Attachment 3

Final Status Survey Final Report Volume 2, Chapter 1, Revision 2

Reuse Soil and Off-site Borrow Material Overview

Westinghouse Electric Company LLC, Hematite Decommissioning Project

Docket No. 070-00036

Westinghouse

Final Status Survey Report

Hematite Decommissioning Project

Final Status Survey Final Report Volume 2, Chapter 1

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REVISION LOG	
Revision No. Effect. Date	**Revisions(s)**
0 12/16/2015	Revision 0 is the initial issuance of the Final Status Survey Final Report Overview.
1 05/26/2016	FSSFR Volume 2, Chapter 1, Final Status Survey Final Report Overview Revision 1 supersedes Revision 0. Revision 1 provides the following updates: • Assignment of Chapters – Reuse stockpiles • Enhanced discussion of Modified Investigation Level • Discussion on Weighted Average Calculation • Discussion on Data Presentation • Discussion on Survey Methodology • Discussion on Reuse Soil Sampling • Discussion on Management of Reuse Soil Used for Backfill
2 See Cover Page	FSSFR Volume 2, Chapter 1, Final Status Survey Final Report Overview Revision 2 supersedes Revision 2. Revision 2 incorporates resolution to NRC review comments received via publicly noticed teleconference, and includes the following: • Discussion on Ra-226 Background • Discussion on Weighted Average Calculation • Additional Reuse Stockpile Information

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LIST OF ACRONYMS AND SYMBOLS

AEC	Atomic Energy Commission
Bq	becquerel
CAPAL	Corrective Action Prevention and Learning
cyd	cubic yards
CSM	Conceptual Site Model
DCGL	Derived Concentration Guideline Level
$DCGL_w$	DCGL ("W" suffix denotes "Wilcoxon")
DP	Hematite Decommissioning Plan
FSS	Final Status Survey
FSSFR	Final Status Survey Final Report
g	gram
GARDIAN	Gamma Radiation Detection and In-Container Analysis
GWS	Gamma Walkover Survey
HDP	Hematite Decommissioning Project
HP	Health Physics
kg	kilogram
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
µCi	microcurie
MDC	Minimum Detectable Concentration
MIL	Modified Investigation Level
NaI	Sodium Iodide
NRC	U.S. Nuclear Regulatory Commission
ORAU	Oak Ridge Associated Universities
pCi/g	picocurie(s) per gram
QC	Quality Control
Ra	Radium
RSO	HDP Radiation Safety Officer
RML	Reuse Material Screening Action Level
S3	ISO-Pacific Nuclear Assay Systems S3 Soil Sorting System
Tc	Technetium
Th	Thorium
WHA	Waste Holding Area
U	Uranium

1.0 REUSE SOIL AND OFF-SITE BORROW MATERIAL SOIL INTRODUCTION

The purpose of this document, Final Status Survey Final Report (FSSFR) Volume 2, Chapter 1, *Reuse Soil and Off-site Borrow Material Overview,* is to provide a general description of, the survey methodologies, survey outcomes for the disposition of the reuse soil stockpiles and off-site borrow soil at the Hematite Site. Information specific to a reuse soil stockpile will be provided in the respective Volume 2 chapter for each stockpile as follows:

FSSFR Document	**Stockpile/Source**
Volume 2, Chapter 2	Combined Reuse Stockpile 1-2
Volume 2, Chapter 3	Reuse Stockpile 3
Volume 2, Chapter 4	Combined Reuse Stockpile 4-7
Volume 2, Chapter 5	Combined Reuse Stockpile 5-6
Volume 2, Chapter 6	Reuse Stockpile 8a-8b
Volume 2, Chapter 7	Reuse Stockpile 9
Volume 2, Chapter 8	Off-site Borrow

The Hematite Decommissioning Project (HDP) FSSFR Volume 1, Chapter 1, *Final Status Survey Final Report Overview,* provides overview information in regards to the approval process and history of the HDP Decommissioning Plan (DP). The Hematite Decommissioning Plan (Reference 10.1) {ML092330123} and associated documents contain the requirements for reuse soil (backfill).

