling were also provided with the response (ML110730270) to RAI 3-Q9, and the Evaluation of Technetium-99 under the Process Buildings (ML111260624).

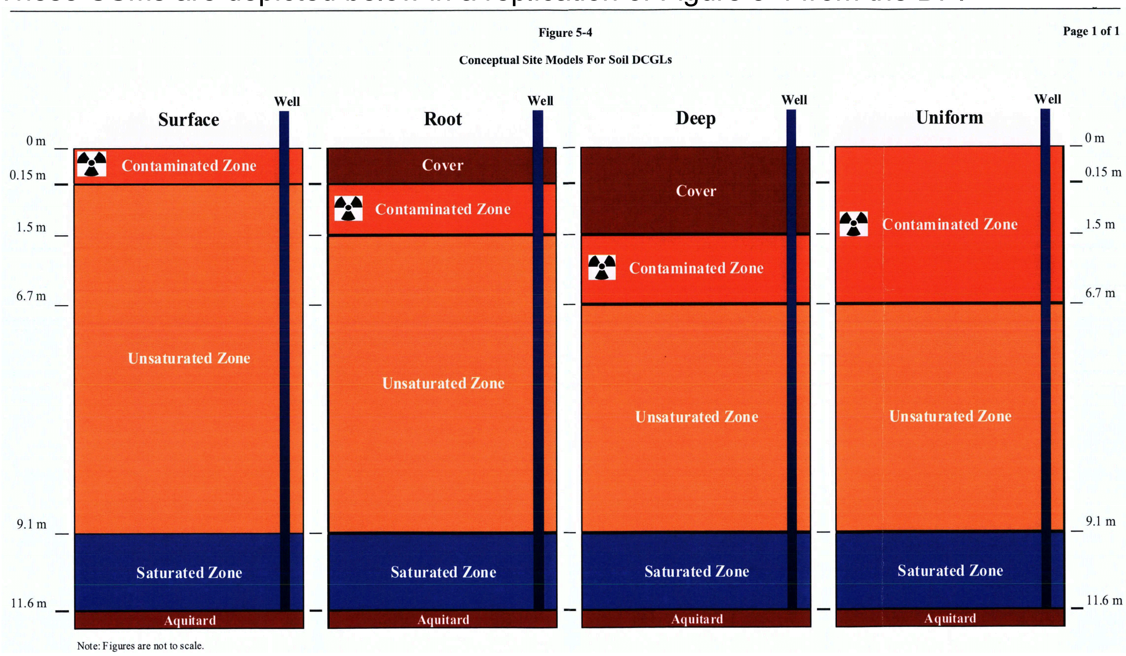
WEC's response (ML102140158) to RAI 14-Q15, clarified that the groundwater monitoring will consist of the samples collected for the FSS, which will be conducted after remediation is complete. WEC will add the contribution to dose from groundwater based on the highest individual aquifer sample to the dose from the survey unit with the maximum dose. WEC may initiate additional groundwater investigations beyond the samples collected for the FSS if this initial approach proves to be overly conservative.

The staff has reviewed the groundwater source term description. WEC has provided an adequate description of the types, levels, and extent of radioactive material present at the site with the exception of a clear description of the location of the soil contamination resulting in the high readings in the groundwater wells BD02 and BD04. The description provided enabled staff to determine whether WEC appropriately abstracted the source term in modeling applied to derive the DCGLs. Where there is currently a lack of adequate characterization data, WEC has committed to performing extensive excavation, and additional characterization throughout the excavation (ML111260624). With such a commitment in conjunction with WEC's description of the groundwater source term noted above, the staff finds WEC's determination of a groundwater source term acceptable for development of the site-specific DCGLs.

5.2.3 Soil Site Conceptual Model

Due to the fact that some areas of the site are known to have contaminated soil underneath clean material (e.g., burial pits), while other areas of the site are believed to be contaminated only on the surface, WEC developed the following CSMs for three layers of contamination: Surface (0 - 0.15 m), Root (0.15 - 1.5 m), and Deep (1.5 - 6.7 m). The thickness of the cover and the CZ thickness (depth) both depend on the CSM. In addition to the multilayered geometry, WEC also defines a second subsurface geometry, Uniform CSM, which assumes uniform contamination is present from the surface to 6.7 m.

These CSMs are depicted below in a replication of Figure 5-4 from the DP.



For the Surface CSM, there is no cover and the CZ thickness is 0.15 m. A value of 0.15 m (top 6 inches) is suggested in NUREG-1757 for surface contamination.

For the Root CSM, the top 0.15 m of soil is assumed to be clean cover material. On page 5-7 of the DP, it states that the 1.5 m CZ depth is justified based on the erosion rate. The depth of 0.6 m is the amount of thickness which will be eroded in 1,000 years at a rate of 0.0006 m/yr. The depth of roots assumed is 0.9 m. The depth 0.6 m is added to 0.9 m to obtain 1.5 m. By setting the CZ to 1.5 m, WEC ensures that the thickness of the CZ for the Root CSM is equal to or greater than the depth of the roots for the entire 1,000 yr period.

For the Deep CSM, the top 1.5 m is assumed to be clean cover material, and the CZ thickness of 5.2 m is deduced from the depth of the contaminated zone assumed in the Uniform CSM of 6.7 m (6.7 m - 1.5 m = 5.2 m). The depth of the CZ is discussed in the section on site-specific parameters.

The NRC staff reviewed the use of alternative conceptual site models and the assumptions regarding thickness of the CZ for each CSM. The staff concluded, based upon the discussion above, that the use of the alternative CSMs is appropriate as long as each area is determined to fall under either the Surface, Root, and Deep CSM (applying the sum of fractions rule as appropriate), *or* the Uniform model. In other words, it would not be appropriate to use the sum of fractions rule to combine the Uniform CSM and any of the other CSMs.

5.2.4 Scenarios

5.2.4.1 Resident Farmer Scenario

WEC applies the Resident Farmer scenario based on the current and likely future use of the property. In this scenario a hypothetical adult farmer is assumed to live on the site and grow a portion of his/her food on the site, using the water for irrigation and drinking.

The Resident Famer is exposed through the following pathways: direct radiation, inhalation of re-suspended dust, direct ingestion of soil, ingestion of food from crops grown in contaminated soil and irrigated with site water, ingestion of aquatic food from a nearby pond, and drinking water. The radon exposure pathway is not included. The included pathways reflect a subsistence farming practice and are feasible considering the physical, geological, and hydrogeologic characteristics of the Hematite Site; therefore, they are determined to be applicable for the site.

The staff has concluded that the choice of the resident farmer scenario is reasonable as it reflects the critical group under several circumstances. The critical group is defined in 10 CFR 20.1003 as, “the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.”. Additionally, the use of the resident farmer scenario is consistent with the guidance of NUREG-1757, and NUREG/CR-5512. Since the exposure pathways associated with the resident farmer scenario cover all the potential routes of exposures, it results in more restrictive DCGLs (lower concentration levels allowed to be left on-site) than other scenarios. Therefore, the resident farmer scenario is considered acceptable for consideration in developing soil DCGLs.

5.2.4.2 Intruder Scenario

As noted above, 10 CFR 20.1003 requires an assessment of the critical group. To satisfy this requirement, WEC applied the guidance from NUREG-1757, Appendix J for the intruder scenario. In this scenario, a house is built upon the site for a resident farmer. The displaced soil, which includes part of the residual radioactivity, is spread across the surface and food is grown on the contaminated soil. This scenario also includes the leaching of the radionuclides from their buried position to the ground water, which is then used by a residential farmer. The staff finds WEC's application of the intruder scenario acceptable because WEC appropriately identified the intruder scenario as a possibility. In some cases, this scenario will result in a greater dose than the resident farmer. and therefore has the potential to represent the critical group.

5.2.5 Computer Code and Parameter Selection Method for Soil Conceptual Models

WEC utilized the Residual Radioactivity (RESRAD) Code, Version 6.4 to calculate the soil DCGLs. For these calculations, WEC used deterministic values for input parameters.

The method which WEC utilized for selection parameter values was described in Section 5.3.4 of the DP. Parameters were categorized as behavioral, metabolic, or physical and were assigned a Priority 1 through 3 based on their importance to dose. Parameters categorized as behavioral or metabolic were assigned the mean of the parameter distribution function as found in NUREG/CR-5512, Vol. 3. When values were not available from NUREG/CR-5512, RESRAD default values were used. Using the NUREG/CR-5512 values is consistent with the guidance in NUREG-1757 and using the RESRAD default values is expected to result in conservative dose estimates.

The physical parameters for which site-specific information was available were assigned site-specific values. The physical parameters that were not assigned site-specific values were assigned values dependent on their Priority. Priority 3 physical parameters were assigned RESRAD default values, while Priority 1 and 2 physical parameters were assigned the mean of the distribution in Attachment C of NUREG-CR/6697 if they were not sensitive parameters and the 25th or 75th percentile if they were sensitive parameters.

The staff has concluded WEC's selection process was developed in accordance with the approach presented in NUREG/CR-6755 (ML020590035), NUREG/CR-6676 (ML003741920), NUREG/CR-6692 (ML003774030), and NUREG/CR-6697, which satisfies the requirements of 10 CFR 20.1003.

5.2.5.1 Soil Sensitivity and Uncertainty Analysis

This section describes the sensitivity analysis that was performed by WEC to determine which of the non-site-specific Priority 1 and 2 parameters should be treated as sensitive. The Uncertainty Analysis module in the RESRAD code was used, applying the RESRAD default distributions for the Priority 1 and 2 physical parameters. Three realizations of the analysis were performed for each of the CSMs, and the Partial Rank Correlation Coefficients (PRCCs) were recorded. If the PRCC was greater than 0.25 in all three repetitions, the parameter was determined to be sensitive for a CSM. If a parameter was found to be sensitive for one CSM, it was treated as sensitive for all CSMs.

The DP states that the sensitivity of the non-site specific parameters was determined using the probabilistic method in RESRAD for each CSM, assuming a different ratio of ROCs was used for the source term in each CSM. The relative ratios of ROCs for each CSM were determined by using the mean concentrations of sample data from the most applicable surrogate evaluation area.
A staff RAI regarding the technical basis for using the mean concentration for sample data, (RAI 5-Q6, ML101760058) questioned whether the use of the mean concentration adequately captured the variability in relative ratios present at Hematite. In WEC's response to RAIs dated August 11, 2010 (ML102290015), and in WEC transmittal of the Chapter 5 RAIs Resolution Table (ML111880290), WEC provided additional sensitivity analyses in which they adjusted the relative ratios of the ROCs. Instead of using a deterministic value for the Technetium-99 relative concentration, WEC applied a distribution representing the variation in relative Technetium-99 concentration based on available site characterization data and concluded that the Milk Transfer Factor was insensitive when the distribution was applied.

While the staff does not agree that the distribution of Technetium-99 concentrations WEC applied in the sensitivity analysis necessarily bounds the various relative ratios of Technetium-99 present at the site, the staff agrees that the DCGLs are insensitive to adjustments in the milk transfer factor and, therefore, NRC staff finds the value applied for the technetium milk transfer factor to be appropriate for use in modeling to derive DCGLs.

WEC states that the Alternative Excavation CSM was not included as one of the CSMs in the sensitivity analysis because it is essentially the same as the Root and Surface CSMs and, therefore, the sensitive parameters for this CSM would have been determined in those analyses.

Staff RAI 5–Q5 (ML101760058) requested additional information on the selection of certain transfer factors that was inconsistent with the selection process defined by WEC in the DP. WEC acknowledged that the values it previously used were incorrect, and revised the parameter selection for the protactinium plant transfer factor, the radium milk transfer factor, the lead plant and milk transfer factor, and the thorium bioaccumulation for fish in their August 11, 2010 submittal (ML102290015) to be consistent with NUREG-6697, which was consistent with WEC's selection process and appropriate for use in modeling to derive the DCGLs.

Based upon the discussion above, the staff has concluded that WEC has identified sensitive parameters and has chosen appropriate values for those parameters.

5.2.6 Soil Site-Specific Parameters

Many of the physical parameters were assigned site-specific values. A complete listing of these site-specific physical parameters was presented in Table 5-3 of the DP. Some parameters were not based on site-specific data, but were selected from literature using site-specific characteristics, such as soil type.

The following site-specific parameters were determined by laboratory analysis or field testing of the site soil or hydrogeology, or onsite hydrological investigations:

- CZ and unsaturated zone (UZ) distribution coefficients (Kds) for technetium and uranium,
- density and total porosity of the CZ and UZ,
- hydraulic conductivities of the contaminated UZ, and saturated zone (SZ),
- length parallel to the aquifer flow, and
- watershed area parameters.

The staff requested in RAI 5–Q2 (ML101760058) that WEC provide the laboratory testing procedure and results used to determine the technetium and uranium distribution coefficients. WEC provided their justification for the site-specific Kds applied for technetium and uranium in their response dated October 7, 2010 (ML102850223). The response stated that the Technetium-99 value of 106 cm^3/g was validated through the use of a no-solids control group in the site-specific experiment, as well as by a literature review of Kd values for the particular soil type at Hematite. WEC showed that the DCGLs for the Surface, Root, Uniform, and Excavation CSMs were insensitive to the Kd for Technetium-99. The Deep DCGL was sensitive, but this was unimportant since WEC had committed to use the Excavation DCGL for all soil beneath 1.5m. Because the DCGLs are sensitive to the Kd for uranium, WEC applied the most conservative 95% confidence limit of the uranium Kd and recalculated the DCGLs to account for uranium Kd variability. The upper confidence limit was applied for Surface, Root, Uniform, and Excavation CSMs, while the lower limit was applied for the Deep in order to be more conservative.

The soil erosion rate and evapotranspiration rate were calculated using site-specific input for site slope, soil type, irrigation rate, precipitation rate, and evapotranspiration coefficient. Using site-specific data gamma emissions as input to the Microshield computer code the indoor site shielding factor was derived while characterization data was utilized to derive the depth of the contaminated zone.

The staff requested additional information regarding the value assumed for evapotranspiration coefficient of 0.8 (unitless) RAI 5–Q4 (ML101760058). WEC revised the value assumed for the evapotranspiration coefficient to be consistent with the maximum value of 0.75 (unitless) cited in NUREG/CR-6697 in their response dated August 11, 2010 (ML102290015).

The runoff coefficient was estimated based on a method described in NUREG-6697, Attachment C, Table 4.2-1 assuming flat cultivated land with intermediate combination of clay and loam soil. This method resulted in a runoff coefficient of 0.8. This value differs from the value of 0.305 presented on pg A-3 of a document supporting the 2004 Hematite DP titled "Derivation of Site-Specific DCGLs for Westinghouse Electric Co. Hematite Facility" (ML0413103960). The 2004 value was based on 30.5 cm of annual average runoff, and 96.5 cm of average annual precipitation. In Section 3.3 of the 2009 DP, p. 3-5, it is restated that the area receives 12" of average annual runoff. In response (ML102290015) to RAIs dated August 11, 2010, Westinghouse found the difference in value chosen for runoff coefficient to be unimportant to the DCGL values.

WEC applied a value of 0.9 m for the root depth parameter. WEC is calculated this value by taking the average of 0.6 m (typical root depth for corn, soybeans and wheat grown in Jefferson County) and 1.1 m (generic average root depth for fruits, vegetables, grains and leafy vegetables). In resolution of RAI 5–Q8 (ML111880290), WEC provided the following, additional justification on why the two values were averaged,

> Because corn, soybeans, and wheat are clearly not fully representative of the broader range of crops considered in the Resident Farmer scenario, it was considered reasonable to average the root depth results from both methods. The selected value (0.9 m) is more conservative than the 25th percentile of the root depth PDF from NUREG/CR-6697, Table 6.1-2 which is 1.225 meters.

The depth of the CZ is based on the analysis of Figure 5-5 in the DP. Section 5.3.4.2 of the DP states that the depth of the CZ for the Deep CSM was determined through an analysis of characterization data. This data was provided in Figure 5-5 in units of sum of fraction. The Final Status Survey Alternative Excavation CSM DCGLs, as shown in Table 14-10 of the DP, were used as the denominators for determining the sum of fraction unit for depths greater than 1.5 m. In response (ML102850223) to a staff request regarding the data in Figure 5-5, WEC provided the concentrations at each depth (used in the numerator of the sum of fraction). In WEC's RAI response and the subsequent Chapter 5 RAI Resolution Table (ML111880290), regarding the basis for the thickness of the CZ layer in the Deep CSM, WEC performed sensitivity analyses to show that the DCGLs are insensitive to an increase in the contaminated zone thickness from 6.7 m to 9.1 m.

The staff notes that the data shown in Figure 5-5 may not be comprehensive enough to determine a value for CZ thickness due to the following:

- Lack of Technetium-99 characterization data points in the deeper levels beneath the buildings to be demolished.
- High readings from water samples in the upper aquitard associated with wells beneath Buildings 253 and 240 (Wells BD-02 & BD-04).

However, because WEC has demonstrated that DCGLs are insensitive to increasing the CZ thickness to that of the average thickness of the clay layer, the staff finds the value chosen for the CZ thickness to be acceptable. The staff has concluded that the lack of prior characterization will be compensated for by WEC's commitment to extensive excavation in this area (ML111260624).

As described in Reference 5-8 of the DP, based on Hematite's soil type, WEC selected values for the following parameters from literature values:

- effective porosity, field capacity,
- "b" parameters for the CZ, UZ, and SZ
- Kds for all radionuclides, except for uranium and technetium.

In the selection of literature values for Kd, WEC selected the sand value for the saturated zone, and for the CZ and the UZ, the lower of the literature values for either silty loam or clay was selected.

In RAI 5-Q7 (ML101760058), the staff requested additional information regarding the values chosen for the distribution coefficients for actinium, neptunium, and thorium. In response to this request, WEC revised the Kds of Actinium-277, Neptunium-237 (with the exception of the Neptunium-237 Kd for in the CZ and UZ), and Thorium-232 consistent with NUREG-1757 guidance (ML102740175). The guidance of NUREG-1757 applies the 25th or 75th percentile for sensitive parameters and the 50th percentile for insensitive parameters. WEC selected a representative value from known distributions for the existing soil type for the Neptunium-237 Kd in the CZ and UZ. WEC verified the conservatism of the values chosen by comparing the chosen value to the 25th percentile of samples representative of Hematite's soil. The 25th percentile of the samples for similar soil type was calculated to be a less conservative value than the value that was chosen.

Based upon the analyses described above, the staff has concluded that the values for site-specific parameters are appropriate, having been chosen in accordance with NRC guidance. These parameters will enable staff to ensure compliance with applicable NRC regulations.

5.2.7 Calculated DCGL Values

In their Chapter 5 Resolution Table, WEC submitted revised DCGL Values for DP Tables 5-7 through 5-12 (ML111880290). These values are repeated below for convenience and are listed separately for each of the CSMs.

Table 5-3 Soil DCGL Values

	Three Layer Approach DCGL Values (pCi/g)			**Uniform DCGL Values (pCi/g)**
	0 to 0.15 m layer	**0.15 to 1.5 m layer**	**> 1.5 m layer**	
Uranium-234	545.4	252.7	935.6	209.6
Uranium-235+D	109.7	68.7	223.2	55.3
Uranium-238+D	319.2	196.6	591	181.0
Technetium-99	162	32.3	79.4	26.9
Thorium-232+C	5.0	2.1	5.6	2.1
Radium-226+C	5.4	2.3	5.8	2.0
Neptunium-237+D	17.4	5.0	0.3*	0.3
Plutonium-239/ Plutonium-240	239.6	85.1	246.6	83.1
Americium-241	220.7	118.5	229.2	79.3

* Neptunium-237 DCGL for >1.5 m is determined using the DEEP CSM, while all other radionuclides are determined using the Excavation CSM

Since the proposed Deep DCGLs could result in doses to the intruder above 0.25 mSv/yr (25 mrem/yr), WEC developed an alternate scenario for Deep DCGLs, referred to as the Excavation scenario. This scenario is applied to develop DCGLs for contamination below 1.5 m up to 6.7 m that result in acceptable doses to the Intruder. WEC committed to using the more conservative of the Excavation DCGLs or Deep DCGLs to all soil at depths below 1.5 m in response to RAI 5-Q9 (ML102850223).

As a result of WEC's incorporation of the Excavation scenario as an alternate scenario for the Deep DCGL's, the staff finds WEC's revised soil DCGL values acceptable.

5.2.8 Area Factors

A common assumption in dose modeling is that contamination on a site is uniformly distributed over the entire site. In most cases, however, contamination is restricted to a few "hot spots", i.e., smaller areas with elevated contamination levels within the larger area. Different types of DCGLs are calculated based on the assumptions considered when performing dose modeling. The $DCGL_W$ (wide area average) assumes that the contamination is spread evenly over the entire area of concern. When considering just the contamination area for the "hot spots" within the larger area, the $DCGL_{EMC}$ (elevated measurement comparison) is used. Area factors, which are radionuclide-specific, describe the magnitude by which the concentration in a specific hot spot can exceed the $DCGL_W$ and still maintain compliance with the release criterion.

WEC applied the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) to evaluate the dose from small areas of elevated activity. Area Factors were developed for the Surface, Root, Deep, and Uniform DCGLs by adjusting the size of the contaminated zone while keeping all other parameter inputs the same.

In response to RAI 5-Q9 (ML102850223) WEC states that the area factor that will apply to soil below 1.5 m will be based on the Excavation CSM. The method used to calculate area factors for the other CSMs was not directly applicable to the Excavation CSM in the traditional sense since the Excavation CSM modeling construct assumes that a volume of contaminated soil exhumed from an excavation surface area of 200 m^2 to a depth of 3 m is spread across a surface area of 700 m^2. If the Area Factors calculated from using the Excavation CSM were applied in a traditional way, the inherent assumption is that the hotspot remains contiguous when brought to the surface, which may not be realistic given that mixing may occur in the action of exhuming material. Since the hotspot may not necessarily remain contiguous under the intruder scenario, WEC developed an alternative approach assuming the hot spot does not remain contiguous, and is instead uniformly mixed across the 200 m^2 area during the excavation activities. WEC calculated an alternative Area Factor using this alternative approach, which is the quotient of 200 m^2 and the original area of the hotspot. WEC commits to using the smaller of the two alternative area factors for soil below 1.5 m: (i) the Area Factor developed based on the Excavation CSM RESRAD model by adjusting the size of the contaminated zone and keeping all other parameter inputs the same, or (ii) the Area Factor developed using the quotient of 200 m^2 and the original area of the hotspot. The Area Factors listed in the DP are reproduced below in Tables 5-4a through 5-4c.