The purpose of this document is to also provide a general description of the actions and analysis conducted for approval of off-site borrow material to be acceptable for use as backfill at the Hematite site.

2.0 BACKGROUND

A key component of the HDP DP remediation process within open land areas was to identify and separate soil that could be used for reuse soil from the soils that exceed the site cleanup criteria. The soil that exceeded the site cleanup criteria was disposed of as waste. For that reason the DP Chapter 14 described that "as soil is excavated, gamma scans will be used to guide the remediation and to support the segregation of soil for potential re-use as backfill." Furthermore, DP Chapter 14 described the survey methodologies to be used during the removal of soil intended to be used as backfill.

As stated in the DP, the objectives of the gamma scan surveys performed during the excavation of soil potentially suitable for re-use as backfill (e.g., overburden in the Burial Pit Area) include the identification of discrete locations of elevated concentrations (as indicated by count rate) for segregation from the balance of the soil. These segregated soils were dispositioned as waste and disposed of as described in DP Chapter 12.0, *Radioactive Waste Management Program.*

These surveys also serve to confirm that the count rates associated with the remaining soil intended for re-use as backfill are relatively uniform, and below those typically associated with soil containing concentrations in excess of the Derived Concentration Guideline Level (DCGL). All soil is surveyed and subsequently excavated in lifts rather than by bulk excavation. The excavated soil then continued to be processed to determine if it was acceptable for reuse soil or if the soil would be disposed of as waste. Soil that was determined to be acceptable for reuse was then placed into stockpiles.

The survey methodologies for reuse soil are described in detail in Section 4.0. HDP developed and utilized two site procedures for radiological survey and sampling of potential reuse soil. HDP-PR-HP-601, *Remedial Action Support Surveys,* provides instruction for the survey and sampling of potential reuse soil during the excavation process. HDP-PR-FSS-710, *Final Status Surveys and Radiological Sampling of Re-Use Soil*, provides instruction for the survey and sampling of potential reuse to determine if the soil meets the requirements for reuse soil as specified in the DP. The current revision of these and all site procedures are provided on a compact disc to the U.S. Nuclear Regulatory Commission (NRC) upon arrival for each site inspection and upon request. Revision histories for the two procedures listed above are also provided in Appendix A.

2.1 History of the Development of the Reuse Stockpiles

During the development of the DP and at the beginning of the remediation process, there was an assumption that only one large reuse stockpile of soil would be generated. However, as work evolved it became apparent that it was more efficient from an operational standpoint to manage multiple stockpiles. As a result, a total of ten original stockpiles of reuse soil were generated during the site remediation process, resulting in seven final reuse soil stockpiles upon completion of processing the soil to determine the acceptability of the soil for reuse.

Because reuse soil was to be used as backfill and returned to land survey areas, the dose impact of these reuse stockpiles had to be incorporated into the total dose impact for any land survey area ultimately receiving the soil. Therefore, these soils were radiologically assessed and stored segregated from other site activities and each other until they were used for backfilling onsite excavated areas. The methodology utilized to incorporate the dose impact from reuse soil is discussed in detail in FSSFR Volume 3, Chapter 1.

2.1.1 Reuse Stockpiles 1 through 7 General Discussion

The initial generation of Reuse Stockpile 1 began on January 30, 2012, with the processing of two truckloads of off-site borrow soil. During facility licensed operations Westinghouse Electric Company LLC (Westinghouse) had a commitment with the NRC to fill in depressions in the overburden caused by settling of the buried waste in the Burial Pit Area. To accomplish this in a timely manner the site maintained a stockpile of off-site borrow material to use on an as needed basis to fill the depressions. With the approval by the NRC to commence remediation of the site it was no longer necessary to fill depressions in the Burial Pit. As a matter of preparation for the start of remediation and to demonstrate that the stockpile had not been radiologically impacted while on-site

it was determined that the appropriate disposition of the material would be as potential reuse soil. As the origin of this soil was from an off-site source it was not chemically impacted by site operations and therefore was placed in the Reuse Soil Laydown Area located directly to the east of site. Generation of Reuse Stockpile 1 recommenced on May 14, 2012, and with closure of the stockpile on July 30, 2012.

The HDP Radiation Safety Officer (RSO) established the initial (beginning January 26, 2012) Reuse Material Screening Action Level (RML) for gamma walkover survey of potential reuse soil at 2,000 ncpm as indicated by a Sodium Iodide (NaI) 2" x 2" detector. Based upon a review of the reuse soil process during the onset of remediation the RSO conducted a comparison of the RML to the analytical sample results of the reuse soil generated to that point. It was determined that it was appropriate to increase the RML to 4,000 ncpm. This would allow for the increased generation of reuse soil volume while minimizing the volume of clean soil sent for disposal. The increase of the RML was implemented on April 10, 2012. The establishment and use of the RML is discussed in further detail in section 2.2.

Generation of Reuse Stockpile 2 commenced on March 20, 2012, and was generated concurrent with Reuse Stockpile 1. Soil in Reuse Stockpile 2 originated primarily from the top four feet of overburden soil in the Burial Pit Area. As this soil was yet to be determined to meet the chemical remediation requirements, it was prohibited from being located in the Reuse Soil Laydown Area until such time that chemical sampling and analysis was complete. To preclude stoppage of work excavating the overburden soil, Reuse Stockpile 2 was located in a laydown area established on the west side of the facility. Reuse Stockpile 2 was closed to the addition of soil on May 10, 2012. Subsequent to closure of Reuse Stockpile 2, upon completion of chemical sampling and analysis, the stockpile was relocated to the Reuse Soil Laydown Area.

Generation of Reuse Stockpile 3 commenced on August 7, 2012, and was located in the Reuse Soil Laydown Area. Chemical sampling and analysis was performed for Reuse Stockpile 3 and all subsequent reuse stockpiles prior to relocation to the Reuse Soil Laydown Area; therefore, there was no longer a need to temporarily hold reuse soil in the West Laydown Area as there was with Reuse Stockpile 2. The commencement of the generation of Reuse Stockpile 3 coincided with the closure of Reuse Stockpile 1 on July 30, 2012. Soil in Reuse Stockpile 3 originated from the Burial Pit Area. Reuse Stockpile 3 closure occurred on January 8, 2013. The RML utilized for Stockpile 3 was 12,000 ncpm.

Continuing remediation in the Burial Pit Area resulted in the commencement of the generation of Reuse Stockpile 4 on January 14, 2013, and was located in the Reuse Soil Laydown Area. The majority of soil that comprised Reuse Stockpile 4 originated in the Burial Pit Area. During this time period of remediation of the Burial Pit Area the Barns Area remediation had begun. This remediation work in the Barns Area resulted in the contribution of soil to Reuse Stockpile 4. Closure of Reuse Stockpile 4 occurred on June 5, 2013. The RML utilized for Stockpile 4 was 25,000 ncpm.

Between December 10, 2012, and January 15, 2013, during Barns Area remediation, two piles of soil had been generated within the area that were not initially designated as potential reuse soil. One pile consisted of just soil and the second pile consisted of soil and some minor debris. After inspection of the piles the RSO designated the soil as potential reuse soil and directed that HDP-PR-FSS-710 (Revision 4) Approach 1, *Utilizing the Box Counter*, was the approach used to process the reuse soil.

During an on-site inspection by the NRC, an inspector noted the piles of soil staged in the Barns Area and questioned site personnel to determine from where it had been exhumed and how it was to be dispositioned in the future. The soil piles had been designated as reuse material and were awaiting transport to the reuse area. Since this area was designated as a non-nuclear criticality safety (NCS) area, in-situ surveys were not required before each lens of soil was exhumed from the area for waste disposal. However, in-situ surveys were required for each lens of soil that was planned to be used as reuse on site. The inspectors discussed with the licensee what surveys had been performed for the soils in the pile designated for reuse and found that in-situ surveys had not been performed for each lens of soil that was exhumed into the reuse pile. This resulted in a Severity Level IV Non-cited Violation for failure to conduct activities in accordance with requirements.