Table 5-4a Area Factors for Soil Contamination for Surface, Root, and Uniform CSMs

Radionuclide	Elevated Measurement Area (m^2)									
	153,375	10,000	3,000	1,000	300	100	30	10	3	1
	Surface Soil									
Uranium-234	1.0	1.5	2.2	2.6	7.8	19.3	41.7	67.3	96.0	119.5
Uranium-235+D	1.0	1.1	1.2	1.2	1.3	1.5	1.8	2.6	5.4	12.1
Uranium-238+D	1.0	1.2	1.5	1.6	2.2	2.6	3.4	4.9	10.2	22.3
Technetium-99	1.0	1.0	1.0	1.0	3.4	10.3	34.2	102.2	338.5	1,009
Thorium-232+C	1.0	1.0	1.1	1.1	1.4	1.7	2.3	3.5	7.3	16.9
Radium-226+C	1.0	1.1	1.2	1.2	1.8	2.2	3.0	4.5	9.6	22.4
Neptunium-	1.0	1.1	1.1	1.1	2.6	4.5	7.1	11.0	23.4	52.4
Plutonium-239/ Plutonium-240	1.0	1.1	1.1	1.1	3.6	9.5	23.5	43.0	65.5	83.4
Americium-241	1.0	1.0	1.1	1.1	2.9	5.6	9.4	13.9	25.4	42.4
	Root Soil									
Uranium-234	1.0	1.2	1.3	1.4	4.1	9.4	19.2	33.0	67.9	130.4
Uranium-235+D	1.0	1.0	1.1	1.1	1.9	2.3	2.9	4.1	8.3	17.9
Uranium-238+D	1.0	1.1	1.3	1.3	2.5	3.6	5.0	7.2	14.8	31.5
Technetium-99	1.0	1.0	1.0	1.0	3.4	10.3	34.3	103.0	343.3	1,029
Thorium-232+C	1.0	1.0	1.0	1.0	2.1	3.0	4.2	6.0	12.8	28.4
Radium-226+C	1.0	1.0	1.1	1.1	2.4	3.9	5.8	8.7	18.5	41.6
Neptunium-	1.0	1.0	1.0	1.0	3.4	9.9	30.7	57.2	132.0	298.4
Plutonium-239/ Plutonium-240	1.0	1.0	1.0	1.0	3.4	9.8	29.1	68.4	137.7	207.4
Americium-241	1.0	1.0	1.0	1.0	3.1	7.8	17.4	31.0	62.2	109.8
	Uniform Soil									
Uranium-234	1.0	1.2	1.3	1.3	4.0	9.3	19.6	34.3	70.5	132.8
Uranium-235+D	1.0	1.1	1.1	1.1	1.9	2.5	3.3	4.7	9.6	20.5
Uranium-238+D	1.0	1.1	1.3	1.3	2.5	3.6	5.0	7.2	14.9	31.6
Technetium-99	1.0	1.0	1.0	1.0	3.4	10.3	34.3	102.9	342.7	1,027
Thorium-232+C	1.0	1.0	1.0	1.0	2.1	3.0	4.2	6.1	12.9	28.9
Radium-226+C	1.0	1.1	1.1	1.1	2.5	4.1	6.1	9.1	19.3	43.4
Neptunium-	1.0	1.7	4.7	9.7	31.0	84.0	221.3	425.7	981.7	2,218
Plutonium-239/ Plutonium-240	1.0	1.0	1.0	1.0	3.4	9.8	29.1	68.4	137.7	207.3
Americium-241	1.0	1.0	1.0	1.0	3.1	7.8	17.4	31.0	62.1	109.7

Table 5-4b Calculated Area Factors Based on Excavation Scenario Constraints 1 and 2

Radionuclide	Area Factor Based on Contiguous Elevated Area after Excavation (size of elevated area shown in m^2)					
	148	**100**	**30**	**10**	**3.1**	**1.0**
Uranium-234	1.0	4.0	12	19	35	65
Uranium-235+D	1.0	1.3	2	2	4	7
Uranium-238+D	1.0	1.9	3	4	7	13
Technetium-99	1.0	4.2	14	42	140	410
Thorium-232+C	1.0	1.9	3	4	7	14
Radium-226+C	1.0	2.3	4	5	10	20
Neptunium-237+D	1.0	3.6	9	17	37	79
Plutonium-239/ Plutonium-240	1.0	4.1	13	32	71	117
Americium-241	1.0	3.6	9	17	32	58
	Area Factor Based on Elevated Area being Uniformly Mixed after Excavation					
Any	1.0	2.0	6.7	20	67	200

* Note - An adjustment factor of 1.5/0.9 was applied during modeling for geometrical transformation between the excavation (200 m2 x 3 m) and modeled (700 m2 x 0.9 m) geometry.

Table 5-4c Effective Area Factor for use with Excavation DCGLs

Radionuclide	Size of elevated area shown in m^2					
	148	**100**	**30**	**10**	**3**	**1**
Uranium-234	1.0	<u>2.0</u>	<u>6.7</u>	19	35	65
Uranium-235+D	1.0	1.3	2	2	4	7
Uranium-238+D	1.0	1.9	3	4	7	13
Technetium-99	1.0	<u>2.0</u>	<u>6.7</u>	<u>20</u>	<u>67</u>	<u>200</u>
Thorium-232+C	1.0	1.9	3	4	7	14
Radium-226+C	1.0	<u>2.0</u>	4	5	10	20
Neptunium-237+D	1.0	<u>2.0</u>	<u>6.7</u>	17	37	79
Plutonium-239/ Plutonium-240	1.0	<u>2.0</u>	<u>6.7</u>	<u>20</u>	<u>67</u>	117
Americium-241	1.0	<u>2.0</u>	<u>6.7</u>	17	32	58

* Values shown as underlined were constrained based on uniform mixing after excavation (200 / area)

5.2.9 NRC Independent Analysis

The staff performed independent analyses of WEC's calculations used in developing the DCGL values and area factors. These calculations involved replication of spreadsheet calculations, and independent modeling calculations in RESRAD to verify output results. Staff also performed the following additional analyses as part of their confirmatory analyses.

5.2.9.1 Analysis of Excavation CSM Sensitive Parameters

Since Alternative Excavation was not included as one of the CSMs in the sensitivity analysis, the staff used the Uncertainty Module in RESRAD to identify any additional sensitive physical Priority 1 and 2 parameters for this CSM. In addition to the parameters that were tested for other CSMs, listed in Section 5.3.4.3 of the DP, the staff also tested the Kds for uranium and technetium in the CZ and UZ. The staff used the concentrations listed in DP Table 5-11 (corresponding to 0.25 mSv/yr) which were used to derive the Excavation DCGLs as the source term for the model as opposed to 1 pCi/g to apply appropriate relative ratios of the ROCs.

The staff found that the sensitive parameters for the Excavation CSM were similar to those that WEC already found to be important in the Surface CSM sensitivity analysis. This is logical since the conceptual model for the Alternative Excavation CSM is very similar to that of SURFACE CSM (i.e., no cover and fairly shallow contaminated zone). Two additional parameters that were found to be insensitive in the Surface CSM, the plant transfer factors for americium and plutonium, were found to be sensitive for the Excavation CSM. However, since these radionuclides are considered insignificant contributors (see Chapter 14 of this SER for a description of insignificant contributors), the staff finds WEC's treatment of the plant transfer parameters acceptable in ensuring that WEC's development of site-specific DCGLs is in compliance with 10 CFR 20.1402.

5.3 Buried Piping

Buried piping may remain on site at the time of license termination (see e.g., Table 5-21 in the DP), and residual contamination may remain on the internal surfaces of these pipes. As described in the response (ML102290015) to RAI 5–Q19, WEC plans to use the Building Surface DCGL values as the release criteria for piping that will remain in place.

WEC also generated Buried Pipe DCGL values in the event that buried piping that exceeds the Building DCGLs (and cannot be decontaminated or removed) is found. If such piping is found, the piping will be grouted to fix ROCs in place and to add a volume of clean material to the pipe, and to eliminate the potential for re-use of the pipe. In addition, if such piping is found, the dose from piping that is left in place will be calculated and this dose will be accounted for in the FSS. The Buried Pipe DCGL values were calculated by using a geometry calculation to convert the volumetric soil DCGL values to a surface concentration on the interior of the pipe for various pipe diameters. These calculations were based on the root depth DCGL values because the pipes are generally 0.15 to 1.5 m below grade. The Buried Pipe DCGL values calculated by WEC are presented in the table below.

Table 5-5 WEC Buried Pipe DCGL Values

Pipe Diameter inches (cm)	Radionuclide Specific DCGL (dpm/100 cm^2)								Gross Activity DCGL (dpm/100 cm^2)
	U-234	U-235+D	U-238+D	T-99	Th-232+C	Np-237	Pu-239/240	Am-241	
2 (5.08)	1.22E+05	4.32E+04	9.46E+04	1.50E+04	1.05E+03	2.38E+03	4.04E+04	5.65E+04	8.11E+04
4 (10.16)	2.43E+05	8.63E+04	1.89E+05	2.99E+04	2.10E+03	4.76E+03	8.08E+04	1.13E+05	1.62E+05
6 (15.24)	3.65E+05	1.30E+05	2.84E+05	4.49E+04	3.14E+03	7.15E+03	1.21E+05	1.69E+05	2.43E+05
8 (20.32)	4.86E+05	1.73E+05	3.79E+05	5.98E+04	4.19E+03	9.53E+03	1.62E+05	2.26E+05	3.24E+05
10 (25.4)	6.08E+05	2.16E+05	4.73E+05	7.48E+04	5.24E+03	1.19E+04	2.02E+05	2.82E+05	4.05E+05
12 (30.48)	7.29E+05	2.59E+05	5.68E+05	8.98E+04	6.29E+03	1.43E+04	2.42E+05	3.39E+05	4.87E+05
14 (35.56)	8.51E+05	3.02E+05	6.62E+05	1.05E+05	7.34E+03	1.67E+04	2.83E+05	3.95E+05	5.68E+05
16 (40.64)	9.72E+05	3.45E+05	7.57E+05	1.20E+05	8.39E+03	1.91E+04	3.23E+05	4.52E+05	6.49E+05
18 (45.72)	1.09E+06	3.89E+05	8.52E+05	1.35E+05	9.43E+03	2.14E+04	3.64E+05	5.08E+05	7.30E+05
20 (50.8)	1.22E+06	4.32E+05	9.46E+05	1.50E+05	1.05E+04	2.38E+04	4.04E+05	5.65E+05	8.11E+05
22 (55.88)	1.34E+06	4.75E+05	1.04E+06	1.65E+05	1.15E+04	2.62E+04	4.44E+05	6.21E+05	8.92E+05
24 (60.96)	1.46E+06	5.18E+05	1.14E+06	1.80E+05	1.26E+04	2.86E+04	4.85E+05	6.78E+05	9.73E+05
26 (66.04)	1.58E+06	5.61E+05	1.23E+06	1.94E+05	1.36E+04	3.10E+04	5.25E+05	7.34E+05	1.05E+06
28 (71.12)	1.70E+06	6.04E+05	1.32E+06	2.09E+05	1.47E+04	3.34E+04	5.66E+05	7.90E+05	1.14E+06
30 (76.2)	1.82E+06	6.48E+05	1.42E+06	2.24E+05	1.57E+04	3.57E+04	6.06E+05	8.47E+05	1.22E+06
32 (81.28)	1.94E+06	6.91E+05	1.51E+06	2.39E+05	1.68E+04	3.81E+04	6.46E+05	9.03E+05	1.30E+06
34 (86.36)	2.07E+06	7.34E+05	1.61E+06	2.54E+05	1.78E+04	4.05E+04	6.87E+05	9.60E+05	1.38E+06
36 (91.44)	2.19E+06	7.77E+05	1.70E+06	2.69E+05	1.89E+04	4.29E+04	7.27E+05	1.02E+06	1.46E+06
38 (96.52)	2.31E+06	8.20E+05	1.80E+06	2.84E+05	1.99E+04	4.53E+04	7.68E+05	1.07E+06	1.54E+06
40 (101.6)	2.43E+06	8.63E+05	1.89E+06	2.99E+05	2.10E+04	4.76E+04	8.08E+05	1.13E+06	1.62E+06
48 (121.92)	2.92E+06	1.04E+06	2.27E+06	3.59E+05	2.52E+04	5.72E+04	9.70E+05	1.36E+06	1.95E+06

Based upon the assessment noted above, the staff has concluded that WEC's proposed approach for evaluating the residual contamination in buried piping remaining on site is reasonable and the proposed buried piping DCGL values are acceptable.

5.4 Conclusion Dose Assessment Review

The staff has reviewed the dose modeling analyses for the Hematite Site as part of the review of the Hematite DP, using NUREG-1757, Volume 2, Section 5.2

The staff concludes that the dose modeling completed for Hematite is reasonable and is appropriate for the exposure scenario under consideration. In addition, the dose estimate provides reasonable assurance that the dose to the average member of the critical group is not likely to exceed the 0.25 mSv (25 mrem) annual dose criterion in 10 CFR 20.1402. This conclusion is based on the modeling effort performed by WEC and the independent, confirmatory analyses performed by the staff.

Major assumptions contributing to this conclusion include the following:

- The use of the alternative CSMs is appropriate as long as each area is determined to fall under either the Surface, Root, Deep CSM (applying the sum of fractions rule as appropriate), or the Uniform model.
- WEC's commitment to performing extensive excavation beneath the buildings, and additional characterization throughout excavation where there is currently a lack of adequate characterization data.
- WEC commitment to using the smaller of the two area factors (based on Excavation CSM or based on hotspot uniformly mixed with the 200 m^2).

Based upon the analyses above, the staff concludes that the dose modeling completed for unrestricted use for the Hematite site is reasonable and is appropriate for the exposure scenario under consideration. In addition, WEC has adequately considered the uncertainties inherent in the modeling analysis. The dose estimate provides reasonable assurance that the dose to the average member of the critical group is not likely to exceed the 0.25 mSv (25 mrem) annual dose criterion in 10 CFR 20.1402. This conclusion is based on the modeling effort performed by the licensee and the independent confirmatory analyses performed by the staff.

5.5 EPA Consultation

On October 9, 2002, the NRC and the U.S. Environmental Protection Agency (EPA) entered into a Memorandum of Understanding (MOU) on "Consultation and Finality on Decommissioning and Decontamination of Contaminated Sites." In accordance with the MOU, for decommissioning sites which trigger the criteria in the MOU, NRC is required to consult with EPA in the decommissioning process. On February 22, 2011 (ML110420275), NRC informed EPA that the soil DCGLs for the Hematite Site exceeded the trigger criteria contained in the MOU. EPA responded to NRC's consultation letter on May 16, 2011 (ML111600193). In that letter, EPA stated that if the Hematite Site is unable to meet the EPA Table 1 soil values for residential land use, then NRC should consider a more restricted land use, such as industrial, with appropriate institutional controls. In addition, EPA suggested that NRC should consider determining if the use of site-specific parameters was justified in modeling at the Hematite site. The use of site specific parameters would not alter NRC's obligation to possibly trigger a Level 2 consultation if Table 1 soil values were found to be exceeded after the FSS measurements. EPA stated that if a Level 2 consultation is needed, NRC should furnish any site specific parameters used and the NRC's rationale for allowing their use during the dose assessment for the site. This information would facilitate EPA offering its views with a more accurate estimate of the risks posed by residual contamination at the Hematite site. The results of the FSS measurements will determine whether the NRC will need to enter into a Level 2 consultation.

6.0 Environmental Information

WEC performed an evaluation of potential environmental impacts associated with decommissioning and license termination of the Hematite site. The results of this evaluation were detailed in the Hematite Environmental Report (ER). WEC's evaluation demonstrated that Hematite site decommissioning activities and license termination will not have a significant adverse impact on the environment.

In accordance with the NRC's regulations in 10 CFR Part 51, which implement the requirements of the National Environmental Policy Act of 1969, as amended, and utilizing the NRC staff guidance contained in NUREG-1748, "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs," dated August 2003, the staff determined that the appropriate level of environmental review required for the DP is an EA. The licensee has provided sufficient information in the Hematite Environmental Report to prepare an EA (ML112101726). The staff provided a draft EA to the Missouri Department of Natural Resources (MDNR) on April 15, 2011. On May 13, 2011, MDNR responded with their comments (ML111580572). In a letter dated August 30, 2011, the staff responded to MDNR's comments (ML112160406). A *Federal Register* notice identifying the availability of the EA, was published on September 29, 2011 (76 FR 60557).

7.0 ALARA Analysis

The NRC's regulations at 10 CFR 20.1402 provide, among other things, that before a site may be considered acceptable for unrestricted use, the residual radioactivity must be reduced to levels that are ALARA. The staff utilized the guidance in NUREG-1757, specifically Section 6 and Appendix N, to assess whether WEC had met this regulatory requirement. This guidance indicates that the ALARA evaluation for compliance with decommissioning criteria should include quantitative analyses, when appropriate, and typical good practice efforts.

Regarding typical good practice efforts, the DP, Section 7, contained a very limited discussion. WEC committed to job-site cleanliness as an ALARA good practice. The staff considered this insufficient, as other common good practices were not mentioned. The staff, in an RAI 7-Q1 (ML102810455), specifically mentioned that for building surfaces, licensees should use typical good-practice efforts such as washing of walls and removal of readily removable radioactivity. In its RAI response dated December 10, 2010 (ML103490105), WEC describes additional good practice ALARA efforts. WEC had decontaminated or removed the majority of areas of elevated activity in buildings so that most surfaces meet the more stringent limits for unrestricted release in WEC's current license. Surfaces were also cleaned, to the extent that maximum measurements of removable contamination met administrative limits and were less than 11% of the DCGL. The staff concluded that WEC has taken appropriate good practice efforts to reduce contamination on building surfaces to ALARA levels. The staff has concluded that WEC's good practice efforts, as described in their December 10, 2010, RAI response, are acceptable.

WEC performed quantitative ALARA analyses. These analyses addressed three areas: soil removal, washing of building surfaces, and scabbling of building surfaces.

For soil removal, WEC quoted NRC guidance that states that quantitative ALARA analysis may not be necessary for residual radioactivity in soil at sites cleaning to the unrestricted use criteria. Nevertheless, WEC still performed a simplified analysis for soils. The staff agrees that the quantitative analysis is not necessary. However, the staff reviewed WEC's parameters associated with their quantitative analysis and their methodology and, although not required, determined that they were appropriate. From this assessment, the staff concluded that WEC's actions are ALARA with respect to soil removal.

For the analysis of washing building surfaces, the WEC results for a zero discount rate appeared to indicate that walls should be washed if contamination levels exceeded 21% of the DCGL. WEC provided reasons why washing surfaces was unreasonable, but the staff did not accept WEC's justification. In an RAI 7-Q1, the staff asked for a commitment from WEC to wash building surfaces or for WEC to provide additional information justifying that such washing is not ALARA. In its RAI response dated December 10, 2010, and its intended DP revision contained in the RAI response, WEC revised its quantitative ALARA evaluation to determine ratios of concentration to DCGL of 1.02 and 0.49 for 7% and 3% discount rates, respectively. In its response, WEC made the point that the existing building surface radioactivity concentrations were reduced to less than these fractions of the DCGL, so that the existing building surface concentrations are already reduced to ALARA levels. With this additional information, the staff reassessed WEC's analysis of washing building surfaces and agrees that WEC has shown that existing building surface radioactivity concentrations are less than the calculated fractions of the

DCGLs, and thus, are ALARA. The staff concludes that WEC has appropriately evaluated potential ALARA actions associated with washing building surfaces and that WEC has appropriately concluded that further actions are unnecessary under ALARA. Therefore, the staff concludes that WEC's actions are ALARA with respect to washing building surfaces. For its analysis of scabbling building surfaces, the WEC results for zero discount rate also appeared to indicate that scabbling should be performed if contamination levels exceeded 21% of the DCGL. WEC provided justification that this was unreasonable. The staff considered the justification unclear and insufficient. WEC's justification included what WEC referred to as an example. However, it was unclear to staff if it was actually just an example. The NRC staff asked, in an RAI (HDP 7-Q2), for WEC to provide clarification regarding its calculations. In its RAI response dated December 10, 2010, and its intended DP revision contained in the RAI response, WEC provided a revised discussion which did not include examples. Thus, the revised discussion is clear to the NRC staff. In its response, WEC also changed the discount rates used in the calculations from 0% and 7% to 3% and 7%. The DP analysis which utilized a 0% discount rate resulted in a ratio of concentration/$DCGL_W$ of 0.21, which indicates that the action (scabbling) should be performed for ALARA if building surface concentrations are greater than 0.21 times the $DCGL_w$. WEC stated in its RAI response that the existing building surface concentrations do not exceed 20% of the $DCGL_w$. Thus, staff concludes that WEC's calculations based on the 0% discount rate show that scabbling is unnecessary with respect to ALARA requirements and, therefore, WEC's actions are ALARA with respect to the potential scabbling of building surfaces. The staff notes that within WEC's RAI response, WEC incorrectly describes the results of the 0% discount analysis, stating "the cost associated with scabbling to avert 5 millirem per year would be $5,350, which far exceeds the cost guideline ($2,000 per person-rem) for averted dose." The staff considers that the $5,350 cost is for averting dose over many years and is to potentially greater than 1 person. Thus, the value of $5,350 should not be compared directly to the ALARA value of $2,000 per person-rem, as the units are not the same. This misinterpretation on WEC's part does not change the staff's conclusions on scabbling building surfaces with respect to ALARA.

The staff has reviewed the ALARA analyses in Chapter 7 (ALARA Analysis) of the WEC Hematite DP using Section 6 and Appendix N of NUREG-1757, Volume 2, and an NRC *Federal Register* notice regarding aspects of ALARA guidance (72 FR 46102; August 16, 2007).

The staff concludes that the ALARA evaluations performed by WEC are appropriate for the decommissioning option, nature of existing contamination, and exposure scenarios assumed. In addition, these evaluations and commitments for ALARA actions provide reasonable assurance that the ALARA requirement of the dose criterion in 10 CFR 20.1402 will be met.

8.0 Planned Decommissioning Activities

8.1 Contaminated Structures

As noted in Section 4.1 of this SER, the NRC issued Amendment 52 (ML061280324) to the Hematite license which authorized WEC to dismantle and demolish Hematite's former process buildings except for the building slabs. In June 2011, WEC completed building demolition. The following buildings remain and will undergo Final Status Survey (FSS).

1. Building 110, Office and Security
2. Building 230, Rod Loading
3. Building 231, Warehouse

The following buildings will remain during soil/buried material remediation, but WEC may chose to dismantle and demolish later. If the following buildings are not demolished, they will undergo FSS.

1. Building 115, Fire Pump House
2. Building 235, West Storage Area
3. Sanitary Wastewater Treatment Shed

Amendment 52 permitted demolition and dismantlement of the entire buildings except for the building slabs. The slabs will be utilized by WEC as staging areas for various decommissioning equipment and process activities. As the decommissioning activities near completion, the slabs themselves will be characterized, demolished, and shipped offsite based upon their contamination types and levels.

Process drains within the foundation slab of buildings that were demolished (Building 240, Building 253, Building 254, Building 255, Building 256 and Building 260) will be surveyed in conjunction with the removal of the building floor slabs and foundations. Concrete foundations, slabs and paved areas may be decontaminated prior to removal, or removed and prepared for off-site disposal. WEC discussed water management methods associated with remediation of concrete foundations, slabs and paved areas in DP Section 8.6.

WEC will perform contamination surveys of surfaces of concrete slabs prior to and following decontamination efforts. Samples of processed concrete and asphalt will be analyzed to determine compliance with appropriate release criteria, or waste acceptance criteria for a waste disposal facility.

WEC will perform decontamination of concrete slabs, foundations and paved surfaces in accordance with approved work instructions and hazard control measures. WEC will employ such decontamination techniques as wiping, High Efficiency Particulate Air (HEPA)-vacuuming, mechanical grinding, scabbling, chipping, saw-cutting, chemical stripping and power-washing surface areas. Surfaces that cannot be decontaminated to levels below DCGL will be removed.

Breaking and sectioning (sizing) of concrete foundations, slabs and paved areas will be performed using an excavator equipped with a hydraulic breaker, or other concrete processing equipment which allows breaking of concrete and asphalt into pieces of manageable size. Concrete rebar will be removed as necessary, and sections that cannot be readily decontaminated will be segregated. Broken concrete slabs, foundations and materials from paved areas will be handled and processed to permit contamination surveys to be performed on all surfaces. WEC will segregate concrete slabs, foundations, and materials from paved surfaces to meet off-site disposal requirements. Remedial Action Support Surveys (RASS) will be performed periodically during decontamination to gauge the effectiveness of method, and to determine when DCGLs have been met.

The staff has reviewed the information in Section 8.3 (Contaminated Structures) of the WEC Hematite DP and associated RAI responses according to NUREG-1757, Volume 1, Section 17.1.1 and Appendix D, Section VIII.a. Based on this review, the staff has determined that WEC has described the planned decommissioning activities associated with contaminated structures at its facility sufficiently to allow the staff to evaluate the potential safety issues associated with remediating the facility and to ensure compliance with 10 CFR 70.38(g)(4).

8.2 Contaminated Systems and Equipment

As noted in SER Sections 4.1and 4.2 most of the contaminated systems and equipment were removed from the Hematite facility except for various drain lines. For buildings which will remain on site following license termination, the contaminated systems and equipment which may undergo remediation include the Sanitary Wastewater Treatment Plant (SWTP) and the Storm Drain System (SDS). WEC intends to survey these systems and determine, from a cost-benefit standpoint, if components will be decontaminated and remain in place or disposed of as radioactive waste.

For drain piping which cannot be accessed for surveying, WEC may remove the piping based upon historical information and information obtained from similar drain components during decommissioning. In those cases where the information is incomplete or inadequate to form a reasonable basis that the drain and surrounding soil meet the DCGLs, then the drain will be removed and surrounding soil evaluated by radiological surveys and sampling.

WEC's planned remediation tasks for the SWTP and SDS include: locating and stabilizing contamination, as necessary for contamination control; excavation, removal and segregation of soil and debris for disposal; *in-situ* Gamma Walkover Surveys (GWS); VOC screening; and, visual inspection. WEC plans for excavations to proceed along the length of marked utilities, and expand and progress forward as soil and debris are removed. FSS will be performed in stages along the length of the excavations, with sufficient buffer zones and physical barriers installed to prevent recontamination of remediated areas.

The WEC plan includes the performance of Remedial Action Support Surveys (RASS) on drain systems and ventilation ducts to determine if further remediation will be required. Contaminated drain and ventilation systems will be remediated to levels below DCGLs or physically removed from the structures, characterized as needed and packaged for disposal at an off-site facility. Access will be established for contaminated drains and piping, which will be decontaminated or removed as necessary. Decontamination techniques may include mechanical decontamination such as brushing, grinding, and stripping. Techniques for physical removal of contaminated systems and equipment may include concrete or asphalt saw cutting, and jackhammer or breaking of concrete and asphalt surfaces.

Drain systems in Buildings 110 and 230 will be evaluated using piping DCGLs to determine if piping will be subjected to FSS and then abandoned in place. Piping left in place will be capped.

The SWTP and SDS will be isolated from existing services, and WEC will redirect or abandon existing services. Residual contamination in piping systems will be stabilized using materials such as latex paint, expanding foam, or low density flowable-fill (grout) prior to removal.

The staff has reviewed the information in Section 8.5 (Contaminated Soil) of the WEC Hematite DP and associated RAI responses according to NUREG-1757, Volume 1, Section 17.1.2 and Appendix D, Section VIII.b. Based on this review, the staff has determined that WEC has described the planned decommissioning activities associated with contaminated systems and equipment at its facility sufficiently to allow the staff to evaluate the potential safety issues associated with remediating the facility and to ensure compliance with 10 CFR 70.38(g)(4).

8.3 Soil

WEC provides a general overview in DP Section 8.5.1 of the techniques to remove or remediate soil and subsurface soil during decommissioning. Those steps are as follows:

- Evaluate soil with in-situ gamma walkover survey, volatile organic compound (VOC) monitoring, and visual inspections,
- Excavate and remove soil in 1 foot lifts,
- Segregate excavated soil based on visual, radiological, and chemical sampling and on Derived Concentration Guideline Levels (DCGLs), Remediation Goals (RGs), and Nuclear Criticality Safety (NCS)-Exempt criticality limits,
- Stockpile soil or load soil onto haul trucks for transfer to the Waste Consolidation Area (WCA),
- Consolidate, inspect, and load excavated overburden soil transferred to the WCA and segregate soils acceptable for re-use or waste disposal,
- Remove objects encountered in the soil via heavy equipment and hand shoveling as deemed necessary,
- Perform sloping and benching as required and until visible wastes are removed and DCGLs and RGs are met, and
- Maintain dust and erosion controls during remediation.

Additional precautions will be in place in the event that an intact or damaged drum is encountered while excavating in the burial pits. Work packages, Activity Hazard Analyses, and Radiation Work Permits will specify additional controls, and excavated drums will be prepared and placed into over-packs for evaluation and proper disposition. WEC also intends to take additional criticality safety measures in areas where characterization and historical data indicated a reasonable possibility of fissile materials. Such screening will typically involve duplicate radiological surveys of defined volumes to ensure that NCS limits are not exceeded.

Methodologies for the excavation of specific soil areas were provided in DP Sections 8.5.3.1 – 8.5.3.5. These areas include the burial pits, evaporation ponds, former leach field, soils in and around site ponds and creeks, as well as the soil beneath on-site buildings.

WEC indicated in DP Section 8.5.3.1 that excavation and removal of burial pit soil will likely begin at the northwest comer and will continue towards the east and south. Excavation may also occur concurrently in multiple burial pit areas. WEC also indicated that they expect a majority of the burial pit materials to consist of contaminated soil and trash (e.g., floor tiles, glass wool, and laboratory glassware - some laden with VOCs). Items such as acid-insoluble residue, filters, metallic debris, and metallic oxides are expected to a limited extent, and may result in multiple waste streams with specific management strategies being required. WEC also noted in Section 8.5.3.1 that historical records for the burial pit area suggest that regulated asbestos-containing material (RACM) may be present within the sub-surface soil, and they have committed that "the excavation and removal of potential RACM will be performed in accordance with Asbestos-NESHAP [National Emission Standard for Hazardous Air Pollutants] (40 CFR Part 61, Subpart M) and Missouri Solid Waste Management requirements."

The remediation of soils southeast of the process buildings and surrounding areas (including the evaporation pond and the former leach field areas) was described in DP Section 8.5.3.2. DP Section 8.5.3.2.1 describes the excavation of the evaporation pond area. WEC indicated that diversions and berms will be utilized in order to isolate the area from water run-on/run-off and to minimize standing water until excavation is completed. Evaporation pond remediation will occur according to the Water Management Plan (ML110330374) and will require pumping of water from the ponds, followed by sampling or treatment of the water prior to discharge. Once the water is removed, excavation and removal of contaminated sediment, limestone, and adjacent soil will occur. DP Section 8.5.3.2.2 describes the remediation of soils in the former leach field area. This includes decontamination and processing of the concrete slab and asphalt, followed by excavation and removal of contaminated soil and piping associated with the abandoned leach field system. Residual contamination surveys, cleaning, and decontamination will be performed for concrete slabs and paved areas covering the former leach field, and these areas will be managed to meet the release criteria for off-site disposal and recycle, or disposed of as radioactive waste.

The remediation of soils beneath and surrounding the barns, cistern burn pit and Red Room roof burial area was described in DP Section 8.5.3.3. WEC indicated that contamination above the DCGLs was identified within the wood barn and cistern burn pit areas, and that the removal of concrete and paved surfaces will occur prior to the excavation and removal of soil and debris. Residual contamination surveys, cleaning, and decontamination will be performed for concrete and paved surfaces in order to meet the criteria for off-site disposal and recycle. If the disposal criteria cannot be met, these surfaces will be disposed of as radioactive waste. Historical data related to the Red Room roof burial area have suggested that RACM may be present in surface and sub-surface soil. Accordingly, WEC has committed that the removal and excavation of potential RACM will be performed in accordance with Asbestos NESHAP (40 CFR Part 61, Subpart M) and Missouri Solid Waste Management requirements.

The remediation of the Site Pond, Site Creek, and surrounding soils and sediment was described in DP Section 8.5.3.4. WEC indicated that, during remediation, the Site Pond and surrounding area will be drained and inflow to the Site Pond will be diverted. This will be accomplished via a water-inflow bypass basin to divert the Site Spring and Outfall #003 storm water discharge to Outfall #001, which will be relocated during remediation of the Site Pond. Excavation and removal of soil and sediments will occur after the water is diverted, and restoration will occur via the placement of material meeting regulatory criteria as backfill, followed by grading. Remediation of the concrete dam will also occur through decontamination or removal, to meet the appropriate DCGLs and RGs. If necessary, a new dam may be constructed during site restoration.

The remediation of soil beneath and surrounding the process buildings was described in DP Section 8.5.3.5. WEC indicated that the designated Waste Consolidation and VOC Treatment Areas will be temporarily relocated to an open area adjacent to the Waste Evaluation Area, or similar location, to allow for excavation and removal of building slabs, foundations and underlying soil. Additional details on the excavation of soil beneath former processing buildings were also provided in WEC's May 5, 2011, "Evaluation of Technetium-99 Under the Process Buildings" (ML111260624).

DP Section 8.5.3.2.1 indicated that soil remediation in the vicinity of the natural gas pipe line could present significant hazards to the workers and the potential for disrupting local utility service. It was stated that an independent dose assessment for achieving the DCGLs may be used in this area if, at the time of remediation, additional excavation to achieve the desired DCGLs may introduce an unacceptable risk to the workers, environment, or the public. The staff had concerns that unrestricted release may not be possible without the excavation of areas around the pipeline. Staff RAI 8-Q5 (ML103300204) requested information on how WEC will collaborate with the gas company if excavation is required. The January 24, 2011, RAI response (ML110270200) indicated that any excavation within 5 feet of the natural gas pipeline will be performed in accordance with 29 CFR 1926.651, "Special Excavation Requirements." Additionally, WEC proposed a revised dose modeling approach to include the calculation of area factors when applying the DCGL defined by the Excavation CSM, which is expected to provide sufficient flexibility to eliminate the need to directly apply the DCGLs calculated for the Deep CSM and to provide the basis for unrestricted release of the pipeline area.

WEC described administrative and engineering controls to prevent the spread of contamination and minimize airborne radioactive materials during site remediation in Section 8.4.3 of the DP. Such controls include:

- Performing contamination control surveys of personnel, equipment, and materials leaving the posted area,
- Covering waste stockpiles,
- Constructing temporary berms around waste staging and handling locations,
- Constructing lay-down areas so storm water will drain into one area for collection and discharge,
- Suppressing dust using water,
- Covering waste piles, and
- Implementing water management practices.

WEC also stated in DP Section 8.4.3 that “prior to removing embedded or buried drain piping systems, residual contamination in piping will be stabilized using an aerosol (e.g., latex paint), expanding foam or low density flowable-fill (grout).” In a response (ML110270200) to RAI 8-Q10 (ML103300204), WEC proposed to revise Section 8.4.3 of the DP with the following additional details on contamination controls during site remediation:

> With respect to preventing the spread of contamination by the wind, the primary method that will be employed to prevent the spread of contamination during material handling will be the use of water mist. After application of water mist, temporary stockpiles (e.g., those that remain until the next workday) may also be tamped using the flat side of the excavator bucket or similar piece of heavy equipment to consolidate the surface of the material thus reducing the potential for erosion. Additives may also be added with the water mist that form a thin crust-like layer, (e.g., a dilute non-hazardous adhesive), or those that posses hygroscopic properties to sustain the effectiveness of water application. (e.g., calcium chloride). To gauge the effectiveness of contamination control measures, the results of general area and breathing zone air samplers will be evaluated to identify outliers or trends in concentration that suggest appropriate actions be taken to mitigate airborne radioactivity. With respect preventing the spread of contamination by precipitation, see Section 8.6.

Additional details on decommissioning activities planned during the excavation of soil beneath former processing buildings were provided in WEC’s May 5, 2011, “Evaluation of Technetium-99 Under the Process Buildings” (ML111260624). During excavation, building slabs and footers will be removed, followed by soil and underground piping. Soil and spent limestone will then be removed. The spent limestone is known to contain Technetium-99. WEC also provided information on plans for post-excavation subsurface soil sampling. These samples will be biased to an “investigation area” beneath the process buildings, in which unexcavated subsurface soil will be sampled for Technetium-99 and uranium at depths extending from the excavation surface to the top of the sand/gravel layer. This “investigation area” encompasses several areas of interest, including four hybrid monitoring wells (BD-01, BD-02, BD-03, and BD-04), the locations where limestone was used as backfill in the construction of Building 253, and the alleys that had existed between Buildings 250, 251, and 240.

Excavation and removal of overburden, waste soil and debris were described in DP Section 8.5.1. Excavation and removal will continue until RASS and chemical sampling activities indicate the applicable DCGLs have been met. Excavation sites will then be prepared for the FSS.

Physical barriers will be installed and buffer zones maintained to protect portions of excavations available for FSS. Buffer zones will be transitioned to areas available for FSS, as excavation proceeds along the length of underground utilities and systems. Open excavations will be maintained throughout the FSS, and until restoration is authorized. Restoration of excavations will include placement of clean fill from an approved source, or site material that meets the criteria for re-use as backfill, followed by grading and re-vegetation.

Additional details on soil treatment and soil staging during decommissioning were requested in RAI 8-Q10 (ML103300204). The January 24, 2011, RAI response (ML110270200) indicated that a Soil Vapor Extraction (SVE) system will be installed in the Volatile Organic Compound Treatment Area. The purpose of the SVE is to remove the VOCs from the soil by running either heated or unheated air through the soil. The intent being that at the end of the process, the soil will either be contamination free and available for onsite fill or limited to radiological contamination. In the latter case, depending upon the concentration level of contamination, the soil would be either shipped offsite to a waste disposal facility or, if sufficiently low in concentration to meet the DCGLs, utilized for site fill. With such an operation the potential exists for driving off not only the VOCs but also radiological contaminants. The radiological contaminants will pass through a HEPA filter and charcoal adsorber for treatment. Additional details on the radiological effluents originating from the SVE are provided in Chapter 11.

The RAI response also provided details on areas that will be used for soil staging during decommissioning. The three primary areas are the WCA located at the edge of the burial area, the Waste Holding Area near the railcar loading pad, and the Laydown Area northeast of the central tract. WEC plans to revise Section 8.5.2.2 of the DP to provide additional information on VOC treatment and radiological screening of soil (ML111880290). WEC will also revise Section 8.5.2.3 (Low Level Radiological Waste) to describe the soil staging areas and the removal and handling of Low Level Radiological Waste (LLRW) (ML111880290). Once soil exceeding the DCGL has been segregated as LLRW, excavated soil will be loaded directly into haul trucks for transfer to the WCA or stockpiled until a sufficient quantity is available to transport to the WCA. At the WCA a final visual inspection and radiological assay will be performed. LLRW will then be sent to the WHA for stockpiling, loading, waste acceptance criteria (WAC) verification, and eventual transportation for off-site disposal.

The NRC staff has reviewed the information in Section 8.5 (Contaminated Soil) of the WEC Hematite DP and associated RAI responses according to NUREG-1757, Volume 1, Section 17.1.3 and Appendix D, Section VIII.c. Based on this review, NRC staff has determined that the licensee has described the planned decommissioning activities associated with contaminated soil at its facility sufficiently to allow the NRC staff to evaluate the potential safety issues associated with remediating the facility and to ensure compliance with 10 CFR 70.38(g)(4).

8.4 Surface and Ground Water

Volume 1, Revision 2 of NUREG 1757 describes the staff's evaluation of the decommissioning of nuclear facilities using one of seven reviews schemes, categorized as Groups. Among these seven groups, Group 4 is unrestricted release with site-specific dose analysis and no ground water contamination. A Group 5 review involves unrestricted release with ground water contamination. The Hematite site presented an interesting dilemma. There was radiological contamination in the water within the clay aquitard. However, the issue was whether the water within the aquitard was sufficient to support a potable water pathway in the dose assessment scenario. If it can, then that affects the decommissioning activities which WEC must undertake as part of the decommissioning effort at Hematite. In the usual scheme for decommissioning, a Group 5 site requires much more extensive actions.

WEC stated in Section 1.3 of the DP that the groundwater was not contaminated radiologically and proposed Hematite as a Group 4 site. The staff questioned that categorization in RAI 1-Q1

(ML102810455). WEC provided their response on December 10, 2010 (ML103490102). In their response, WEC did not define the water in the silty clay overburden as groundwater. Additionally, WEC argued that the silty clay overburden would not provide sufficient yield to meet the aquifer definition given in Group 5. As a result, WEC concluded that the Hematite decommissioning should not be a Group 5 site.

In contrast to WEC's conclusions, the NRC's regulations consistently define groundwater as water that is below the land surface in a zone of saturation (see 10 CFR Part 40, Appendix A and 63.302) and NUREG-1757 defines groundwater as water contained in pores or fractures in the saturated zones. Although the Hematite facility groundwater data indicates that the silty clay overburden is in a saturated condition, this hydraulic data also indicates that the unit will not provide a sufficient yield for domestic use. The upper most aquifer at the Hematite facility is the sand/gravel and Jefferson City-Cotter bedrock hydrostratigraphic units. These units are interconnected hydraulically and behave as a single aquifer. The current levels of uranium and Technetium-99 detected in the sand/gravel and the Jefferson City-Cotter units are significantly less than their respected US EPA maximum contaminant levels (MCLs) (ML110250138). The potential dose resulting from the current levels of radionuclides in these units is negligible. Given the groundwater definition in the NRC regulations and NUREG-1757, staff does not believe that the Hematite site decommissioning is a Group 4 site. Despite this conclusion, staff believes WEC's proposed remedial action of removal of contaminated silty clay and treatment of impacted groundwater is acceptable as explained below and meets the Hematite facility's decommissioning goals.

To protect the sand/gravel and Jefferson City-Cotter aquifer from future radioactive contamination, WEC's has addressed staff's concerns about radiological sources present in the silty clay overburden by committing to the following:

1. Abandoning selected hybrid wells identified with "leachate" impacted with radionuclides (ML112092512). As discussed in Chapter 4, these hybrid wells have well screens that cross both the silty clay overburden and the sand/gravel unit below. This cross-communication has resulted in the transport of contaminated water from the silty clay overburden to the sand/gravel unit (RAI 4-Q8). The hybrid wells proposed for abandonment include PL-06, NB-33, EP-20, BD-14, WS-13, NB-31, NB-81, WS-17B, and DM-02. Most of these wells are located downgradient of the process buildings. New monitoring wells have been installed in the sand/gravel unit in a close proximity of the abandoned hybrid wells. The new wells will be monitored for groundwater during and after site remediation.

2. Removal of the 'leachate" impacted with radionuclides in the overburden clay, (RAI 3-Q9). As soil excavation proceeds, the contaminated "leachate" entering the excavation pit will be pumped out and treated for radionuclides by the water treatment system (WTS).prior to its release in accordance with the effluent discharge requirements.

3. Installation of borings in the close proximity to hybrid wells BD-001, BD-02, BD-03, and BD-04 within the investigation area, and the collection of soil samples to the top of sand/gravel layer for radionuclide analysis. Further soil excavation will be conducted if

spent limestone and soil above the DCGLs are found below the initially proposed excavation depth.

4. Monitoring of groundwater, post remediation. The staff had raised the issue of the lack details on the post remediation groundwater monitoring program (ML110210533, RAI 3-Q4). In response to the request, WEC provided rational and justification for the planned monitoring (ML110730270). WEC's monitoring strategy will focus on potential migration of radionuclides (Uranium-234, Uranium-235, and Uranium-238 and Technetium-99) in the sand/gravel, the Jefferson City-Cotter, and Roubidoux units at locations downgradient of identified source areas at the site. Monitoring will be quarterly. Seven new wells will be installed in the sand/gravel unit and incorporated with seven other existing wells in the sand/gravel monitoring network. The proposed monitoring network for the Jefferson City-Cotter unit includes seven new wells and two existing wells. The Roubidoux unit monitoring network will remain the four existing monitoring wells. Westinghouse committed to revising relevant sections of the DP

The decommissioning activities proposed for surface water at Hematite facility include the treatment of the evaporation ponds and the Site Pond, and the wastewater generated by site decommissioning activities (dust suppression, decontamination of concrete surfaces, foundations and paved areas, and equipments). The ponds and wastewaters will be remediated through the on-site WTS for radionuclides prior to release.

The NRC staff has reviewed the information in Section 8.6 (Surface and Groundwater) of the WEC Hematite DP and associated RAI responses according to NUREG-1757, Volume 1, Section 17.1.4 and Appendix D, Section VIII.d. Based on this review, NRC staff has determined that the licensee has described the planned decommissioning activities associated with surface and groundwater at its facility sufficiently to allow the NRC staff to evaluate the potential safety issues associated with remediating the facility and to ensure compliance with 10 CFR 70.38(g)(4).

8.5 Schedules

WEC proposed a scheduled which anticipated decommissioning requiring 36 months from the time of staff approval of the DP. WEC has projected a period of approximately 21 months for burial pit remediation and restoration and FSS occurring over approximately 18 months. The staff has assessed WEC's schedule and noted that the schedule is greater than the 24 months noted in 10 CFR 70.38(g)(vii). The staff assessed the alternative schedule in accordance with the direction in 10 CFR 70.38(i). The staff concluded that the alternative schedule was appropriate and that a 24-month schedule would not be technically feasible based upon the number of onsite burial pits. Additionally, the undefined nature of some pits both in terms of boundaries and contents justifies an additional 12 months beyond the normal 24 month schedule.

9.0 Project Management and Organization

9.1 Decommissioning Management Organization

WEC's DP organization is led by the Project Director and a staff of functional area managers. In addition to the Project Director and the Chairman of the Project Oversight Committee (POC), WEC has identified the following functional areas as key-to-safety safety for purposes of the license: Radiation Protection, Licensing, and Operations. The following additional functional areas are not key-to-safety for purposes of the license: Environmental Health and Safety, Project Controls, Project Engineering, Security and Quality Assurance (QA). WEC provided a description of the responsibilities in each functional area and the responsibilities of the Department Managers. WEC expects that changes to the organization, either in assignments or responsibilities, will be made by the Hematite Project Director as the decommissioning progresses. WEC indicated that an individual manager may be responsible for more than one management area. In addition, the manager may assign a designee to fulfill specified functions in the manager's absence or when necessary to support decommissioning activities. WEC indicated that any changes to the organization will be in accordance with the requirements of the Hematite License.

In DP Section 9.1.2, WEC indicated that all site personnel have the stated responsibilities to perform decommissioning activities safely and in accordance with site procedures. When anyone at the Hematite facility identifies a potentially unsafe condition, an imminent danger, a procedure step that cannot be performed as specified, or a condition that is not compliant with applicable requirements, they have the authority to stop work. WEC stated the granting of this authority to stop work to anyone working at the Hematite decommissioning project provides an approach that helps ensure decommissioning activities are conducted in a safe manner.

In the staff's RAI 9-01 (ML103300204), WEC was requested to provide a description of the process for authorizing restart and who possesses the authority to issue a restart order following a Stop Work Order. WEC stated in their January 24, 2011 response (ML100270200) that the Hematite Project Director had the authority to restart following a Stop Work Order. If the Stop Work Order was initiated by the RSO, then both the RSO and the Project Director needed to approve the restart. In the January 24, 2011, response WEC also proposed to revise DP Section 9.1.2 by adding a description of the Stop Work process and authorization for restart. However, the staff found that WEC's proposed revision to Section 9.1.2 was too ambiguous. The proposed revision talked about the Manager responsible for the work, the Manager of the appropriate safety discipline and the responsible HDP Manager. The proposed revision was unclear as to whether these were all the same Manager, three different Managers or two different Managers. WEC addressed this ambiguity in Attachment 6 of their July 5, 2011 submittal (ML111880290) of the RAI Resolution Tables. WEC proposed to clarify the situation by using the single term "functional area manager" in DP Chapter 9. WEC clarified that the functional area manager is responsible for the organizational group that has the primary responsibility for a particular aspect of the work. Further WEC proposed to revise Section 9.1.2 to state "The individual declaring the Stop Work informs the Supervisor or Manager in the Department that has overall lead for the work (typically Operations or Project Engineering Departments). That Supervisor or Manager informs the Project Director and the Manager of the appropriate safety discipline (e.g., EH&S, NCS, radiation safety) of the Stop Work. The responsible HDP Manager shall…” With this proposed revision to DP Section 9.1.2 and WEC’s information as who has the authority to issue a restart following a Stop Work Order addresses the staff’s concern.

The staff has reviewed the description of the decommissioning project management organization and project safety position and the manner in which WEC manages the decommissioning of its Hematite facility located near Hematite, MO according to the NUREG-1757, Volume 1, Section 17.2 (Project Management and Organization) and Appendix D, Section IX.a. Based on this review, the staff has determined that WEC has sufficiently described the decommissioning management organization to ensure compliance with 70.38(g)(4)(ii).

9.2 Decommissioning Task Management

Section 9.2 of the Hematite DP describes procedures, site work control, and the usage of Radiation Work Permits (RWPs). Section 9.2.1 states that decommissioning activities will be managed through policies and procedures which establish constraints on programs or plans at the Hematite facility. Functional area managers are responsible for subject matter in each program or plan, and the functional area manager must ensure that impacted organizations are given the opportunity for review prior to issuance. Procedure approval is based upon the approval of appropriate functional area management. Any changes to procedures will be evaluated by qualified individuals prior to implementation. Procedures must also be reviewed biennially from the date of the last revision to ensure that they are applicable to current site conditions.

A site work control process will also be in place during decommissioning, as described in Section 9.2.2 of the DP. This process requires decommissioning tasks to be evaluated by a committee representing the various functional areas. At a minimum this committee will maintain representatives from Operations, Radiation Protection, Environmental Health and Safety, and Licensing. Work activities are also categorized into routine work, work controlled by procedure, and work controlled by work package. In order to change approved work activities, an evaluation must take place to determine the level of functional area review that is required. If a change is outside the scope of the original work activity, it must be evaluated by Licensing to determine if NRC approval is required.

Radiation Work Permits are described in DP Section 9.2.3, and are required to control radiological work. These are developed in accordance with the Hematite Radiation Protection Plan (RPP). Additional information on the development and usage of RWPs was provided in DP Chapter 10 (Sections 10.2.1, 10.3.2, 10.7, 10.7.1, and 10.7.3).

In RAI 9-Q1 (ML103300204), the staff requested WEC to provide a description of the responsibility and authority of each unit to ensure that decommissioning activities are conducted in a safe manner and in accordance with written procedures. An acceptable response to this RAI was provided in the March 21, 2011, letter from WEC (ML110810978). A similar RAI, 8-Q9 (ML103300204), requested that there be a clear commitment to conduct decommissioning in accordance with written, approved, procedures. The January 24, 2011, responses to Chapter 8 and 9 RAIs (ML110270193) proposed a revision to Section 8.1 of the DP to state that

"Westinghouse will conduct decommissioning activities in accordance with written, approved, procedures."

The staff has reviewed the information in Section 9.2 (Decommissioning Task Management) of the WEC Hematite DP and associated RAI responses according to NUREG-1757, Volume 1, Section 17.2.2 and Appendix D, Section IX.b. Based on this review, the staff has determined that WEC has sufficiently described decommissioning task management to ensure compliance with 70.38(g)(4)(ii).

9.3 Decommissioning Management Positions and Qualifications

9.3.1 Radiation Safety Officer

Section 9.3.5 of the DP discusses the functional area of Radiation Protection and indicates the duties of the "Radiation Protection functional area manager." In RAI 9-Q3 (ML103300204) staff asked for clarification on whether or not the "functional area manager" referred to the Radiation Safety Officer and for additional details on the training and experience required for this position. Clarification was provided in WEC's January 24, 2011, RAI responses (ML110270193). Section 9.3 of the DP will be revised (ML111880290) to indicate the title of "Radiation Safety Officer" as the appropriate functional area manager for Radiation Protection. WEC also indicated that they have deferred to training qualifications approved in the Hematite license for key management positions, and that their QA program endorses ANSI/ASME NQA-1-1983 (which does not include position experience requirements). However, as a result of discussions with the staff regarding the RSO work experience requirement, WEC agreed to revise Section 9.3.5 of the DP to indicate that the RSO must have "at least three years of work experience in applied health physics, industrial hygiene, or similar work relevant to radiological hazards associated with site remediation," as opposed to only one year.

The staff has reviewed the information in Section 9.3.5 (Radiation Protection) of the WEC Hematite DP and associated RAI responses according to the NRC staff guidance in NUREG-1757, Volume 1, Section 17.2.3.1 and Appendix D, Section IX.d. Based on this review, the staff has determined that WEC has sufficiently described the Radiation Safety Officer position and its associated qualifications to ensure that a qualified individual is designated and empowered to oversee the licensee's radiation protection program.

9.4 Training

Staff training is described in Section 9.4 of the DP. Here it is indicated that all on-site personnel receive radiation safety training, ranging from radiological awareness training for visitors to exposure reduction methods for radiological workers. Additional details are given in the Hematite Training Plan. WEC will also utilize pre-work plan-of-the-day and toolbox briefings to reinforce concepts associated with: safety items, radiological protection, contamination control, criticality safety, ALARA, emergency response, and other topics dictated by ongoing work activities.

The Hematite Training Plan addresses qualification and requalification requirements as well as training documentation. The categories of training established in the Plan are as follows: Visitor Access Training, General Employee Training, Radiation Worker Training, Fissile Material Handler Training, Health Physics Technician Training, Safeguards Information Training, Plan-of-the-Day and Toolbox Training, and Emergency Responder Training. Contractors will be trained to the same level of Hematite employees performing the same task.

The staff has reviewed the information in Section 9.4 (Training) of the WEC Hematite DP according to NUREG-1757, Volume 1, Section 17.2.4 and Appendix D, Section IX.e. Based on this review, the staff has determined that WEC has sufficiently described training to ensure compliance with 10 CFR 70.22(a)(6) and 70.38(g)(4)(ii).

9.5 Contractor Support

Contractor support is described in Section 9.5 of the DP, where it is stated that the management of decommissioning activities will be performed by both WEC personnel and qualified contractors. A commitment is also given that contractors will be required to comply with applicable Hematite policies, procedures, and license requirements. Internal oversight of contractors will be provided by Hematite personnel to ensure that compliance is maintained with the applicable procedures, regulations, and the NRC license.

The staff has reviewed the information in Section 9.5 (Contractor Support) of the WEC Hematite DP according to NUREG-1757, Volume 1, Section 17.2.5 and Appendix D, Section IX.f. Based on this review, the staff has determined that WEC has sufficiently described contractor support to ensure compliance with 10 CFR 70.38(g)(4)(ii).

10.0 Radiation Safety and Health Program

10.1 Radiation Safety Controls and Monitoring for Workers

10.1.1 Workplace Air Sampling Program

In Section 10.2 (Workplace Air Sampling Program) of the DP, WEC commits to workplace air sampling which will comply with 10 CFR 20.1501, Regulatory Guides 8.24, "Health Physics Surveys During Enriched Uranium-235 Processing and Fuel Fabrication" and 8.25, "Air Sampling in the Work Place," and that controls will be in place to maintain on site workers' exposure and offsite effluents, ALARA. WEC indicates that Derived Air Concentration (DAC) values from 10 CFR 20, Appendix B will be used to assess occupational airborne radioactivity exposure. A commitment is also made to perform work place sampling when airborne radioactivity concentrations are likely to exceed 2 percent of the occupational DAC values in general areas. Sampling representative of the breathing zone will be performed when airborne radioactivity is likely to exceed 10 percent of the DAC in the breathing zone (or 2 percent for a declared pregnant female). Section 10.2.2.1 of the DP states,

> When monitoring is required for the purpose of determining occupational exposure, sampling is accomplished through the use of a personal air sampler (lapel pump), or a portable low volume air sampler. The personal air sampler is the preferred method because the filter cartridge can be easily located within approximately 12 inches of the worker's head during sample collection, increasing the probability of being representative of the concentration in the worker's breathing zone.

The staff raised concerns in DP RAI 10-Q1 (ML103260399) that these statements do not make a clear commitment to providing an air sampling program representative of worker's breathing zones and that there should be a commitment to using a lapel pump within the workers' breathing zones. Alternatively, WEC could provide adequate justification to demonstrate that a portable low volume air sampler will be representative of the breathing zone. A response to this RAI was provided in the January 28, 2011, letter from WEC (ML110330366). WEC stated that in cases where an individual is likely to exceed 10 percent of the annual limit on exposure and the average concentration in the workplace is likely to exceed 10 percent of the DAC, sampling representative of the breathing zone will be in place. Such sampling will either include lapel samplers or other portable low volume air samplers located within approximately 12 inches of the workers head.

The staff has reviewed the information in Section 10.2 of the WEC Hematite DP and associated RAI responses according to NUREG-1757, Volume 1, Section 17.3.1.1 and Appendix D, Section X.a. Based on this review, the staff has determined that WEC has provided sufficient information on when air samples will be taken in work areas, the types of air sample equipment to be used and where they will be located in work areas, calibration of flow meters, minimum detectable activities (MDA) of equipment to be used for analyses of radionuclides collected during air sampling, action levels for airborne radioactivity (and corrective actions to be taken when these levels are exceeded) to allow the staff to conclude that the WEC's air sampling program will comply with 10 CFR 20.1204, 20.1501(a)–(b), 20.1502(b), 20.1703(a)(3)(i)–(ii), and will meet the guidance in Regulatory Guide 8.25.

10.1.2 Respiratory Protection Program

WEC indicated in Section 10.3 of the DP that the Respiratory Protection Program must be capable of addressing radiological and non-radiological hazards, and therefore, NRC and OSHA requirements will be met. There is a commitment that WEC will have implementing procedures which incorporate guidance from NRC Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection" and that respiratory protection equipment will be used in accordance with 10 CFR Part 20, Subpart H, "Respiratory Protection and Controls to Restrict Internal Exposure in Restricted Areas." WEC stated in DP Section 10.3.1 that the primary method to protect workers from occupational exposure to airborne contaminants is the use of engineered controls. Such controls are HEPA ventilation, fixatives, dust suppression by misting, and the use of enclosures. WEC indicated that administrative controls, such as review and implementation of appropriate work practices, stay times, and personnel rotation, will be utilized as needed. Respiratory protective devices will be used when a WEC evaluation determines that administrative and engineering controls alone are inadequate for worker protection. An overview of respiratory equipment was provided in Section 10.3.3 of the DP. Here it was stated that respiratory protection equipment approved for use includes the full-face Negative Pressure (NP) respirator and the full-face Powered Air Purifying Respirator (PAPR). In accordance with 10 CFR Part 20, Appendix A, the NP respirator has a protection factor for radiological contaminants of 100 and the PAPR has a protection factor of 1000.

The staff has reviewed the information in Section 10.3 (Respiratory Protection Program) of the WEC Hematite DP according to NUREG-1757, Volume 1, Section 17.3.1.2 and Appendix D, Section X.b. Based on this review, the staff has determined that WEC has provided sufficient information to implement an acceptable respiratory protection program so as to allow the staff to conclude that the WEC's program will comply with 10 CFR 20.1101(b), and 10 CFR 20.1701 to 20.1704, Appendix A of 10 CFR Part 20, and will meet the guidance in Regulatory Guide 8.15.

10.1.3 Internal Exposure Determination

In Section 10.4 of the DP, WEC committed to monitor individuals likely to receive an intake greater than 10 percent of the Annual Limit on Intake (ALI) or 100 mrem Committed Effective Dose Equivalent (CEDE) for declared pregnant females for occupational exposure to radioactive materials. WEC would base the dose assessment on measurements of radioactivity in the work area air, quantities of radionuclides in the body (or excreted from the body), or from a combination of these measurements. The primary method for monitoring and calculating internal exposure would be from radioactivity concentrations in the air. The staff has reviewed the information in Section 10.4 (Internal Exposure Determination) of the WEC Hematite DP according to NUREG-1757, Volume 1, Section 17.3.1.3 and Appendix D, Section X.c. Based on this review, the staff has determined that WEC has provided sufficient information on methods to calculate internal dose of a worker based upon measurements from air samples or bioassay samples to allow the staff to conclude that the WEC's program to determine internal exposure will comply with 10 CFR 20.1101(b), 20.1201(a)(1), (d) and (e), 20.1204 and 20.1502(b).

10.1.4 External Exposure Determination

In Section 10.5 of the DP, WEC commits to maintaining an external exposure monitoring plan consistent with 10 CFR 20.1502(a) and that, at a minimum, external exposure monitoring shall be performed for individuals likely to receive 10 percent of the annual occupational dose limit from 10 CFR Part 20. There is a commitment to monitor occupational exposure for beta, gamma, and neutron radiation for personnel routinely handling radioactive materials. Primary and secondary dosimetry will include thermoluminescent dosimeters or self-alarming dosimeters. Primary dosimetry will be processed by a facility accredited by the National Voluntary Laboratory Accreditation Program (NVLAP). Secondary dosimetry will be worn in accordance with the Radiation Protection Plan (RPP) and procedures that are consistent with the guidance in NRC Regulatory Guides 8.4, "Direct-Reading and Indirect Reading Pocket Dosimeters" and 8.28, "Audible-Alarm Dosimeters."

Section 10.5 of the HDP stated "although monitoring for external exposure is not required, the HDP has conservatively elected to implement a program that includes provisions for monitoring occupational exposure to beta, gamma and neutron radiation for those personnel who routinely handle radioactive materials," and "the HDP may discontinue the external dosimetry program provided actual conditions support that determination." The staff requested in RAI 10-Q3 (ML103260399) that a detailed dose analysis and justification be provided before any external dosimetry program is discontinued. In WEC's January 28, 2011, Chapter 10 RAI responses (ML110330366), they stated that an evaluation of the potential exposures and the associated requirements for monitoring had already been completed and that "based on the prior work experience (2001 through 2005), individual annual external exposure is expected to be less than 100 mrem." WEC also indicated in the January 28, 2011, RAI responses that the third paragraph of DP Section 10.5 will be deleted from the DP, thus removing the statements that external exposure monitoring is not required. Additionally, WEC's RAI response stated,

> Notwithstanding the conclusion that monitoring for external exposure is not required, Westinghouse has elected to implement an external dosimetry program at this time. This decision is in response to a request from our insurer. Westinghouse will continue to evaluate actual and potential external exposures during the course of the project, and may elect to discontinue monitoring in the future should the evaluation continue to indicate that monitoring for external exposure is not required, and our insurer concurs with our evaluation. This evaluation will be available for inspection.

The staff also requested additional information in RAI 10-Q5 (ML103260399) on the usage of extremity and whole body monitors when the external radiation field is non-uniform. The January 28, 2011, Chapter 10 RAI responses provided a revision which will be made to Section 10.5 of the DP stating that secondary dosimetry usage will be implemented in accordance with the RPP and associated implementing procedures. The latter utilizes the guidance of NRC Regulatory Guides 8.4 and 8.28.

In RAI 10-Q6 (ML103260399), the staff requested information on the action levels for worker's external exposure and the technical bases and actions to be taken when they are exceeded. The January 28, 2011, WEC RAI responses indicated that Section 10.1 of the DP will be revised to include the action levels represented in the RPP. The administrative occupational exposure limit will be set to 2,000 mrem Total Effective Dose Equivalent (TEDE), and the action level for investigation and possible work restrictions will be set to 1,000 mrem Deep Dose Equivalent (DDE).

The staff has reviewed the information in Section 10.5 (External Exposure Determination) of the WEC Hematite DP and associated RAI responses according to NUREG-1757, Volume 1, Section 17.3.1.4 and Appendix D, Section X.d. Based upon this review, the staff has determined that WEC has provided sufficient information on methods to measure or calculate the external dose of a worker to comply with the requirements of 10 CFR 20.1101(b), 20.1201(c), 20.1203, 20.1501(a)(2)(i) and (c), 20.1502(a), and 20.1601.

10.1.5 Summation of Internal and External Exposures

WEC indicated in Section 10.6 of the DP that when dosimeters are issued at the Hematite facility the summation of internal and external exposures will be performed in accordance with 10 CFR Part 20 and the guidance in NRC Regulatory Guides 8.34, “Monitoring Criteria and Methods to Calculate Occupational Radiation Doses” and 8.36, “Radiation Dose to the Embryo/Fetus.”

The staff has reviewed the information in Section 10.6 (Summation of Internal and External Exposure) of the WEC Hematite DP according to NUREG-1757, Volume 1, Section 17.3.1.5 and Appendix D, Section X.e. Based on this review, the staff has determined that WEC has provided sufficient information to conclude that WEC’s program for summation of internal and external exposures will comply with 10 CFR 20.1202 and 20.1208(c)(1) and (2), and 20.2106.

10.1.6 Contamination Control Program

WEC indicated in Section 10.7 of the DP that the contamination control program will: (1) comply with 10 CFR 20, (2) implement the ALARA philosophy, and (3) utilize the guidance from Regulatory Guides 8.24 and 8.15. Access requirements will be in place within areas where radiological contamination has been identified, and Radiation Work Permits (RWPs) will be required for all work in Restricted Areas of the site.

Section 10.7.1 of the DP described various contamination control surveys that WEC will perform during decommissioning. WEC will perform surveys to confirm radioactivity levels, assess work hazards, determine posting/labeling requirements, assist in the implementation of engineered controls/work practices, and demonstrate regulatory compliance. At a minimum, WEC will perform a monthly survey for contaminated areas and non-contaminated areas. Step-off pad areas will be surveyed daily. WEC has indicated that work planning and job coverage contamination surveys will be performed as necessary during planning and during work processes, as defined by RWPs. WEC has established surface survey contamination limits which are consistent with levels from NRC Policy and Guidance Directive FC-83-23, “Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material” (ML003745523). WEC also stated in Section 10.7.1 “for a mixture of radionuclides with differing limits, the effective contamination limit may be derived by using the most conservative radionuclide present, by weighting the radionuclides, or by an alternate means determined by the RSO,” and “the RSO shall approve any effective contamination limit.” The staff disagrees with “weighting the radionuclides” in mixtures and with the RSO approval of alternate release criteria. The staff’s position was that the NRC should approve alternate release criteria. These two concerns were communicated to WEC during discussions of the Hematite Radiological Characterization Report (HRCR) RAI RCR-09-Q5 (ML101740167). As a result, WEC agreed to update 10.7.1 of the DP to use a sum-of-fractions approach for mixtures and to delete the RSO’s ability to approve alternate release criteria (ML111880290).

Sections 10.7.2 – 10.7.5 of the DP provided details of surveys for airborne contamination, personnel contamination, unrestricted release of equipment and facilities, and radioactive material packages. Leak test surveys were described in 10.7.6 of the DP while background surveys were described in Section 10.7.7. WEC will determine background radiation levels by placing reference thermoluminescent dosimeters (TLDs) at the perimeter of impacted areas, and background concentrations in air will be determined by placing an air sampler in locations unaffected by licensed activities. The determination of background soil was described in Section 4 of the HRCR.

The staff has reviewed the information in Section 10.7 (Contamination Control Program) of the WEC Hematite DP according to NUREG-1757, Volume 1, Section 17.3.1.6 and Appendix D, Section X.f. Based on this review, the staff has determined that WEC has provided sufficient information to control contamination on skin, on protective and personal clothing, on fixed and removable contamination on work surfaces, on transport vehicles, on equipment (including ventilation hoods), and on packages to allow the staff to conclude that WEC’s contamination control program will comply with 10 CFR 20.1501(a), 20.1702, 20.1906 (b), (d), and (f).

10.1.7 Instrumentation Program

In DP Section 10.8, WEC states that the RPP provides guidance on the use, calibration, and maintenance of radiological instrumentation which is consistent with ANSI-N323A-1997 (Radiation Protection, Instrumentation Test and Calibration, Portable Survey Instruments). Accordingly, radiological instrumentation, including flowmeters, velometers, rotameters, and orifices will be calibrated annually at a minimum. Calibration will also be performed after maintenance, repairs or adjustments that may affect the original calibration. Calibrations of portable instrumentation and air sampling equipment are performed by qualified vendors, and stationary counting systems are calibrated on-site. Radiological instruments are stored in locked rooms and admittance is controlled by HP supervision.

The staff noted in RAI 10-Q7 (ML103260399) that the DP only provided a general description of instruments to be used during decommissioning. This RAI also noted that the content of the DP tends to rely heavily on the RPP, as Section 10.8 states that “the RPP provides guidance on the use, calibration and maintenance of radiological instrumentation and the guidance is implemented through approved site procedures.” Accordingly, the staff requested WEC submit the RPP for review. WEC provided the RPP with the January 28, 2011, responses (ML110330366) to the Chapter 10 RAIs. RAIs 10-Q8, 10-Q9, and 10-Q10 (ML103260399) requested information on instrument calibration/quality assurance, how uncertainty bounds would be estimated, and calculations for minimum detectable concentration (MDC)/minimum detectable activity (MDA). WEC provided adequate responses in their January 28, 2011, letter

(ML110330366). In their responses, WEC committed to revise Sections 14.4.4.2.2 and 14.4.4.2.3 of the DP to provide additional details on the calibration, maintenance, and quality assurance associated with radiological instruments used for decommissioning. Section 10.8.4 of the DP will also be revised with additional information on instrument uncertainty bounds and MDC calculations.

The staff has reviewed the information in Section 10.8 (Instrumentation Program) of the WEC Hematite DP and associated RAI responses according to NUREG-1757, Volume 1, Section 17.3.1.7 and Appendix D, Section X.g. Based on this review, the staff has determined that WEC has provided sufficient information on the sensitivity and the calibration of instruments and equipment to be used to make quantitative measurements of ionizing radiation during surveys to allow the staff to conclude that WEC's instrumentation program will comply with 10 CFR 20.1501(b) and (c).

10.2 Nuclear Criticality Safety

The staff reviewed WEC's Nuclear Criticality Safety (NCS) Program described in Sections 8.1.2 and 10.9 of the DP. Other information reviewed included the planned decommissioning activities in Section 8, project management and organization in Section 9, RAI responses, and the NCS Contingency Plan for Remediating Contingency Hot Spots dated November 12, 2010, (ML103190704). The objective of the review was to determine whether WEC's NCS program will provide protection for public health and safety, and the environment during decommissioning activities.

In DP Section 10.9.1.4, WEC stated that its NCS program was based upon the ANSI/ANS-8 standards listed, as endorsed by NRC Regulatory Guide 3.71. In Section 8.1.2 of the DP, WEC described its overall approach to criticality safety. WEC stated that it would use radiological surveys and visual inspections during decommissioning to identify potential fissile material. If fissile material is identified, it will be extracted and segregated, then measured to establish the Uranium-235 content and classify it as NCS-exempt or fissile. NCS Exempt Material is defined as material containing Uranium-235 with an average nuclide fissile concentration not exceeding 0.1 g ^{235}U/L, or material that comprises no greater than 15 g Uranium-235 and is enclosed within a container with a volume of at least 5 liters. If fissile material is found that is above the upper concentration limit that has been analyzed, then WEC committed to stopping work while additional criticality safety controls are established. In their response (ML110270200) to RAI 8-Q14, WEC committed to including the definition of NCS exempt material in section 10.9.2.1.1 of the DP. In Sections 9.3 and 10.9 of the DP, WEC provided details on its NCS program and the controls which will be established to maintain criticality safety. The staff reviewed WEC's nuclear criticality safety approach and program to determine whether it is adequate to maintain criticality safety during decommissioning.

The staff has reviewed the information in the Hematite DP, the associated RAI responses, and the NCSCP as described above according to NUREG-1757, Volume 1, Section 17.3.2. Based on this review, staff has determined that WEC has provided sufficient information for the staff to conclude that the WEC's program for the Hematite facility provides reasonable assurance of the protection of public health and safety from the risk of a nuclear criticality during decommissioning. The staff also finds that this program will comply with the applicable requirements in 10 CFR Part 70.

The details of the staff's review are discussed below.

10.2.1 NCS Functions

In DP Section 10.9.1.1, WEC described its NCS organization and how the NCS program will be administered. The RSO is responsible for the NCS program. A functional area manager is assigned to direct the activities of the NCS program including approving and reviewing operations and procedures, and establishing NCS controls. The NCS organization has the authority and responsibility to shut down potentially unsafe Hematite operations. DP Figure 9-1 showed the Hematite organizational structure and shows that the RSO reports to the Hematite Project Director. The qualifications of the functional area manager are that the manager must have a BS or equivalent, previous management experience in environmental and safety, and two years of experience in licensing, or regulatory affairs, or equivalent. The manager is also required to take "Basic Concepts in General Employee Training" and "Fissile Material Training for Supervisors and Managers (FMTSM)." This provides an understanding of criticality safety controls and postings as well as additional training resource for Supervisors and Managers involved in planning work associated with fissile materials in quantities requiring Nuclear Criticality Safety control measures. FMTSM contains the following topics:

- Basic Fundamentals of Nuclear Criticality
- Terms and Definitions
- Use of Criticality Safety Parameters
- Criticality Safety Controls (CSC) and Defense in Depth (DinD)
- Use of CSCs and preferred hierarchy for their application
- Incorporating CSCs and DinDs into Work Planning

In WEC's January 28, 2011, response (ML110330366) to NRC RAI 10-Q11, WEC committed to using the term "NCS specialist" throughout the DP instead of the term "NCS engineer". The qualifications for an NCS engineer were provided in the DP and also apply to an NCS specialist. The NCS specialist is required to have the equivalent of a BS in science or engineering, and at least three years experience in criticality safety. Although WEC proposed revising this to be less restrictive in their response to RAI 9-Q1dated March 21, 2011 (ML110010978) the staff did not accept reducing the qualifications because of the dynamic and non-routine nature of decommissioning. WEC subsequently decided in their July 5, 2011, submittal (ML111880290) to retain its training and experience requirements for an NCS specialist as originally stated in its January 28, 2011, RAI response.

The staff has reviewed the information in Section 10.9.1.1 of the WEC Hematite DP and associated RAI responses according to NUREG-1757, Volume 1, Section 17.3.2. Based on this review, the staff has determined that the NCS organization is independent, to the extent practical, from Operations because the RSO who is responsible for NCS, reports directly to the Project Director. The responsibilities and qualifications of the NCS manager as well as the NCS specialists, are consistent with guidance provided in ANSI/ANS-8.1, "Nuclear Criticality Safety in Operations With Fissionable materials Outside Reactors"; and ANSI/ANS-8.19, "Administrative

Practices for Nuclear Criticality Safety" which the staff finds acceptable. Based on this, the staff has determined that WEC has provided sufficient information to conclude that WEC's management responsibilities and technical qualifications of NCS safety personnel are adequate and will be maintained when needed throughout the decommissioning process.

10.2.2 Maintenance of NCS Procedures, Programs, and Management Measures Throughout Decommissioning

In Section 9.2 of the DP, WEC described how the decommissioning activities will be managed. In DP Section 10.9.1.4, WEC provided a list of guidance documents that it will use to manage its criticality safety program. The functional area manager for NCS, the RSO, and the Project Director have approval authority for policies and procedures related to criticality safety. These procedures will follow WEC's QA program and the guidance in ANSI/ANS-8.19-2005, "Administrative Practices for Nuclear Criticality Safety." The RSO is also included as a member of the Site Work Control Committee (WCC) and the Project Oversight Committee (POC). The WCC is responsible for evaluating activities to ensure that all work is performed in accordance with the license and decommissioning plan and POC is responsible for work place safety.

WEC described its management measures in DP Section 10.9.1.2. For NCS training, WEC committed to following ANSI/ANS-8.20-1991, "Nuclear Criticality Safety Training." They also committed to performing audits and inspections to evaluate the effectiveness of the NCS program. WEC will establish NCS labeling and posting requirements to identify SNM and NCS requirements. WEC uses a change management process to ensure that proposed facility changes are reviewed for impacts to the safety basis and NCS controls.

The staff granted WEC an exemption from the requirements for a Criticality Accident Alarm System of 10 CFR 70.24 for certain activities at Hematite. The details of the staff's assessment can be found in the License Application Amendment SER (ML112101690).

The staff has reviewed the information in DP Sections 9.2 and 10.9.1 and associated RAI responses and WEC's July 5, 2011 submittal (ML111880290) according to NUREG-1757, Volume 1, Section 17.3.2. Based on this review, the staff has determined that WEC has provided an adequate description of how an awareness of procedures and other management measures relied on for criticality safety will be maintained throughout decommissioning among all personnel with access to systems that may contain fissionable material in sufficient amounts for criticality.

10.2.3 NCS Requirements for Decommissioning

DP Sections 10.9.1 and 10.9.2 described WEC's NCS requirements for decommissioning. On November 12, 2011, WEC also submitted an NCS Contingency Plan (NCSCP) for Remediating Contingency Hot Spots (ML103190704). This Plan described how WEC will provide criticality control if material is found that contains more than 700 grams of Uranium-235. WEC develops and documents its NCS controls through the use of Nuclear Criticality Safety Assessments (NCSAs) which were described in DP Section 10.9.1.3. These assessments are subject to an independent review by a qualified NCS specialist. WEC committed to performing its NCSAs using computational methods which are validated in accordance with ANSI/ANS-8.1-1998 and

ANSI/ANS-8.24-2007, “Validation of Neutron Transport Methods for Nuclear Criticality Safety Calculations.” The primary computer code used will be Monte Carlo N-Particle (MCNP) 5, but other codes may be used if the codes meet the validation requirements of ANSI/ANS-8.1-1998 and ANSI/ANS-8.24-2007. WEC determined Upper Subcritical Limits for both homogeneous and heterogeneous systems, consistent with ANSI/ANS-8.24-2007. These Limits were present in DP Table 10-7. The overarching NCS limit is based upon NUREG-6505, “The Potential for Criticality Following Disposal at Low-Level Waste Facilities.” WEC also provided a description of its NCS control philosophy and control parameters, and criteria to establish subcriticality. The criticality safety hazards and controls were summarized in DP Tables 10-8 through 10-13. In response to staff’s RAI 10-Q12 (ML110330366) on the definition and use of “alternative processes” as the preferred NCS control, WEC indicated that it preferred to alter a process to eliminate a criticality hazard in lieu of establishing an engineered or administrative control. Although NCS control hierarchy is typically defined with respect to engineered or administrative controls, this is acceptable to staff. Also, to ensure that the engineered controls are robust and controlled so that they will perform their function as intended, RAI 10-Q13 requested WEC provide information on how engineered controls are managed (ML103260399). The WEC response (ML110330366) stated that NCS controls are procured and, if required, calibrated through their quality assurance program. In response to staff concerns regarding the use of administrative controls (RAI 10-Q14), WEC described how it minimizes, to the extent possible, the use of administrative controls. The staff finds this explanation acceptable because it limits the use of administrative controls and relies instead on engineered controls to the extent possible.

For a Contingency Hot Spot*,* defined as a discrete item with a Uranium-235 mass estimate exceeding 700 g (i.e., a distinct in-situ location where field instruments indicate the presence of more than 700 g of Uranium-235), the NCSCP will be employed.

The staff has reviewed the information in DP Sections10.9.1 and 10.9.2, as well as the NCSCP and associated RAI responses to NUREG-1757, Volume 1, Section 17.3.2. Based on this review, the staff determined that WEC’s analytical methods are acceptable because it uses industry standard codes and because WEC committed to validating these codes using appropriate ANSI/ANS standards. WEC provided a summary of generic NCS requirements to be applied to general decommissioning operations. WEC also provided a summary of the NCS requirements and NCS analysis it performed. The staff determined that WEC performed a systematic evaluation of parameters that impact criticality safety so that appropriate NCS controls can be established for decommissioning. The staff found that WEC had utilized appropriate data from NUREG-6505, "The Potential for Criticality Following Disposal of Uranium at Low-Level Waste Facilities," to determine the concentration limits. WEC also developed a contingency plan to deal with systems that may unexpectedly contain fissionable material.

10.3 Health Physics Audits and Recordkeeping Program

Section 10.10 of the DP specifies that a Project Oversight Committee (POC) will provide management oversight over decommissioning activities to ensure that radiation exposures are maintained ALARA. The RSO will provide a comprehensive written report of the Radiation Protection Program to the POC, who will then assess the effectiveness of the program. Several audits will be performed by the RSO as follows: POC meeting (quarterly), ALARA report to site manager (semiannually), ALARA report by RSO to POC (annually), RSO review of operating procedures affecting radiation protection (biennial), ALARA program audit (annually), and manager self assessment (annually).

The staff has reviewed the description of WEC's audit and recordkeeping program (DP Section 10.10) which will be used during decommissioning according to NUREG-1757, Volume 1, Section 17.3.3 and Appendix D, Section X.i. Based on this review, the staff has determined that WEC has provided sufficient information to allow the staff to evaluate WEC's executive management and RSO audit, and recordkeeping program to determine if the decommissioning can be conducted safely and in accordance with 10 CFR 20.1101 and 20.2102.

11.0 Environmental Monitoring and Control Program

11.1 Environmental ALARA Evaluation Program

WEC provides an ALARA commitment in Section 11.1.1 of the DP stating that "in accordance with Regulatory Guide 8.37, ALARA Levels for Effluents from Materials Facilities, every reasonable effort will be made to ensure that decommissioning activities are conducted in accordance with ALARA principles, and that concentrations of radioactive materials in air and liquid effluents are minimized in a manner consistent with the ALARA philosophy." ALARA goals for air and liquid effluent concentrations are stated in Section 11.1.1.1 of the DP as 20 percent of the applicable 10 CFR 20, Appendix B values. Additionally, ALARA investigation levels are given in Section 11.1.1.2 as 50 percent of the applicable 10 CFR 20, Appendix B values. In the DP, WEC indicated that if these investigation levels are exceeded a review of work activities will be performed in order to identify changes to methods and engineering controls that will reduce concentrations to below the investigation levels.

The staff requested additional details on the ALARA program for decommissioning in RAI 11-Q1, (ML101740507). WEC proposed to revise Section 11.1 of the DP in the August 10, 2010, Chapter 11 RAI responses (ML102250089). The ALARA goals that were provided were consistent with Regulatory Guide 8.37. However, WEC provided no commitment for compliance with the air emissions constraints of 10 CFR 20.1101(d), which states:

> To implement the ALARA requirements of § 20.1101 (b), and notwithstanding the requirements in § 20.1301 of this part, a constraint on air emissions of radioactive material to the environment, excluding Radon-222 and its daughters, shall be established by licensees other than those subject to § 50.34a, such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent in excess of 10 mrem (0.1 mSv) per year from these emissions. If a licensee subject to this requirement exceeds this dose constraint, the licensee shall report the exceedance as provided in § 20.2203 and promptly take appropriate corrective action to ensure against recurrence.

The need for 10 CFR 20.1101(d) compliance was communicated to WEC and WEC subsequently agreed to update Section 11.1.1.1 of the DP to state that "HDP will constrain airborne radioactivity emissions in accordance with the requirements of 10 CFR 20.1101(d) and will demonstrate compliance with this requirement using methodology contained within Regulatory Guide 4.20 using the data obtained from air monitoring locations defined in Tables 11-1a and 11-1b of this chapter." (ML111880290)

In RAI 11-Q2 (ML101740707), NRC staff requested additional details on the ALARA program and WEC proposed to clarify Section 11.1 of the DP in their August 10, 2010, Chapter 11 RAI responses (ML102250089). During staff discussions with WEC on WEC's Chapter 11 RAI responses, the staff also noted that the environmental ALARA program appeared to be limited to controlling dust from soil movement and excavation while not addressing the soil vapor extraction (SVE) system. WEC agreed to revise Table 11-1 of the DP to include the soil vapor extraction process as a point source emission. As a follow up to RAI 10-Q3, WEC also agreed to revise DP Section 11.2.1 to state that "air effluents from the soil vapor extraction will be treated and monitored as discussed in Section 12.4.3.4." Further details on sampling of the soil vapor extraction system were provided in WEC's response to RAI 12-Q3 (ML110330366). While the soil vapor extraction SVE system (SVES) is considered a point source, the system is potentially mobile so that it may be moved to different site areas during decommissioning. WEC provided additional clarification on the proposed locations of the SVES in a proposed revision to Section 11.2.3.3 (ML111880290). WEC's clarification indicated that "the point source of air effluent from the SVES will initially originate from the equipment location on the eastern portion of the slab of the former process buildings," but that "during remediation of the former process building slab and underlying soil, it is planned that the SVE equipment will be relocated to a location in the Central Tract that does not impact remediation work activities."

The staff has reviewed the information in Section 11.1 (Environmental ALARA Evaluation Program) of the WEC Hematite DP and associated RAI responses according to NUREG-1757, Volume 1, Section 17.4.1 and Appendix D, Section XI.a. Based on this review, the staff has determined that the licensee has provided sufficient information on the staff to conclude that the licensee's program will comply with 10 CFR Part 20.1101(b) and (d).

11.2 Effluent Monitoring Program

Specific requirements of the WEC effluent monitoring program are given in the Effluent and Environmental Monitoring Plan (EEMP), and a summary of air and liquid effluent requirements are provided in Section 11.2 of the DP. Table 11-1 of the DP also summarizes the ALARA goals, investigation levels and regulatory limits for air and liquid effluents. WEC plans to monitor air effluents by placing perimeter air sampling placed downwind of decommissioning activities. WEC will perform such sampling when airborne radioactivity values are likely to be greater than 20 percent of the 10 CFR 20, Appendix B, Table 2 values. Liquid effluents will be measured weekly at the Sanitary Wastewater Treatment Plant and the Site Dam. Weekly composite samples or a batch grab sample prior to release will be taken at the Remediation Water Treatment System. Air and water samples will be compared to baseline samples established from monitoring during historical site operations and during the decommissioning period.

Section 11.3 of the DP stated that "the HDP Environmental Monitoring Program is contained in the EEMP," and that "locations for air particulate, soil, vegetation, ground water, and surface water monitoring are established and documented as part of this program." Environmental monitoring locations and the associated sampling parameters were provided in Table 11-5 of the DP.

In RAI 11-Q1 (ML101740507), the staff requested that WEC provide the EEMP and the Water Management Plan. The EEMP was provided as Attachment 4 (ML110330371) to the January 28, 2011, responses from WEC, and the Water Management Plan was provided as Attachment 5 (ML110330374).

NRC staff RAI 11-Q3 (ML101740507) asked WEC to address how they would determine the maximum dose from airborne effluents at a downwind, offsite location. In their August 10, 2010, response (ML102250089), WEC indicated that decommissioning activities, such as building demolition, soil excavation, and waste handling, are not expected to create discrete release points for effluents or elevate the release height. Thus, WEC concludes that only perimeter monitoring is required, and WEC committed to revise Section 11.2.1 of the DP to clarify this conclusion. However, the EEMP indicated in Section 8.3.1 (Airborne Sources) that “from on-site meteorological data, prevailing winds on-site are generally from the south-southwest or from north-northeast (essentially parallel to State Road P and the adjacent hill).” The staff’s review of EEMP Appendix A and Figure B-1 showed that 6 air monitoring locations (AS-A, AS-B, AS-C, AS-D, AS-F, and AS-G) will be in place around the decommissioning area perimeter. There appeared to be an air sampling void in the south-southwest area of the site (west of the site pond), which is along the direction of the prevailing winds. This fact, coupled with statements in DP Section 11.2 and EEMP Section 8.4 that perimeter sampling of air effluents will only be performed when work activities could potentially generate at the perimeter of the work activities, airborne radioactivity concentrations in excess of 20 percent of annual limits specified in 10 CFR 20, Appendix B, raised concerns whether adequate effluent air monitoring would be performed when winds were blowing toward the south-southwest. This concern was raised to WEC and in response, WEC agreed to place two additional air samplers on site (ML111880290). One permanent air sampler will be added southeast of Building 231 to provide sampling in the vicinity of the loading pad. Another permanent, but mobile, air sampler will be added to the west of the Site Pond. In addition, WEC also agreed to revise Section 11.2.1 of the DP to state that “in practice, it is Westinghouse’s intent to run perimeter samplers during nearly all operations that involve movement of exposed soil, (e.g., excavation, rail car loading), thus portable downwind air samplers will be utilized for many activities that have the potential to generate concentrations that are less than 20 percent of the air effluent limit.”

In RAI 11-Q5 (ML101740507), the staff requested information on the types of detection methods and laboratory analyses that will be used to determine the suitability of liquid effluent releases. Clarification was also requested on the threshold for isotopic analysis instead of gross radioactivity measurements. WEC’s August 10, 2010, Chapter 11 RAI responses indicated that Section 11.2.3.4 of the DP will be revised to include Minimum Detectable Concentration (MDC) targets at 5 percent of the applicable 10 CFR Part 20 limit for gross beta and alpha laboratory measurements. On-site analysis using a proportional counter carries a MDC target of 25 percent of the applicable 10 CFR Part 20 limits. The MDC targets for laboratory analysis of isotopic uranium and Technetium-99 will be 1.0 pCi/L and 3.0 pCi/L, respectively. WEC will also revise Section 11.2.3.4 to indicate that isotopic analysis of effluent water samples will be performed when radioactivity concentrations are greater than 10 percent of the annual limits specified in 10 CFR Part 20, Appendix B, Table 2, Column 2. RAI 11-Q12 (ML101740507) also dealt with liquid effluents, and pointed out that a composite sample would be more appropriate than the weekly grab sample which was indicated in Section 11.2.3.4 of the DP. The August 10, 2010, response to this RAI stated that WEC “will establish composite sampling using an auto-sampler prior to commencement of work activities under the approved DP and the EEMP will be updated to reflect continuous sample collection.”

RAI 11-Q7 (ML101740507) requested information on effluent monitoring locations and on the replacement of locations. WEC proposed to revise Chapter 11 of the DP to include Figure 11-1 (Effluent and Environmental Sampling Locations during Decommissioning Operations (ML102250089). Section 11.3 of the DP will also be revised to clarify the conditions for replacing a monitoring station. RAI 11-Q7 requested WEC to provide an explanation of how upward trends in monitoring results will be evaluated. Their response (ML102250089) stated “the quarterly environmental monitoring results shall be reviewed for trends using the non-parametric Mann-Kendall test, or equivalent,” and “If an adverse trend is identified in the sampling data, the EH&S Manager and RSO will be notified and a review of the associated decommissioning activity(s) will be conducted identify changes to work methods and/or engineering controls should be implemented, as appropriate, to reduce effluent concentrations to ALARA levels.” Additional details on the usage of the Mann-Kendall test and the parameters to be used were provided in response to discussions on the EEMP, and are found in Revision 1 to that document (ML110330371).

Related to RAI 11-Q11 (ML101740507), the staff requested clarification on which regulatory levels from Part 20, Appendix B, Table 2, were being used in Table 11-1 of the DP. Initial responses from WEC indicated that the Uranium-234 value would be used for gross alpha levels and the Thorium-234 limit would be used for gross beta levels. WEC intended to use the Uranium-234 effluent limit (class Y) to evaluate gross alpha results in both air and water due to fact that uranium is the predominant alpha emitting radionuclide. Thorium-234 (class Y) was chosen to evaluate gross beta activity in both air and water since it has a more restrictive effluent limit than Technetium-99, and Thorium-234 is a uranium progeny. The staff raised concerns (ML101740507) that these limits may not be the most restrictive for areas of elevated Radium-226 or Thorium-232 contamination. WEC indicated that since the concentrations for the mixture of the radionuclides was known for Hematite soil, the most restrictive DAC was not required to be used based on Note 1 to Appendix B of 10 CFR Part 20. Note 1 states “if the identity of each radionuclide in a mixture is known, but the concentration of one or more of the radionuclides in the mixture is not known, the DAC for the mixture shall be the most restrictive DAC of any radionuclide in the mixture.” The staff felt that there was insufficient evidence that the radionuclide concentrations and ratios in soil equate to the same concentrations and ratios in an effluent media (i.e., water or air) and that Note 1 to Appendix B of 10 CFR Part 20 would not apply. In order to address staff concerns, WEC provided the “Supplemental Response to NRC Request for Additional Information on the Hematite Decommissioning Plan Chapter 11” (ML111880293). Here, it was indicated that WEC would determine “Derived Effluent Limits” based upon the current soil data for comparison of gross alpha or beta analyses and would also perform isotopic radionuclide analyses throughout decommissioning to confirm radionuclide identities and ratios and for compliance purposes. Table 11-1 of the DP was to be revised to include the frequency of isotopic analysis with Table 11-1a for air effluents and Table 11-1b for liquid effluents. The staff determined that the frequency of isotopic analysis in these two Tables was sufficient to confirm the effluent radionuclide identities and ratios and that the approach was consistent with Note 4 of Appendix B to 10 CFR Part 20, which states: “If the identity and concentration of each radionuclide in a mixture are known, the limiting values should be derived as follows: determine, for each radionuclide in the mixture, the ratio between the concentration present in the mixture and the concentration otherwise established in Appendix B for the specific radionuclide when not in a mixture. The sum of such ratios for all of the radionuclides in the mixture may not exceed “1” (i.e., “unity”).” Additionally, WEC committed that if isotopic results indicate that the Derived Effluent Limits are no longer within 10 percent of the applicable limit then a different derived effluent limit would be developed and applied. For compliance purposes, the isotopic analysis results would be used directly in the unity rule determination.

The staff has reviewed the information in DP Section 11.2 (Effluent Monitoring Program) of the and associated RAI responses according to NUREG-1757, Volume 1, Section 17.4.2 and

Appendix D, Section XI.b. Based on this review, the staff has determined that the licensee has provided sufficient information to allow the staff to conclude that the licensee's program will comply with 10 CFR 20.1301(a) and (d), 20.1302(a) and (b), 20.1501, 2001(a), 20.2003(a), 20.2103 (b), 20.2107(a), 20.2202(a), 20.2203(a), and 70.59.

11.3 Effluent Control Program

WEC indicates in Section 11.2.4.1 of the DP that process and engineering controls will be evaluated for each major decommissioning work activity. Process controls may include recycling, leak reduction, and modification to facilities, procedures, and operations. Examples of engineering controls included encapsulation, water mists, filtration, adsorption, containment, and storage. WEC also stated that the primary effluent control measures were expected to be dust suppression and erosion control. Water sprays will typically be used to control fugitive dust emissions during decommissioning, and controls such as filter fabric, erosion control blankets, and storm water channels/barriers will be in place for the purpose of erosion control. Once decommissioning is completed, WEC plans to implement permanent erosion controls, such as seeding for vegetative covers, as necessary.

Contaminated water will be held and treated in accordance with the Hematite Water Management Plan. Holding tanks for the Hematite facility Wastewater Treatment System (WTS) will maintain secondary containment, and weekly inspections will be performed on the buried holding tank associated with the Sanitary Wastewater Treatment Plant. WEC also stated in Section 11.2.4.1 of the DP that "there are no discharges to public sewer systems from the Hematite Site."

WEC provided details on their estimation of public dose in Section 11.2.4.2 of the DP. Dose estimates will be performed by comparison effluent concentrations to the applicable regulatory limits of 10 CFR Part 20, Appendix B, and it is anticipated that levels will be less than 10 percent of the limits. The quantitative analysis results from effluent monitoring will be compared to action levels in NRC Regulatory Guide 8.37, "ALARA Levels for Effluents from Materials Facilities."

The staff requested in RAI 11-Q6 (ML101440507) for WEC to provide information on their methods to reduce concentrations released to the environment from the water treatment facility. WEC's August 10, 2010, Chapter 11 RAI responses (ML102250089) indicated that DP Section 11.2.4.1 will be revised to state "[c]ollected water will be directed to the WTS for analysis and treatment as required. Surface water that pools on-site will be tested. Based upon the concentration of contaminants (by comparison to the ALARA goals) it may either be filtered to remove solids using the bag filters and released to a permitted outfall or processed through the WTS." The following treatment mechanisms were also included: settling of solids entrained in the liquid, 10-25 micron bag filters to remove remaining entrained material, granulated activated carbon filters to remove volatile organics and technetium-99, 5-10 micron bag filters to remove remaining entrained material, and ion exchange units (zeolite media) to remove metals. WEC also added to Section 11.2.4.1 of the DP (ML102250089) a statement indicating that liquid effluent from the Sanitary Wastewater Treatment Plant will be monitored in accordance with the EEMP.

The staff noted in RAI 11-Q14 (ML101740507) that, according to DP Section 11.2.4.1, contaminated water will be collected and treated in accordance with the Water Management Plan. Accordingly, the RAI requested that the Water Management Plan or a description of the methods which will be incorporated to collect and treat contaminated water be provided. The following revision to Section 11.2.4.1 was provided in place of the Water Management Plan reference:

> Potentially contaminated water could result from decommissioning operations, from precipitation that enters work areas, or from excavations that encounter ground water. HDP will use Best Management Practices to divert surface water away from work areas, collect water from work areas (such as open excavations), and to prevent sedimentation run-off. Examples include:
>
> - Earthen berms to keep surface water from entering impacted areas.
> - Coverings/tarps to keep precipitation from soil stockpiles.
> - Sumps within excavation areas during remediation.
> - A French drain from the railroad loading area to a collection pond.
> - Temporary Storage Tanks (Baker Tanks) within/near excavation areas.
>
> Collected water will be directed to the WTS for analysis, and treatment as required. The treatment will reduce contaminates in the water through the following mechanisms:
>
> - Settling of solids entrained in the liquid. This mechanism is enhanced by the addition of polymer flocculent via a mixer as water enters a series of quiescent settling tanks.
> - 10-25 micron bag filters to remove remaining entrained material.
> - Granulated activated carbon filters (virgin anthracite media) to remove volatile organics and Technetium 99.
> - 5-10 micron bag filters to remove remaining entrained material.
> - Ion exchange units (zeolite media) to remove metals, including uranium and the Technetium-99 that may be in solution as uranyl or technetium carbonate complexes and are not removed by the granulated activated carbon filters.
>
> The Temporary Storage Tanks within/near excavation areas will be within a secondary containment and located within/near the excavation(s). The secondary containment will be installed and operated to prevent the migration of wastes or accumulated liquid outside the secondary containment area. The WTS is located inside Building 230 within a lined secondary containment designed to hold the contents of the two largest tanks in the WTS. The Temporary Storage Tanks, WTS, and connecting piping are above-ground systems with the exception of underground crossings at on-site travel paths. The underground crossings will be configured so the system piping passes through larger conduit that has above ground openings on both ends to allow visual inspection. Temporary Storage Tanks, WTS, and connecting piping, including underground crossings will be visually inspected on a daily basis during operation of this equipment. Controls and practices such as spill prevention and overfill controls will be employed. Components will be removed from service, repaired or replaced following equipment failure or malfunction resulting in a leak.

Additionally, the Water Management Plan was provided as Attachment 5 (ML110330374) to the January 28, 2011, responses from WEC.

The staff requested information in RAI 11-Q15 (ML101740507) on the implementation of leak detection for liquid systems with below-ground components, along with the basis for determining whether a system or component requires secondary containment. Leak detection and integrity assessments were addressed in the above-mentioned RAI 11-Q14 response (ML102250089). In that response, WEC commits to a daily visual inspection of the Temporary Storage Tanks, WTS, and connecting piping, including underground crossings. WEC's RAI 11-Q15 response additionally noted that "the Sanitary Wastewater Treatment Plant was installed in 1977-78", and that "consistent with systems of that era, it does not have a leak detection system." While no leaks have been identified during the treatment plant's operation, WEC commits in the RAI response that "the components and surrounding soil will be thoroughly evaluated as a part of the Final Status Survey."

The staff has reviewed the information in Section 11.2.4 (Effluent Control Program) of the WEC Hematite DP according to NUREG-1757, Volume 1, Section 17.4.3 and Appendix D, Section XI.c. Based on this review, the staff has determined that the licensee has provided sufficient information to allow the staff to conclude that the licensee's program will provide adequate controls to minimize effluent releases and doses to the public and to ensure compliance with 10 CFR 20.1301(a) and (d), 20.1302(a) and (b), 20.1501, 2001(a), 20.2003(a), 20.2103 (b), 20.2107(a), 20.2202(a), and 20.2203(a).

12.0 Radioactive Waste Management Program

The Hematite facility Historical Site Assessment (HSA) identified three major types of wastes that are expected during decommissioning: solid radioactive waste (including radioactive asbestos), liquid radioactive waste, and mixed waste. A general description of decommissioning waste handling was described in Chapter 12 of the DP. Waste will be segregated as it is removed, and prior to being loaded directly into containers or stockpiled awaiting packaging, treatment, or transportation. Best Management Practices (BMPs) will be used to prevent the spread of contamination from stored waste. Waste will be packaged in appropriate shipping containers, and will mostly be packaged in rail-cars with lids and Industrial Packaging-1 (IP-1) flexible bags. Intermodal containers, metal boxes, and drums will also potentially be used. WEC has indicated that, if necessary, additional criticality and security precautions will be taken based upon the quantity of SNM.

WEC intends to use both rail and truck methods of transporting radioactive waste. Section 12.1.2 of the DP indicates that, prior to shipment, verification will be performed to ensure that the carrier is permitted to carry a given load of waste, and that pre-transportation checklists will be used to ensure compliance with United States Department of Transportation (DOT) and NRC regulations.

The staff requested additional information in RAI 12-Q1 (ML103260399) on actions that will occur in the event that a radiological survey, prior to excavation in the burial pit area, identifies areas of elevated radioactivity. WEC's January 28, 2011, Chapter 12 responses (ML110330366) indicated that DP Chapters 8 and 12 will be revised. The first bullet of DP Section 8.5.1 (Excavation And Removal Of Soil And Buried Objects) will now state that:

> Soil will be evaluated using in-situ GWS, volatile organic compound (VOC) monitoring (Photo-Ionization detector) and visual inspection of the exposed surface, repeated for each newly exposed surface. If elevated radioactivity measurements indicating amounts in excess of the NCS Exempt Material Limit are encountered prior to or during excavation, the detector response will be evaluated and the appropriate excavation depth determined. An analysis shall be performed that establishes the detector response that corresponds to the NCS Exempt Material Limit (defined in Section 8.5.2.1).

Accordingly, the last paragraph of DP Section 8.5.2.1 was revised to state that:

> Unless otherwise defined and justified within a nuclear criticality safety evaluation, NCS Exempt Material is conservatively defined as material containing Uranium-235 with an average nuclide fissile concentration not exceeding 0.1 g Uranium-235/L, or material that comprises no greater than 15 g Uranium-235 and is enclosed within a container with a volume of at least 5 liters. Refer to Chapter 10 for further details on NCS and handling of fissile material." DP Section 12.2.2.5 (Nuclear Criticality Safety) will also be revised to state that "prior to excavation of an area, a radiological and visual survey will be performed . . .

and that “actions specified in Section 8.5.1 will be implemented upon identification of an object/intact container or an elevated radioactivity measurement in excess of the NCS Exempt Material Limit.”

RAI 12-Q2 (ML103260399) requested that WEC provide the Hematite Waste Management and Transportation Plan, (WMTP) or enhance the discussion in Section 12.1 with a description of the manner in which radioactive waste management activities will be conducted in accordance with the WMTP. The WMTP was provided as Attachment 3 (ML110330370) to the January 28, 2011, responses from WEC. Additionally, the following statement was provided as a response to RAI 12-Q2:

The WMTP identifies regulatory responsibilities and other requirements for the characterization, packaging, transportation, security and disposal of the various types of radioactive, nonradioactive waste materials expected to be encountered. The types of waste anticipated for include: Asbestos Waste (radioactive and non-radioactive), Commercial Solid Waste (nonradioactive), Construction and Demolition Waste (radioactive and non radioactive), Electronic Waste (non-radioactive), Hazardous Waste (various types, non-radioactive), Infectious Waste, (radioactive and non-radioactive), Low Level Radioactive Waste (solid or liquid), Mixed Waste, (Radioactive and Hazardous), PCB Waste or PCB Bulk Product Waste, Universal Waste, and Used Oil.

The staff requested in RAI 12-Q3 (ML103260399) that WEC provide a description of the on-site treatment of wastes described in DP Sections 12.4.3.3 - 12.4.3.5 (toxic-dense non-aqueous phase liquid, toxic volatile organic compounds, and reactive uranium metal fines), along with the amounts, types, activity level and waste classification resulting from such treatment. Details were also requested on the effluents which may/will be generated as a result of such treatment. WEC provided a revision to DP Sections 12.4.3.1 – 12.4.3 in Attachment 1 (ML110330366) to the January 28, 2011, RAI responses.

The staff has reviewed WEC’s descriptions of the radioactive waste management program (DP Chapter 12) for the WEC Hematite Facility according to NUREG-1757, Volume 1, Section 17.5 (Radioactive Waste Management Program) and Appendix D, Section XII. Based on this review, the staff has determined that the licensee’s programs for the management of radioactive waste generated during decommissioning operations ensure that the waste will be managed in accordance with NRC requirements and in a manner that is protective of the public health and safety. Additional details on the management of the various types of wastes are provided in Sections 12.1 – 12.3 of this SER.

12.1 Solid Radioactive Waste

Section 12.2.1 of the DP indicates that solid waste will primarily be associated with excavation activities, and that two general types of waste are expected: demolition debris (i.e., concrete rubble, building materials, piping, conduit, and exhumed burial pit waste) and volumetrically contaminated material (i.e., soil, sediment, charcoal, resin, and limestone). The estimated volumes of demolition debris and volumetrically contamination material are 173,200 cubic feet and 801,500 cubic feet, respectively. Both types represent Class A waste.

Demolition of all but six Hematite structures was completed in June 2011. Most of the demolition debris, which is associated with the Hematite process buildings, has already been shipped from the site. Approximately 4,000 tons was shipped offsite in 238 truck shipments. It is WEC's intent that as much as 50,000 tons of contaminated soil may be shipped to U.S. Ecology, Idaho as part of WEC's 10 CFR 20.2002 alternate disposal amendment request for soil (ML091480071)

Specific isotopes and activities depend on the origination of the waste. Section 12.2.1 indicates that burial pit wastes will contain primarily Uranium-234, Uranium-235, and Uranium-238 with daughter products along with Radium-226 and Thorium-232. Soil areas were predominantly contaminated with uranium isotopes in addition to some areas of Technetium-99 contamination. The southeast area of the site and areas under process buildings are contaminated with uranium isotopes (plus daughters) and Technetium-99. Table 12-2 of the DP provided the following estimated solid waste activities: Uranium-234 + daughters (5 Ci), Uranium-235 + daughters (0.1 Ci), Uranium-238 + daughters (0.7 Ci), Technetium-99 (0.4 Ci), Radium-226 + daughters (<3.16E-03 Ci), and Thorium-232 + daughters (<1.50E-03).

During follow up discussions to RAI 12-Q3, the staff requested additional details on soil waste treatment, and on the treatment methods associated with the exhaust from the Soil Vapor Extraction (SVE) system. WEC proposed to revise Section 12.4.3.4 of the DP as follows (ML111880290):

> VOC treatment will be conducted in treatment tanks by ex-situ soil vapor extraction (SVE). SVE uses a mechanical blower to induce a vacuum, which causes the VOCs to be stripped and volatilized into the air stream. The exhaust air is then treated to remove particulates and VOCs before it is emitted to the atmosphere. The exhaust air treatment consists of condensate trap, heat exchanger, condensate filter separator (condensate set to water treatment system), HEPA filter, and vapor phase activated carbon filter.

<u>Sampling for Radioactive Emissions</u>.

- During SVE operations, a representative sample will be collected using a continuous sampler and a method consistent with ANSI N13.1-1999.
- The sampling media will include a charcoal absorber in addition to the particulate filter to account for any radioactivity not collected on the particulate filter. The charcoal medium will be used until sufficient data are compiled to conclude that airborne radioactivity is not in a form requiring collection on a charcoal filter.
- The sample media will be removed and analyzed as defined in Table 11-1a, "Air Effluent Monitoring and Limits."

During the June 24, 2011, Category 1 conference call between WEC and the NRC, WEC agreed to perform weekly isotopic sampling when the SVE is operating (either with or without heat). Accordingly, the Effluent and Environmental Monitoring Plan (EEMP) will be updated to reflect this sampling frequency.

The disposition of solid waste was described in DP Section 12.2.4. The following sites are listed as potential disposal sites: Studsvik, Inc. (Memphis, TN), Energy Solutions, Inc. (Oak Ridge, TN, and Clive, UT), and U.S. Ecology (Grandview, ID). Waste will be disposed of in accordance with the receiving facility Waste Acceptance Criteria (WAC), facility license or NRC approved exemption.

12.2 Liquid Radioactive Waste

Section 12.3 of the DP describes liquid wastes generated during decommissioning as predominantly lubricants, such as oil and hydraulic fluid from the maintenance of on-site equipment. As shown in DP Table 12-3, it is anticipated that approximately 1,200 liters of radiologically contaminated lubricants will be generated as Class A waste. The following isotopes and activities were provided in DP Table 12-4: Uranium-234 (1,500 pCi), Uranium-235 (90 pCi), Uranium-238 (150 pCi), and Technitium-99 (45 pCi).

Disposition of liquid waste was described in DP Section 12.3.4. The following sites were listed as potential disposal sites: Permafix of Florida, Inc. (Gainesville, FL), DSSI, Inc. (Kingston, TN), Energy Solutions, Inc. (Clive, UT and Oak Ridge, TN), and U.S. Ecology (Grandview, ID).

Waste will be disposed of in accordance with the receiving facility WAC, facility license or NRC approved exemption, and DOT regulations.

12.3 Mixed Waste

Section 12.4 of the DP describes mixed waste management at the site and indicates that waste will be managed to meet the treatment or disposal facility WAC and land disposal restrictions prior to off-site disposal. WEC proposes a step-wise process for the management of mixed waste that includes systematic assays of excavated material, preparing wastes to develop a physical form amenable to treatment, and the use of ex-situ treatment technologies to reduce hazardous waste characteristics. The on-site treatment of waste will be performed in tanks constructed to standards in 40 CFR Part 265, "Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.") and in accordance with EPA's, "Management of Remediation Waste Under RCRA", EPA530-F-98-026, October 1998. Additionally, waste storage areas will be posted and controlled, and inspection requirements will be in accordance with 40 CFR Part 262, "Standards Applicable to Generators of Hazardous Waste." Mixed waste that cannot be treated on-site will be prepared for transport to a licensed processing facility. Resultant to the review of waste treatment processes, the staff also determined that an incomplete treatment of soils (with both radiological and VOC contamination) may result in soils requiring disposal as mixed waste.

Details of hazardous wastes that are potentially present on-site, based on the Historical Site Assessment (HSA), are provided in Section 12.4.1 of the DP. These include corrosive acids [hydrochloric acid (HCl), nitric acid (HNO_3), or hydrofluoric acid (HF)] and bases [potassium hydroxide (KOH)], toxic volatile organic compounds [trichloroethylene (TCE), tetrachloroethylene, (PCE), and degradation products], toxic dense non-aqueous phase liquids (DNAPL), toxic heavy metals (lead, mercury), and reactive-pyrophoric uranium fines. Characterization sampling did not identify mixed wastes historically at the site. However, for planning purposes, it was assumed that approximately 5,700 cubic feet of solid mixed waste and 1300 liters of liquid mixed waste will be generated during decommissioning.

Disposition of mixed waste was described in Section 12.4.4 of the DP. The following sites were listed as potential disposal sites: Permafix of Florida, Inc. (Gainesville, FL), Permafix of Tennessee, Inc. (Oak Ridge, TN), NSSI (Houston, TX), Energy Solutions, Inc. (Clive, UT and Oak Ridge, TN), and U.S. Ecology (Grandview, ID). Waste will be disposed of in accordance with the receiving facility WAC, facility license or NRC approved exemption, and DOT regulations.

Waste permitting was described in DP Section 12.4.5, where it is indicated that the Westinghouse Hematite Facility is registered with the EPA and the State of Missouri as a large quantity hazardous waste generator (EPA Identification Number MOR000012724). While WEC is a generator and all requirements of 40 CFR Part 262 must be met, they intend to operate under a conditional exemption for low-level mixed waste storage and treatment in accordance with 40 CFR Part 266, "Conditional Exemption for Low-Level Mixed Waste Storage, Treatment, Transportation and Disposal."

RAI 12-Q4 requested that WEC provide the status of their application for a conditional exemption for low level mixed waste storage and treatment as allowed under 40 CFR Part 266 Subpart N and whether or not it was granted. The RAI response (ML110330366), indicated that the original DP terminology to "apply for a conditional exemption for low-level mixed waste storage and treatment" was inaccurate, and that "the correct description of this process is to 'use a conditional exemption for low-level mixed waste storage and treatment'." Accordingly, the third paragraph of DP Section 12.4.5 (Permitting) will be revised to state:

> Generators are not required to obtain a permit prior to storing or treating mixed waste (other than thermal treatment) under Title 40 Code of Federal Regulations 266, Subpart N, Conditional Exemption for Low Level Mixed Waste Storage, Treatment, Transportation and Disposal (Reference 12-20). Westinghouse intends to use this conditional exemption and notify MDNR of its use within 90 days after the storage unit for low-level mixed waste storage and treatment has been placed into service, as allowed in Reference 12-20.

13.0 Quality Assurance Program

The staff has reviewed the Hematite Quality Assurance Program (QAP) utilizing Section 17.6 (Quality Assurance Program) of NUREG-1757, Volume 1.

The Hematite facility QAP is based upon the WEC Quality Management System (QMS). The QMS is the overarching system developed by WEC to comply with NRC regulatory requirements and industry QA standards. The system applies to the materials and services provided by WEC as well as its contractors, subcontractors and suppliers. The system affirms its commitments to the requirements found in the following: (1) Title 10, Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants", (2) the American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA) – 1, (3) the International Organization for Standardization, ISO 9000:2005, "Quality Management Systems – Fundamentals and Vocabulary", and (4) ISO 9001:2000, "Quality Management Systems – Requirements."

The QMS is divided into three levels with the uppermost level, Level 1 – QMS, providing the basis for all policies and procedures that are utilized to implement a comprehensive quality assurance (QA) management system. The details for how management controls the work processes is contained in Level 2, Westinghouse and Operational Organization Policies and Procedures and Level 3, Functional/Department/Plant Procedures and Work Instructions. The Hematite facility specific QA plan for decommissioning is detailed in the WEC Document Number HDP-PO-QA-001, "Project Quality Plan" or PQP. All work related to the Hematite facility decommissioning is required to comply with the PQP. The PQP and its implementing procedures establish the requirements that personnel are required to take for quality related activities. The quality of the work is verified by a system of audits, surveillances and inspections with additional detailed information provided below in Section 13.2 Quality Assurance Program.

The staff has determined that the Hematite facility QA program is sufficient to ensure submittal of quality information and the performance of decommissioning activities in accordance with NRC requirements. This finding incorporates the results of the staff's assessment of the entire QA program as described in the following subsections of Section 13.0.

13.1 Organization

The Hematite Project Director has the ultimate responsibility for the quality of the work and the implementation of the work elements as it relates to the DP. The Hematite QA Manager manages the implementation of the QAP for the DP and reports to upper management through a separate chain-of-command. Information on the decommissioning management organization and structure, positions, qualifications, control of tasks/work orders/specific instructions, training and contractor support are provided in Section 9.0 Project Management and Organization.

The staff has reviewed WEC's descriptions of project organization according to NUREG-1757, Volume 1, Section 17.6 and has determined that the Hematite facility QAP provides for an adequate organization and resource base to ensure that the information and data submitted support decommissioning.

13.2 Quality Assurance Program

The Hematite facility PQP enumerates the DP requirements to meet quality objectives as it relates to management controls and decommissioning of the site. The QAP requires that the responsibility for quality resides with the line and staff organizations involved in meeting the goals and objectives of the decommissioning effort. Contractors utilized by the WEC to perform assigned decommissioning tasks are required to comply with PQP. Field implementation of the PQP is achieved, in part, through procedures, instructions and documents that include quantitative and qualitative acceptance criteria for quality activities. Documents such as procedures and specific work instructions are controlled documents which require review by qualified personnel before revisions are made, a chronology of the revisions made, and a program to ensure that field personnel are fully trained and qualified to perform the assigned task.

The Hematite PQP correctly focuses on the quality requirements associated with the Final Status Survey (FSS) with the FSS designed to meet the guidance contained in NUREG-1575, “Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)” and the requirement that any residual radioactive material or contamination left on site meet the NRC criteria for unrestricted release.

The QMS requirements flow through the WEC procurement system and, in particular, WEC’s vendor laboratories. Such requirements ensure that quality laboratory analyses are performed and that defensible data packages are transmitted to the WEC. Upon receipt of critical data quality packages, such as those supporting the FSS of the site, these packages will be reviewed by qualified WEC staff to validate that the data can be used and that all of the data quality objectives (DQO) have been met.

The staff has reviewed WEC’s descriptions of the Hematite QAP according to NUREG-1757, Volume 1, Section 17.6 and has determined that the Hematite QAP provides reasonable assurance that, if effectively implemented as described, the conclusions of the FSS report can be obtained.

13.3 Document Control

The PQP requires the establishment of a document control system applicable to a number of documents that include, in part, QA/QC manuals, technical reports and supporting data, non-conformance documents, and procurement documents. The process for the implementation of the DP document control system includes, in part, a requirement to identify the documents to be controlled, document control procedures for the document themselves, and the identification of qualified individuals and/or organizations that are responsible for the preparation, review, approval and issuance of the controlled documents as well as for subsequent revisions to the documents. The process also includes the requirements, in part, as to how documents/records will be classified and a determination as to which quality records/documents will be retained. The process also requires, in part, criteria for such quality factors as document collection, criteria for legibility, filing, indexing, storage, distribution, retention, storage and protection, provision for creation of backup records and the ultimate disposition of records. Record retention requirements for contractors and suppliers are specified in procurement documents, as applicable.

The staff has reviewed WEC's descriptions of the Hematite PQP according to NUREG-1757, Volume 1, Section 17.6 and has determined that the Hematite PQP provides reasonable assurance that, if effectively implemented as described, provides for a document control system that identifies, classifies, retains, stores, and protects those documents important to quality. In addition, the staff has concluded that a similar system is provided in the procurement system for the purchase of supplies and equipment that may affect quality.

13.4 Control of Measuring and Test Equipment

A Measuring and Test Equipment (M&TE) program is required under the DP with the M&TE programs being designed and implemented to meet the PQP requirements. The M&TE program provides for a list of measuring and test equipment, their associated measurement reference standards and their assigned locations and custodians. Procedures are established for the control of M&TE to ensure, in part, that the right type of equipment is used to accomplish the specified requirement and that it is the proper type with the proper range of accuracy and tolerance to achieve the desired outcome. Qualified personnel who use the M&TE are responsible for making sure that the M&TE has been properly calibrated before use. Calibration of the M&TE is a controlled process and is performed with controlled procedures. In addition, the system and related procedures have been put in place to help ensure that the M&TE is protected from adjustments or modifications that would invalidate the data collected, requirements for tagging items as out of service/calibration, as well as a methodology for documenting and evaluating the validity of any data collected from previous measurements when the M&TE was found to be out of calibration. The calibration and maintenance of M&TE is in conformance with guidelines provided in MARSSIM. Radioactive sources used for calibration of field instruments will be traceable to the National Institute of Standards and Technology (NIST) as well as for other equipment such as high purity germanium detectors.

The staff has reviewed WEC's descriptions of its control of measuring and test equipment according to NUREG-1757, Volume 1, Section 17.6 and has determined that the Hematite PQP provides reasonable assurance that, if effectively implemented as described, a program that provides for the control of measurement and testing equipment used to support decommissioning activities and that the M&TE will be properly controlled, calibrated and maintained.

13.5 Corrective Action

Hematite has a formal Corrective Action Program (CAP) which is part of the PQP. The PQP includes requirements for procedures for non-conforming situations.. As part of the PQP, any member of the decommissioning project can submit an issue report to their management that documents a condition that may be adverse to quality. Upon notification, the manager will perform an assessment and will initiate a response action which could result in a stop work order. As part of the CAP program process a formal process is initiated that includes, in part, a determination of causal factors that led to the non-conformance, a determination as to what interim and/or preventative actions can be implemented, identification of the final corrective action, assignment of qualified personnel for implementing the corrective action, documentation as to the root cause of the non-conformance and verification/documentation that the corrective action has been implemented.

The staff has reviewed WEC's CAP according to NUREG-1757, Volume 1, Section 17.6 and has determined that the Hematite PQP provides reasonable assurance that, if effectively implemented as described, the CAP and its implementing procedures will provide a mechanism to promptly identify conditions that are adverse to quality and the corrective action required to address the non-compliance.

13.6 Quality Assurance Records

The WEC broadly defines a quality record as any record that affects compliance with the PQP. A quality record is further defined as a completed or final document that confirms that the quality of materials, services and activities that affect quality have been met. Examples of quality decommissioning records include such things as traceable calibration records for survey instruments, radiological and air sampling results as well as final status survey results used to document that the criteria for unrestricted release have been met. The PQP and established procedures determine the control and retention of QA records. Administration of the records is through a centralized document control system, the Westinghouse Electronic Document Management System (EDMS). The system provides, in part, an index of the record type, the retention time for the document and its storage location. Examples of a quality assurance record include calibration documentation, audit, assessment, inspection and test results and FSS records. A system is in place, which is implemented by procedure so that the quality records are protected against damage and/or loss. Records that have been identified as requiring long term secure storage are maintained at an approved single storage facility or duplicate copies are stored at separate locations.

The staff has reviewed WEC's descriptions of its quality assurance records program according to NUREG-1757, Volume 1, Section 17.6 and has determined that the Hematite PQP provides reasonable assurance that, if effectively implemented as described, system will be in place that, when coupled with associated implementing procedures will provide for adequate storage and maintenance of the QA program records.

13.7 Audits and Surveillances

Hematite has a QA organization that is independent of line organizations responsible for implementing the DP. The QA organization's responsibilities, in part, are to objectively evaluate compliance with the PQP. Compliance is measured, in part, through internal audits and surveillances of activities affecting quality. The audits and surveillances are conducted in accordance with the PQP and associated procedures. The PQP specifies that audits and surveillances are to be performed by qualified personnel. Qualification records for individuals are maintained by the QA organization. Findings and observations are integrated into the CAP. The non-conformances are documented in audit reports as well as part of the CAP. The QA organization follows the implementation of the corrective action to ensure that is has been completed. They also track and monitor compliance and non-conformance trends.

The staff has reviewed WEC's descriptions of its audits and surveillances program according to NUREG-1757, Volume 1, Section 17.6 and has determined that the Hematite PQP provides reasonable assurance that, if effectively implemented as described, a system is in place that provides for a formal system of audits and surveillances as part of a comprehensive system to verify compliance with the Hematite QA program as well as determining its effectiveness through tracking and trending analyses.

14.0 Facility Radiation Surveys

14.1 Release Criteria

The staff has reviewed the information in the DP according to NUREG-1757, Volume 2, Section 4.1Based on this review, the staff has determined that WEC has summarized the Derived Concentration Guideline Levels (DCGLs) and area factors used for survey design and for demonstrating compliance with the radiological criteria for license termination.

In addition to the DCGLs provided, WEC committed in their July 5, 2011, submittal (ML111880290) associated with the staff's RAI No. 17 of the Chapter 5 Resolution Table, to develop volumetric DCGLs if the need arises during decommissioning. WEC acknowledged that the volumetric DCGLs would need to be approved by NRC at that time, through the license amendment process.

14.1.1 Determination of Insignificant Radionuclides

DP Section 14.1.3.1 and Section 2.2 of the WEC document "Derivation of Surrogates and Scaling Factors for Hard-To-Detect Radionuclides" (ML092870492) indicate that Neptenium-237, Plutoniumu-239/240, and Americium-241 are considered to be insignificant radionuclides of concern. WEC's conclusion was based on the aggregate dose of these radionuclides being less than 10% of the Total Effective Dose Equivalent (TEDE) for each Conceptual Site Model (CSM). Population activity concentration results are given for these radionuclides in the Surrogate Report (DO-08-008), "*Derivation of Surrogates and Scaling Factors for Hard-To-Detect Radionuclides"* (ML092870492).

In WEC's response (ML102140158) to the staff's RAI 14 - Q1 (ML103260399), WEC revised their approach for determining insignificant radionuclides after an error was discovered in the column heading in Table 2-2 of DO-08-008. Specifically, the value reported for each of the three CSMs in units of "Dose (mrem per year)" actually represented the fractional contribution to the DCGL (average Sum of Fractions (SOF)) for each of the three CSMs. Since, after correcting this error, the fractional contribution would have been over 10% of the TEDE using the former approach, WEC revised their approach. WEC stated the reason for changing their approach being that "CSM boundaries are constructs used for modeling purposes and do not necessarily represent the radionuclide concentration profile."

The revised approach was based on site-wide average concentrations as opposed to average values within each individual CSM. WEC calculated the average concentration for each radionuclide (across all samples), and then divided the average for each radionuclide by its Uniform DCGL to obtain the SOF for each radionuclide. The sum of the SOF values for each radionuclide was compared to 10% of the TEDE, or 2.5 mrem/year.

Using this approach, WEC calculated the combined contribution from Neptunium-237, Plutonium-239/240, and Americium-241 to be 1.7 mrem, which is 6.8% of the 25 mrem limit. The revised Tables from of DO-08-008, "*Derivation of Surrogates and Scaling Factors for Hard-To-Detect Radionuclides"* are replicated below.

Table 14-1 Dose Contribution from Insignificant Radionuclides

Insignificant Radionuclide	Average Concentration (pCi/g)	DCGL	Average SOF	Dose Contribution (mrem/yr)
Americium-241	5.1E-03	7.9E+01	6.4E-05	1.6E-03
Neptunium-237 + D	2.0E-02	3.0E-01	6.8E-02	1.7E+00
Plutonium-239/240	1.6E-03	8.3E+01	2.0E-05	4.9E-04
Total			6.8E-02	1.7E+00

Table 14-2 Summary of Statistics - Am-241, Np-237 and Pu-239/240

Number of Samples			
Insignificant Radionuclide	Conceptual Site Model (pCi/g)		
	Surface	Root	Deep
Americium-241	390	434	456
Neptunium-237	74	57	19
Plutonium-239/240	74	57	19

Table 14-3 - Insignificant Radionuclides Average Concentrations

Insignificant Radionuclide	Average Concentration (pCi/g)
Americium-241	5.1E-03
Neptunium-237	2.0E-02
Plutonium-239/240	1.6E-03

As stated in NUREG 1757, Vol. 2, Rev 2, Appendix O, “It is incumbent on the licensee to have adequate characterization data to support and document the determination that some radionuclides may be deselected from further detailed consideration in planning the Final Status Survey (FSS). Radionuclides that are undetected may also be considered insignificant, as long as the Minimum Detectable Concentrations (MDCs) are sufficient to conclude that the dose contribution is less than 10% of the dose criterion (i.e., with the assumption that the radionuclides are present at the MDC concentrations).”

In reviewing the characterization data used to determine the contribution, the staff noted that WEC reported negative values for Neptunium-237 in some cases. WEC provided additional details on the calculation of the mean values presented in the Chap 14 RAI 1b. response from the Resolution Table associated with WEC’s July 5, 2011 submittal (ML111880290). WEC provided all analytical values used in this calculation (including negative and < MDC values). WEC further explained that some negative values would be expected given the low concentration of Neptunium-237, and stated that inclusion of these values was appropriate for providing an accurate estimate of the mean concentration. In addition, WEC noted that the difference between including and excluding the negative values is 0.93 versus 0.92. WEC referred to the following guidance in Section 6.2 of NUREG-1505, "A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys" on the use of negative values for calculating averages.

The staff has concluded, based upon the above discussion, that WEC's revised approach is an acceptable method of calculating insignificant radionuclides, and that WEC has provided adequate characterization data to support the conclusion.

14.1.1 Adjusted DCGLs

Licensees are required to comply with the applicable dose criteria in 10 CFR Part 20, Subpart E, and thus the dose contribution from the insignificant radionuclides must be accounted for in demonstrating compliance with the dose criteria. WEC has accounted for the dose contribution from the insignificant radionuclides, and adjusted the DCGLs accordingly. The adjusted soil DCGLs are replicated in Table 14-4 below.

The staff has reviewed the adjusted DCGLs, and finds that they were calculated appropriately.

14.1.2 Modified DCGLs

14.1.2.1 Soil DCGLs

Since Uranium-234 cannot be detected using conventional field instrumentation during a scan survey, or by gamma spectroscopy, WEC proposed a method for inferring Uranium-234 concentrations. WEC proposed using the ratio of the Uranium-238 to Uranium-235 concentrations obtained from gamma spectroscopy to estimate the Uranium-234 to Uranium-235 ratio based on "observations of the enrichment in a large number of characterization samples, assumptions regarding the consistency of the enrichment shown by the characterization data, and published values for the enrichment based on isotopic ratios."

The approach for inferring Uranium-234 concentration is summarized in Table 14-5 below. The staff has reviewed the related enrichment ratios, and finds the approach for inferring U-234 acceptable.

The staff did not approve of the proposed approach for inferring Technetium-99 concentration from Uranium-235, so therefore WEC will sample for Technetium-99 and compare sample analysis to the adjusted DCGLw for Technetium-99.

Table 14-4 Adjusted Site-Specific Soil DCGLs

Radionuclide	$DCGL_w$ (pCi/g) [a] By Conceptual Site Model				
	Shallow Stratum	**Root Stratum**	**Deep Stratum**	**Uniform Stratum**	**Excavation Scenario**
Uranium-234	**508.5**	**235.6**	**2890**	**195.4**	**872.4**
Uranium-235 + D [b]	**102.3**	**64.1**	**3034**	**51.6**	**208.1**
Uranium-238 + D [b]	**297.6**	**183.3**	**3028**	**168.8**	**551.1**
Technetium-99	**151.0**	**30.1**	**98649**	**25.1**	**74.0**
Thorium-232 + C [c]	**4.7**	**2.0**	**9279**	**2.0**	**5.2**
Radium-226 + C [c]	**6.0**	**2.3**	**13389**	**2.1**	**5.4**

[a]The reported soil limits are the activities for the parent radionuclide as specified and were calculated using Equation 14-1 to account for the dose contribution from insignificant radionuclides (see Section 14.1.3.2).
[b] "+ D" = plus short-lived decay products.
[c] "+ C" = plus the entire decay chain (progeny) in secular equilibrium.

Table 14-5 – Inferred Uranium-234 Concentrations

Scenario	C_{U-235}	C_{U-238}	**Ratio** $R_{U-238:U-235}$	**Inferred** C_{U-234}
Natural Uranium	Negative or Zero	Positive	N/A	Equal to C_{U-238}
Highly Enriched Uranium	Positive	Negative or Zero	0	32.50 x C_{U-235} maximum enrichment (100 percent) U-234:U-235 ratio
Highly Enriched Uranium	Positive	Positive	< 0.0001	32.50 x C_{U-235}
Depleted Uranium	Positive	Positive	> 155.37	46.31x C_{U-235} minimum U-234:U-235 ratio
Various Enrichment Levels	Positive	Positive	0.0001< R< 155.37	$R_{U-234:U-235}$ x C_{U-235}

14.1.1.2 Building and Structural Surface DCGLs

WEC used Equation 4-4 from the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) and the relative ratios of the radionuclides inside the buildings to determine the gross DCGL value for building surfaces. The calculated value was 18,925 disintegrations per minute (dpm)/100 cm^2. The same methodology was used to convert the individual radionuclide DCGL values for the buried piping to gross DCGL values (see SER Table 5-5).
In staff RAI 14-Q2 (ML103260399), information about the basis for the assumed ratios for radionuclides used to determine the gross DCGL value and how WEC ensured that the gross DCGL value generated was conservative was requested. In response (ML102140158), WEC stated that the ratios were obtained from dust and floor drain samples. WEC noted that, in these samples, the majority of the radioactivity came from the uranium isotopes and the other isotopes were only present in trace amounts. Therefore, the dose contribution from non-uranium isotopes was expected to be small.

Based upon the above information provided by WEC, the staff finds that the assumed ratios of radionuclides used by WEC in generating a gross DCGL value for building surfaces and buried piping are reasonable, and the gross DCGL values generated are acceptable.

14.1.2 Sum of Fractions (SOF)

WEC will calculate the relative contribution of each radionuclide by dividing the measured concentration (or inferred, in the case of Uranium-234) by the $DCCL_w$. Since the Technetium-99 samples will be measured and not inferred, WEC will use Equations 14-11 and 14-12 from DP Chapter 14, to determine the SOF and sigma, respectively. If residual contamination resides in multiple strata, the SOF for each stratum will be summed to ensure that the Total Effective Dose Equivalent (TEDE) limit is met.

14.2 Characterization Surveys

WEC indicates in Chapter 4 of the DP that several radiological characterization campaigns were conducted over the last 26 years and that while a summary is provided in the DP additional details can be found in the Hematite Radiological Characterization Report (HRCR), as provided in July 2009 (ML092870496 and ML092870506). The various sampling campaigns produced samples from monitoring groundwater, surface water, surface soil, sediment, and sub-surface soil. The Historical Site Assessment (HSA) and the HRCR, determined the following as potential radionuclides of concern (ROC) at the site: Uranium-234, Uranium-235, Uranium-236, Uranium-238, Technetium-99, Thorium-232, Radium-226, Americium-241, Neptunium-237, and Plutonium 239/240. It was further indicated that most of the residual radioactivity is attributed to Uranium-234, Uranium-235, Uranium-238, and Technetium-99.

In RAI 14-Q2 (ML101740133) the staff requested information on the ROCs and their dose contributions. The RAI also noted that DP Section 14.2.7 (Adequacy of the Characterization) states that "samples taken in each area, along with the historical information, provide a clear picture of the residual radioactive materials and its vertical and lateral extent at the site". The staff's assessment was that it was not clear in the DP that structural DCGLs were always developed from actual structural data. In the response to this RAI, WEC provided an overview of the ROC determination and indicated that results near the surface of drain systems in Buildings 110 and 230 were combined with surface results due to limited surface contamination. WEC indicated that the combined result was more conservative. Additionally, WEC indicated that “two volumetric material samples (dust) were obtained (BD1-230-1-DUST and BD3- 230-1-DUST) from surfaces in Building 230 during the characterization following the identification of localized areas of elevated activity.” One of the dust samples was taken from an anchor bolt joint and the other was taken from a floor seam. The dust sample results were combined with the floor drain results to develop the Adjusted Gross DCGL. The staff’s assessment was that while this may give a conservative result for surface samples, these dust samples did not represent volumetric contamination. This concern was expressed to WEC during discussions of the RAI responses, and WEC indicated in their response to RAI 5-Q17 (ML111880290) that “volumetric DCGLs have not been developed for buildings that are expected to remain at the time of license termination based on no evidence of volumetric contamination from process knowledge and analysis to date,” and “should volumetrically contaminated material be identified, it is anticipated that it will be removed and shipped for disposal prior to final status survey.” However, if the material will remain on-site, WEC also committed to develop appropriate DCGLs and submit them for NRC approval.

Radiological surveys of impacted media were described in the Section 14.2.1 of the DP and in the HRCR. It was indicated that the survey campaigns included in excess of 2,200 monitoring well water samples, surface water samples, sediment, surface and sub-surface soil samples, as well as samples from drains and measurements of building surfaces. These samples were used to further define the impacted and non-impacted areas of the site. The associated field instrument methods and their sensitivities were also provided in the HRCR and were summarized in Section 14.2.2 of the DP. Scan Minimum Detectable Concentration (MDC) values were provided for alpha and beta building surface radioactivity measurements and for gamma radiation open land surveys. The methods and sensitivities associated with laboratory instruments were also provided in DP Section 14.2.3, and the methodology used was based upon standard industry methods from the EPA and the Environmental Measurements Laboratory (EML).

The impacted and non-impacted areas of the site were summarized in Sections 14.2.5 and 14.2.6 of the DP, where it was indicated that the Central Tract Area (defined as an area bounded by State Road P to the north, the Northeast Site Creek to the east, the Union-Pacific Railroad to the south, and the Site Pond to the west) was impacted. Additionally, a 3.8 acre parcel of land adjacent to the Site Creek and downstream to Joachim Creek is considered potentially impacted. WEC assumed a 7.1 acre plot near the Northeast Site Creek that will be used for soil staging will become impacted as a result of decommissioning activities. The remaining portions of the 228 acres Hematite facility were considered to be non-impacted. The staff noted in RAI 14-Q4 (ML101740133) that Section 14.2.6 of the DP (Justification for Non-Impacted Areas) states that "sufficient survey coverage and an adequate number of samples were obtained in the areas subsequently designated as non-impacted to serve as the basis for this classification, and that “the survey measurements and laboratory data from the samples showed radioactivity levels in all cases to be only a small fraction of the DCGLs, and in most instances, within the range of background." Per MARSSIM guidance, non-impacted areas should not contain residual radioactivity above background. However, the justification given in DP Section 14.2.6 indicates that some residual radioactivity above background may be located in areas that have been classified as non-impacted. It was also noted that there were inconsistencies between what was stated in DP Section 14.2.6 and the HRCR. It was indicated in the Executive Summary of the HRCR that "the conclusion that areas were non-impacted was based on a review of the Historical Site Assessment (HSA), gamma scan measurements, and analytical results obtained from soil sampling," and that "non-impacted areas do not show detectable Tc-99 activity or concentrations of licensed radioactivity statistically distinguishable from background." Staff RAI 14-Q4 requested that WEC provide a revised justification of non-impacted areas that is consistent with MARSSIM and that WEC re-evaluate (and re-classify if necessary) any currently designated non-impacted areas that may contain residual radioactivity above background levels. Additionally, the staff expressed concerns on WEC's proposals to separate out certain areas as radionuclide specific impacted (mainly Thorium-232 and Radium-226). Details on the staff's concerns were provided in RAI RCR-Q4, where it was pointed out that in Appendix A of the HRCR, "Th-232 Soil Concentration Comparison With Background Th-232 Soil Concentration," the preliminary site DCGL for Thorium-232 was said to be only slightly higher than the typical background concentration and that some areas would be considered indistinguishable from background. The staff requested additional details on the analysis used to determine that Thorium-232 concentrations in certain areas are indistinguishable from background. The WEC response to this RAI (ML102140158) indicated that "the data (in Appendix A of the RCR) were being used to determine if areas were impacted by Thorium-232 from licensed activities," and that "the characterization reference area data provides background concentrations that will be used to correct gross final status results." It was also noted in WEC's proposed revision to DP Section 14.4.2.5 that "background reference area measurements are required when using statistical application of the WRS test, and when background subtraction is required to correct gross radioactivity measurements for naturally-occurring radioactivity present in soil, and in construction materials prior to applying the Sign test." During discussions of the RAIs, the staff conveyed to WEC that a background correction, prior to the application of the sign or Wilcoxon Rank Sum (WRS) tests, to soils is inappropriate. As a result, WEC provided in their July 5, 2011, response (ML111880290) that the concept of individual radionuclide impacted areas (i.e., Thorium-232, Radium-226, etc.) would no longer be used and that areas will be specified as impacted or non-impacted prior to remediation. Additionally, for compliance purposes, dose contributions from all radionuclides of concern will be considered in the SOF calculations for all impacted areas. WEC also proposed to update several sections of the DP to indicate that gross FSS results for soils will be used for either the Sign or WRS test for compliance purposes.

WEC's response to RAI 14-Q4 also indicated that "for total uranium, the Mann-Whitney U test concluded that the data from non-impacted areas were indistinguishable from the background data, but the Quantile test concluded that the data from non-impacted areas were distinguishable from the background data." WEC still considered these areas to be non-impacted with the justification that "the non-impacted data, while having greater variability, was not skewed compared to the background data," and that "the Quantile test specifically looks at the upper tails of the two distributions and does not consider the lower tails and therefore it is expected that the Quantile test would fail in this situation." The RAI response also indicated that greater variability was expected in the non-impacted area results since they were taken over a larger geographic area. The staff had concerns that an insufficient number of samples may have been used to declare some areas as non-impacted, and as a follow up to RAI 14-Q4, NRC staff requested the data used in WEC's analysis. The data which was provided (ML102140158, ML111880290) consisted of 16 uranium samples performed via alpha spectroscopy and 148 samples by gamma spectroscopy. When compared to WEC's background threshold value (BTV) for uranium (2.4 pCi/g), there were numerous gamma spectroscopy results with activities above the proposed BTV. The gamma spectroscopy MDC values were, in many cases, above this value as well. Of the 16 alpha spectroscopy samples, one sample was above the BTV. The gamma spectroscopy samples were not considered to be conclusive, and the extent of the alpha spectroscopy samples was limited, considering the size of the geographic area being measured was over 200 acres.

In order to address the staff concerns, WEC agreed to create additional impacted Class 3 survey units as buffer areas along the edges of some of the previously defined impacted/non-impacted area borders. The newly created buffer areas included an expansion of the existing survey unit, LSA-11-01, and a new Class 3 survey unit (LSA-11-02) defined along the southern edge of the active rail line. LSA-11-01 will increase in size from 14,885 m^2 to 24,715 m^2, and it will encompass the area of characterization sample NB-71-01 (the one elevated alpha spectroscopy sample from the previous characterization) as well as land further to the northeast. LSA-11-02 will include an area of 5,394 square meters south of the railroad track. WEC also proposed to add a Section 14.4.4.1.6.6 to the DP stating that, given the history, nature, and safety considerations of the active rail line, "the active rail line will not be surveyed or sampled," and that "surveys and sampling will be limited to the 20 foot section of ground between the southern edge of the active rail line and the southern boundary of this survey unit." Section 14.4.4.1.6.6 will be added in a revision to the DP in order to discuss survey operations near the active rail line. The proposed new DP Section would state that random sampling locations that fall on the active rail line during survey design would be relocated to the southern edge of the railroad bed. Table 14-16 and Figure 14-14 of the DP are to be revised to show these new Class 3 areas. Section 14.2.5 of the DP was also to be revised to indicate that "additionally, a 20 foot wide area immediately south of the railroad in the central tract, an area west of the Site Pond, and an area between the Northeast site creek and the soil staging area are also considered as impacted (total of about 10.1 acres)."

Areas that were inaccessible or not readily accessible for characterization surveys were discussed in Section 14.2.8 of the DP. These areas include drain piping within buildings that will remain after site closure, the storm drain system, and the Sanitary Wastewater Treatment Plant. Some limited direct surveys were performed on drain surfaces, and drain trap residues were sampled. Additional surveys of these areas will be performed at the time of decontamination and/or removal. The staff requested additional clarification in RAI 14-Q5 (ML101740133) as to whether drains and certain areas currently inaccessible, will be surveyed as Class 1 areas during decommissioning to demonstrate DCGL compliance or will they be removed. WEC's July 30, 2010, response (ML102140158), indicated that "buried piping and equipment that will remain in place after site closure that have had a potential for radioactive contamination above the $DCGL_W$ (based on site operating history) or known contamination above the $DCGL_W$ (based on previous radiation surveys or surveys performed during decommissioning) will be designated as Class 1 for the purpose of Final Status Survey," and that "the DP will be revised to reflect such a condition." WEC's response also indicated that "piping sections that are currently inaccessible or not readily accessible and are slated for removal during decommissioning will be surveyed in accordance with HDP Radiation Protection Plan and Nuclear Criticality Safety Assessment requirements to support Radiation Work Permit generation, proper waste classification, and the establishment of radiological and nuclear criticality safety controls." WEC also stated in Section 14.4 of the DP (Final Status Survey Design) that "Guidance for conducting an FSS on piping internals is outside the scope of MARSSIM. These special situations will be evaluated by judgment sampling and measurements. Pipe crawlers or other specialty conveyance devices will be deployed using conventional instrumentation. If advanced technology instrumentation, such as in situ gamma-spectroscopy, is selected for use, a technical support document will be developed which describes the technology to be used and how the technology meets the objectives of the survey." RAI 14-Q6 (ML101740133) requested that WEC provide, for NRC approval, a comprehensive approach to embedded pipe and buried piping characterization that accounts for limitations and uncertainties, taking into account MARSSIM guidance in developing the related DQOs. WEC's response (ML102140158) indicated that "HDP will provide buried piping survey methodology and technical support documentation for buried piping that is consistent with MARSSIM and NUREG-1757 guidance for NRC review and approval prior to Final Status Survey of buried piping." Additionally, as a part of their July 5, 2011, response (ML111880290), WEC proposed a revision to Section 14.4 of the DP to state that "the method for final status surveys of piping will be submitted for NRC review and approval, with approval received prior to implementation of final surveys of piping."

The usage of surrogate radionuclides was discussed in Section 14.1.4.3 of the DP. Characterization results were used to develop surrogate relationships for hard-to-detect radionuclides, and details were provided in the "Derivation of Surrogates and Scaling Factors for Hard-To-Detect Radionuclides" (ML092870492). Ratios were presented for Technetium-99 to Uranium-235 and Uranium-234 to Uranium-235. The Uranium-234:Uranium-235 ratio was based on observations of the enrichment in a large number of characterization samples, assumptions regarding the consistency of the enrichment shown by the characterization data, and on published values for the enrichment (based on isotopic ratios). Surrogate ratios for Tc-99:U-235 were developed for three specific areas, the Technetium Soil Area (TSA), the Burial Pit Area (BPA), and the Plant Soil Area (PSA). Within each area additional subsets of ratios were developed for the following soil strata: Surface Soil (0 to 15 cm), Root Stratum Subsurface (15 cm to 1.5 m), and Deep Subsurface (> 1.5 m). WEC indicated in the report that the laboratory instrument's associated MDCs were substituted when Technetium-99 or Uranium-235 results were below the lower limit of detection. In order to confirm the correlation of Uranium-235 to Technetium-99, the staff reviewed the percentage of laboratory samples that were below the detection limit. The results showed that MDC values were substituted as follows: 6.74% of the Technetium-99 values and 41.35% of the Uranium-235 values for the overall Technetium Soil Area, 43.82% of the Technetium-99 values and 28.09% of the Uranium-235 values for the overall Burial Pit Area, and 35.16% of the Technetium-99 values and 32.42% of the Uranium-235 values for the overall Plant Soil Area. The results do not clearly indicate that Uranium-235 and Technetium-99 are co-located at the site. Therefore, staff does not recognize the Uranium-235:Technetium-99 ratio analysis as a viable option for compliance surveys. The staff communicated this point to WEC, and WEC proposed to revise DP Section 14.1.4.3.1 to state that "the Tc-99 surrogate relationship is prohibited from use in the evaluation of analytical results to determine compliance with the final status survey dose criteria," and that "instead of a surrogate relationship, laboratory analysis for Tc-99 will be performed for all FSS samples." WEC also proposed to revise all affected sections of the DP as a result of their change in approach for Technetium-99.

The NRC staff has reviewed the information in the WEC Hematite Decommissioning Plan (Chapters 4 and 14) according to NUREG-1757, Volume 2, Section 4.2 and Volume 1, Appendix D, Section XIV.b. The DP was reviewed concurrently with the HRCR, as WEC indicates in the DP that several radiological characterization campaigns were conducted over the last 26 years and that while a summary is provided in the DP additional details can be found in the HRCR. This review has determined that the radiological characterization of the site, area, or building is adequate to permit planning for a remediation that will be effective and will not endanger the remediation workers, to demonstrate that it is unlikely that significant quantities of residual radioactivity has not gone undetected, and to provide information that will be used to design the final status survey.

14.3 Remedial Action Support Surveys

Section 14.3 of the DP indicated that Remedial Action Support Surveys (RASS) for soil will primarily rely on direct radiation measurements using gamma instrumentation along with the collection of soil, sediment, and surface residue samples for laboratory analysis. RASS for the surfaces of structures, buildings, and systems to be remediated (or where there is a potential for residual contamination will be performed using surface contamination monitors along with sampling for removable surface contamination. A description of the field screening methods and instrumentation was provided in Section 14.3.1.1 of the DP. In addition to field screening, soil samples can be analyzed via gamma spectroscopy at the on-site laboratory or by liquid scintillation beta spectroscopy and alpha spectroscopy at an off-site laboratory. Field screening methods will typically include gamma walkover surveys using a 2 inch by 2 inch NaI gamma scintillation detector. Typical MDCs for field instruments were provided in Table 14-14 of the DP.

The staff has reviewed the information in Section 14.3 (Remedial Action Support (In-Process) Surveys) of the DP according to NUREG-1757, Volume 2, Section 4.3 and Volume 1, Appendix D, Section XIV.c. Based on this review the staff has determined that WEC has provided sufficient information to allow the staff to evaluate the licensee's planned RASS, and the staff has reasonable assurance that they can be conducted in accordance with NRC requirements.

14.4 Final Status Survey Design

An overview of WEC's FSS design was provided in Section 14.4 of the DP. The primary objectives of the FSS were outlined in Section 14.4.1 as follows:

- select/verify survey unit classification;
- demonstrate that the potential dose from residual radioactivity is below the release criterion for each survey unit; and,
- demonstrate that the potential dose from small areas of elevated radioactivity is below the release criterion for each survey unit.

Four principal elements of the FSS process were also provided in Section 14.4 as follows: Planning (Section 14.4.2); Design (Section 14.4.3); Implementation (Section 14.4.4); and, Data

Assessment (Section 14.4.5). Section 14.4.2 (Final Status Survey Planning) of the DP indicates that "[t]he DQO process will be incorporated as an integral component of the data life cycle, and is used in the planning phase for scoping, characterization, remediation and final status survey plan development using a graded approach." The six steps of the Data Quality Objectives (DQO) process, as outlined in Appendix D of MARSSIM, were represented in the DP as follows: State the Problem (Section 14.4.2.1.1), Identify the Decision (Section 14.4.2.1.2), Identify Inputs to the Decision (Section 14.4.2.1.3), Define the Study Boundaries (Section 14.4.2.1.4), Develop a Decision Rule (Section 14.4.2.1.5), and Specify Limits on Decision Errors (Section 14.4.2.1.6).

Details on the initial site designation (impacted vs. non-impacted) were provided in Section 14.4.2.2 of the DP. The designations were based on the assessment of the HSA, HRCR, and a horizontal and vertical profile review of the characterization results. Areas designated as non-impacted were shown in Figure 14-11 of the DP, and impacted areas were shown in Figure 14-12 (along with Class 1, Class 2, or Class 3 designations). Impacted areas were further subdivided into survey units, as shown in DP Figure 14-14 (open land areas), and Figures 14-15, 14-16, and 14-17 for buildings.

Background reference areas were described in Section 14.4.2.5 of the DP. Reference areas for soil were identified in Chapter 4 of the DP, and these areas are stated to have "a soil type similar to the soil type within the site impacted areas." Originally, it was stated that "background reference area measurements are required when using statistical application of the WRS test, and when background subtraction is required to correct gross radioactivity measurements for naturally-occurring radioactivity present in soil, and in construction materials prior to applying the Sign test." Per discussions with WEC on their responses to RAI 14-Q4 (ML102140158), RAI RCR-Q4 (ML102140158), and RAI 5-Q1 (ML102290015), this statement was updated (ML111880290) to state that only gross results will be used for soil measurements. Section 14.4.2.5 of the DP also states that the Kruskal-Wallis test may be used to determine variability between reference areas. WEC anticipates that no background references will be required for building or structural surface survey units, but areas of similar construction materials will be selected if they become necessary. In response to the RAIs, WEC proposed to revise Section 14.4.2.5 of the DP to indicate that "the Sign test will be used for surface contamination on building surfaces, and will be based on net FSS results; the net results will be obtained by subtracting the instrument response to ambient conditions from the gross results, but will not include a correction for the response due to naturally-occurring radioactivity in materials of construction."(ML111880290)

The FSS design process was further explained in Section 14.4.3 of the DP. MARSSIM survey design criteria are enumerated in Section 14.4.3, and WEC's design approach is consistent with MARSSIM guidance. As such, it was stated that "at least a minimum number of measurements or samples be taken within a survey unit, so that the nonparametric statistical tests used for data assessment can be applied with adequate confidence. Decisions regarding whether a given survey unit meets the applicable release criterion are made based on the results of these tests. Scanning measurements are used to confirm the design basis for the survey by evaluating if any small areas of elevated radioactivity exist that would require reclassification, tighter grid spacing for the total surface contamination measurements, or both." Sampling size determination was described in DP Section 14.4.3.1, and is consistent with Section 5.5 of

MARSSIM and Appendix A of NUREG-1757. Details on scan coverage and calculations related to reference grid development were provided in DP Sections 14.4.3.2 and 14.4.3.3.
A discussion of survey decision errors was provided in DP Section 14.4.3.1.1. The associated null hypothesis and alternate condition are consistent with MARSSIM, and were defined as:

- Null Hypothesis (H_o) - The survey unit does not meet the release criterion; and,
- Alternate Hypothesis (H_a) - The survey unit does meet the release criterion.

Type I and II error probabilities were also defined, and are consistent with NRC guidance from NUREG-1757. The type I error (α) will be set to 0.05, unless prior NRC approval is granted for a less restrictive values, and the type II error (β) will be nominally set to 0.10.
The usage of area factors and the treatment of small areas of elevated radioactivity were described in DP Section 14.4.3.1.11 and are consistent with Sections 2.5.1.1 and 5.5.2.4 of MARSSIM. The investigation process used when areas of concern or elevated measurements are encountered was described in Section 14.4.3.4 of the DP, and it was stated that this process and the associated investigation levels are consistent with Section 5.5.2.6 of MARSSIM. It was further indicated in DP Section 14.4.3.4 that "during the FSS process, locations with potential residual radioactivity exceeding investigation levels will be marked for further investigation and biased sampling or measurement, and that "for Class 1 survey units, the size and average radioactivity level within the elevated area may be acceptable if it complies with the AFs and other criteria as it applies to the $DCGL_{EMC}$." Discussion of investigation levels was provided in DP Section 14.4.3.5, and Table 14-18 of the DP gives the applicable investigation levels. The investigation levels are consistent with Table 5.8 of the MARSSIM guidance.

Details on remediation, reclassification, and resurvey were provided in DP Sections 14.4.3.6 and 14.4.3.7. There, it was stated that "any areas of elevated residual radioactivity above the $DCGL_{EMC}$ will be remediated to reduce the residual radioactivity to acceptable levels." The following description of the reclassification process was provided:

> If an individual survey measurement (scan or direct) in a Class 2 survey unit exceeds the $DCGL_w$, the survey unit, or portion of the survey unit, will be investigated, and if necessary, be reclassified to a Class 1 area and the survey re-designed and re-performed accordingly. If an individual survey measurement in a Class 3 survey unit exceeds 50 percent of the $DCGL_w$, the survey unit, or portion of a survey unit, will be investigated, and reclassified to a Class 1 survey unit (if determined to exceed the DCGL) or Class 2 survey unit (if determined to be less than the DCGL but greater than 50 percent of the DCGL), and the survey re-designed and re-performed accordingly. If the elevated survey measurement is confirmed by investigation, but cannot be thoroughly described as an isolated condition, (i.e., it cannot be demonstrated with great certainty that this condition does not exist elsewhere in the survey unit) the survey unit will be reclassified. If the result cannot be duplicated, the population of the individual and average measurement results with respect to the DCGL will be reviewed, and if the variability does not suggest the initial classification was inappropriate, the survey unit will not be reclassified.

It was also stated in Section 14.4.1 of the DP (Final Status Survey Design) that "although expected to occur infrequently, a situation could arise where it can be determined that, the origin of a location of localized elevated concentration (>$DCGL_w$) within a Class 2 or 3 survey unit is understood, and it is highly unlikely that a similar condition exists elsewhere within the survey unit." It was further stated that "in this instance, it may be determined that reclassification and re-survey are not required," and that "this determination will be thoroughly documented in the release record, and will be based on further research into operational history, the results of additional scan surveys and sampling, or a combination of these sources of information." The staff raised concerns in RAI 14-Q7 (ML101740133) that WEC's statements on reclassification are inconsistent with MARSSIM Sections 4.4 and 5.5.3. The staff requested WEC revise statements on classification to be consistent with MARSSIM guidance for reclassification of survey areas. In RAI 14-Q7, the staff also noted that for areas being reclassified, the results of the investigation of measurements exceeding the investigation level and the basis for reclassification from a higher to lower designation (i.e., Class 3 or 2 areas reclassified to either Class 2 or 1 areas) should be appropriately documented in the final status survey report. After discussion of their RAI 14-Q7 response with the staff, WEC agreed to revising Sections 14.4.1, 14.4.3.1.11, 14.4.3.6, and 14.6.1 of the DP to use wording from MARSSIM (ML111880290).

Information on Final Status Survey implementation was provided in Section 14.4.4 of the DP. Here, survey methodologies are described for scanning, static, and removable contamination measurements, and methods for the analysis of volumetric materials are provided in DP Section 14.4.4.1.4. Survey considerations for buildings, structures, and equipment are provided in DP Section 14.4.4.1.5. Such survey areas include: cracks/crevices, wall-floor interfaces and small holes, paint covered surfaces, piping and floor drains, ventilation ducts – interiors, building foundations and sub-grade soil. In regard to these survey considerations, RAI 14-Q14 (ML101740133) requested the technical basis for determining if floor drains will need to be removed, how they will be surveyed, and the criteria WEC will apply to ensure floor drains have not leaked material under the slabs. Additional details were also requested on the survey criteria that will be employed to detect the accumulation and migration to subsurface soils from cracks, floor and wall interfaces, etc. The response (ML102140158) to RAI 14-Q14 indicated that two options will be considered regarding buried piping to remain after site closure in Buildings 110, 230, and 231 (and potentially Building 115 and the Sanitary Water Treatment Plant). Those options are as follows:

> **Option 1**: Buried pipe that WEC has decided will be removed during decommissioning will be surveyed in accordance with the Hematite Radiation Protection Plan (RPP) and Nuclear Criticality Safety Assessment requirements to support Radiation Work Permit generation, proper waste classification, and the establishment of radiological and nuclear criticality safety controls. During removal, adjacent soils will be surveyed and excavated as needed in accordance with RPP and Nuclear Criticality Safety Assessment requirements, and to ensure the area has been properly prepared for Final Status Survey.
>
> **Option 2**: Buried piping that WEC has decided will remain in place after site closure will be surveyed in accordance with the NRC approved FSS buried piping survey methodology referenced in the response to RAI 14-Q6. If buried piping surveys determine that remediation is required to meet the appropriate DCGLs, remediation

activities will be conducted in accordance with RPP and Nuclear Criticality Safety Assessment requirements. Following remediation, FSS surveys will be performed to verify DCGLs have been met.

WEC's RAI 14-Q14 response (ML102140158) additionally noted that "to verify that buried piping leaks have not contaminated surrounding soil, HDP will utilize biased core bore samples through building slabs to evaluate soils adjacent to buried piping against appropriate DCGLs," and that "factors for determining biased location decisions will include location of pipe joints, low points, and any survey or video evidence available from the buried piping."

Details on FSS survey instrumentation were given in Section 14.4.4.2 of the DP, where information on instrument selection and the associated calibration, maintenance, and response checks are provided. Calculations for static and scan MDCs were also provided. In RAI 14-Q16 (ML101740133), the staff requested information on efficiencies for instruments to be used in operational and characterization surveys. The following details on instrument efficiencies were provided in the RAI response (ML102140158):

> For the purpose of implementing the HDP operational health physics program, the instrument efficiencies are based on a 4π geometry. The instrument efficiency values are determined using NIST traceable sources having energies that are comparable, or conservative, with respect to the energies of the radionuclides that are present. These methods are consistent with ANSI N323A-1997, *American National Standard Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments*. For operational surveys, the gross results of alpha and/or beta surface contamination measurements are converted to standard units of activity, and compared to limits specified in the HDP Materials License and health physics operational implementation procedures. Radiological surveys conducted to support the operational health physics program are implemented through written procedures which are followed by health physics technicians who have been trained in accordance with this program.
>
> For the measurements to be conducted during final status survey, HDP will implement the recommendations of ISO 7503-1. Final status survey procedures and associated training lesson plans specific to the performance of final status surveys will include calculation of a weighted efficiency as detailed in Chapter 14 of the DP. Training to these procedures will be administered to technicians prior to the implementation of final status survey, and subsequent changes to these procedures will be reviewed with technicians prior to implementation.
>
> The previous characterization surveys of building structures (Buildings 110, 230, and 231) implemented ISO 7503-1 recommendations, but did not apply the weighted efficiency. Net alpha and beta surface contamination measurements were converted to standard units of activity using an efficiency based on Th-230 and Tc-99 for alpha and beta efficiency determination, respectively. A surface efficiency of 0.25 was assumed for both alpha and beta measurements which are conservative with respective to the recommendations of ISO 7503-1. The results of these surveys have been reviewed and assuming that the weighted efficiency had been applied, this could have resulted in an increase in the reported activity. This review also indicated the use of the weighted

efficiency would not have resulted in any change to the decisions regarding the classification that will be implemented for final status survey.

Survey considerations for open land areas were provided in DP Section 14.4.4.1.6, and these include: surface soil, sub-surface soil, paved areas, groundwater, sediments and surface water. In RAI 14-Q15, the staff requested that WEC provide a detailed discussion of how groundwater will be assessed during FSS implementation. The RAI response (ML102140158) stated that "the discussion of groundwater monitoring is provided in Section 14.5 which describes the groundwater monitoring to be performed after soil remediation is complete," and that "this groundwater monitoring program represents the Final Status survey for groundwater." The following details were provided on how any groundwater results above background will be handled:

> If there are positive results, above background, from samples collected in the sand/gravel or bedrock aquifers, then the corresponding dose will be calculated using the Dose to Source Ratios (DSRs) listed in DP Chapter 5, Table 5-14. Initially, the contribution to dose from the groundwater sample showing the highest individual aquifer sample result will be added to the dose attributable to the survey unit with the highest dose (calculated in accordance with Section 14.4.5.6.1) to ensure that the total dose remains below 25 mrem/yr. This contribution to dose is expected to be insignificant when compared to soil, however if this initial approach is determined to be unduly conservative, then Westinghouse may choose to perform additional hydrogeological investigations. The investigations will be used to determine the extent of the groundwater contamination and a more realistic estimate of the groundwater source term for the purpose of performing the dose estimate as opposed to applying an individual maximum value. NRC will be provided a report describing the method used to assess the groundwater source term if the maximum individual result is not deemed appropriate.

WEC's RAI 14-Q15 response (ML102140158) indicated that "the commitment to add groundwater dose to demonstrate compliance with the 25 mrem/yr limit will be added in a new section to DP Chapter 14," and "the method for calculating the dose will also be included in the new Section 14.4.5.6.3." Additionally, DP Equation 14-47 will be revised to add a term for groundwater dose in the summation of doses.

Section 14.4.5 of the DP provided information on how FSS data assessment will occur. The data assessment process will evaluate data collected from a survey unit against the release criteria and ensure that appropriate procedural and QA/QC requirements have been met. Data collection documentation will also be compared to the DQOs to ensure that an appropriate number of samples were taken from appropriate locations and that adequate measurement sensitivity was in place. The WRS test or Sign test will be used, depending on the data being analyzed and whether or not contaminants are also in background. Tables 14-21 and 14-22 of the DP provide the evaluation matrices that will be used for the WRS test and the Sign tests, respectively. DP Section 14.4.5.3 states that "for the site, the WRS test will be applied to the soil surveys using the guidance in Section 8.4 of MARSSIM," and DP Section 14.4.5.4 states that "the Sign Test will be applied to the building and structural surface surveys using the guidance in Section 8.3 of MARSSIM." Elevated measurement comparison (EMC) evaluation was explained in DP Section 14.4.5.6, where it is indicated that "the EMC will be applied by summing the contributing dose fractions of the survey unit through the unity equation," and that "this will be performed by determining the fraction of dose contributed by the average radioactivity across the survey unit and by adding the additional dose contribution from each individual elevated area following the guidance as provided in Section 8.5.1 and Section 8.5.2 of MARSSIM." A SOF calculation will be applied once all the dose contributions are determined.

The staff has reviewed the information in the WEC Hematite Decommissioning Plan according to NUREG-1757, Volume 2, Section 4.4 and Volume 1, Appendix D, Section XIV.d. Based on this review, the staff has determined that the FSS design will demonstrate compliance with 10 CFR Part 70.38(g)(4)(iv).

14.5 Final Status Survey Report

Section 14.6 of the DP includes an outline for the forthcoming Final Status Survey Report (FSSR). Here it is stated that "documentation of the FSS will transpire in two types of reports and will be consistent with Section 8.6 of NUREG-1575." The first type is the FSS Survey Unit Release Record, which will be prepared to provide a complete record of the as-left radiological status of an individual survey unit, relative to the specified release criteria. These Release Records may be made available to the NRC for inspection. The second report type will be the FSS Final Report, which is a written report provided to the NRC for review. This report will provide a summary of the survey results and the overall conclusions which demonstrate that, the site, or portions of the site, meets the radiological criteria for unrestricted use.

It was stated in DP Section 14.6.2 that the FSS Final Reports will usually incorporate multiple FSS Survey Unit Release Records and that they may be prepared and submitted in a phased approach. The following outline on the FSS Final Report content was provided:

- Introduction, including a discussion on the phased approach for submittals;
- FSS Program Overview to include sub-sections on survey planning, survey design, survey implementation, survey data assessment, and Quality Assurance and Quality Control measures;
- Site Information to include sub-sections on site description, survey area/unit description (specific to current phase submittal), summary of historical radiological data, conditions at the time of survey, identification of potential contaminants, and radiological release criteria;
- Final Status Survey Protocol to include sub-sections on Data Quality Objectives, survey unit designation and classification, background determination, FSS plans, survey design, instrumentation (detector efficiencies, detector sensitivities, instrument maintenance and control and instrument calibration), survey methodology, quality control surveys, and a discussion of any changes that were made in the FSS from what was proposed in this DP;
- Survey Findings to include sub-sections on survey data conversion, survey data verification and validation, evaluation of number of sample/measurement locations, and comparison of findings with the appropriate DCGL;

- Appendix A: FSS Program and Implementing Procedures (initial phased submittal - subsequent submittals contain only revisions or additions to program and/or implementing procedures); and,
- Appendix B: FSS Technical Basis Documents (initial phased submittal - subsequent submittals contain only revisions or additions to FSS technical basis documents).

The staff has reviewed the WEC plans for FSS reporting according to NUREG-1757, Volume 2, Section 4.5 and has determined that the outline-level plan for FSS Reports is acceptable. However, the staff will review the full FSS Reports prior to a final determination that the site can be released for unrestricted release and the license terminated.

15.0 Financial Assurance

On July 10, 2010, WEC submitted the Hematite Decommissioning Funding Plan (DFP) (ML091950063) in support of the Hematite Decommissioning Amendment Request. In Chapter 15 of the Hematite DP WEC referenced the DFP and provided a brief summary of the information in the DFP. The staff reviewed the DFP and the review resulted in RAIs (ADAMS No. ML102980081). WEC responded to the staff's request in a December 21, 2010, submittal (ML110120334). With the RAI response WEC also provided a revision to the DFP. WEC subsequently supplemented those RAI responses and revised the DFP in a June 30, 2011, submittal (ML11189A017). The staff completed its review of the revised DFP and issued an SER evaluating its sufficiency. Because the DFP contains proprietary information, which is limited in terms of availability, the staff prepared both a public and a non-public version of the DFP SER. The public version of the DFP SER is publicly available through ADAMS (ML111661970) and the non-public version of the DFP SER is being transmitted to WEC along with this SER. The staff concluded that WEC has demonstrated that: (1) its cost estimate for decommissioning and decontaminating the site and facility to unrestricted release criteria; (2) the currently approved Letters of Credit, Standby Trust Agreements, Certification of Financial Assurance, and supporting documentation; and (3) an appropriate amount of decommissioning financial assurance is provided to carry out all required decommissioning activities prior to license termination, and, therefore, WEC satisfies the regulatory requirement of providing adequate financial assurance as set forth in 10 CFR 70.25.