As a result of the identification of this issue, the site identified that insufficient information was contained in the procedure and subsequently revised HDP-PR-HP-601 to revision number 9 on March 6, 2013. The pile of soil that contained only soil was again deemed to be soil that was suitable as backfill. This soil was designated Reuse Stockpile 5 and the survey methodology used to determine acceptability as reuse soil was changed to Approach 3 as provided in HDP-PR-FSS-710. The soil that comprised Reuse Stockpile 5 was still assayed by the box counter prior to placement in the designated lay down area on the west side of the facility, but once in the designated laydown area the entire stockpile was spread out in approximate 6 inch lift and an FSS survey was performed in accordance with HDP-PR-FSS-711, *Final Status Surveys and Sampling of Soil and Sediment* (Revision 3). The entire volume of soil that comprised Reuse Stockpile 5 was assayed in the box counter on February 4, 2013. Closure of Reuse Stockpile 5 occurred on February 4, 2013. The pile of soil that had been previously staged in the barns areas that contained debris was combined with other soil containing debris from the Barns Area to become Reuse Stockpile 6.

As stated above, the soil that comprised Reuse Stockpile 6 at the time of excavation in the Tile Barn section of the Barns Area was not originally designated as potential reuse soil. A visual inspection of the stockpile revealed an unexpected amount of non-burial pit type debris which was not anticipated to be in the Barns Area as the Tile and Wood Barns construction predated any Atomic Energy Commission (AEC)/NRC licensed activities. The majority of debris identified was clay tile fragments, with indication of very minor amounts of a plastic type material, and metallic materials (door hinges, etc.) such as would be associated with the previous dairy farm activities.

The identification of this debris did call into question the suitability of the soil for reuse, therefore, an evaluation was initiated to determine if the soil containing the debris could

be suitable as reuse soil. Research and review of the Historical Site Assessment, characterization data, and historic aerial photos provided no indication that this type debris might be encountered during remediation within the Barns Area. Subsequently, further excavation in the area of the Tile Barn identified, at a lower elevation, a foundation below the existing foundation that had structurally supported the Tile Barn. Also identified at this elevation were charred materials which indicated a fire may have occurred in that location. This indicated that the debris originated as a result of a previous fire of a barn and the large amount of clay tile fragments originated from the construction of the Tile Barn in the elevation above the debris left by the fire. The evaluation concluded that the debris was not associated with any licensed activities and its origins predated any AEC/NRC licensed activity.

To ensure acceptability of the soil in Reuse Stockpile 6 it was processed through a McCloskey shaker screener to remove all objects having greater than a 2 inch diameter. The soil was also spread out and site personnel removed by hand any remaining pieces of debris. The survey methodology used for determining if Reuse Stockpile 6 soil was suitable as backfill was Approach 3 as provided in HDP-PR-FSS-710. The soil that comprised Reuse Stockpile 6 was processed through the box counter from March 13, 2013, through May 8, 2013.

Anticipating closure of Reuse Stockpile 4 which occurred on June 5, 2013, continuing remediation in the Burial Pit Area resulted in the need to commence generation of Reuse Stockpile 7 which started in April 2013. Close out of Reuse Stockpile 7 was completed on November 27, 2013.

In June 2013, there was a discovery of a fuel pellet fragment in a Barns Area survey unit LSA 05-02 while undergoing a confirmatory survey by Oak Ridge Associated Universities (ORAU) for the NRC. The event was entered into the Westinghouse corrective action system and prompted an evaluation of the effectiveness of the implementation of the gamma walk over survey in regards to identification of a discrete item (pellet fragment). The gamma walkover survey method as prescribed in site procedures at that time was that the surveys were performed with the detector probe being held at 3-inches from the surface. The evaluation concluded that the discrete item would be identified during the survey if the probe was held closer to the surface. The site modified its site procedures to state that the Health Physics (HP) Technician would hold the probe as close to the surface as possible when performing gamma walkover surveys.

Although it was determined that the dose consequence of a missed discrete item (pellet fragment) in a reuse soil stockpile that was eventually returned to a survey unit excavation was minimal, the same conclusion could not be reached for multiple missed discrete items. It is for this reason that one of the recommended corrective actions from the evaluation was to re-evaluate all of the soils that comprised the seven reuse stockpiles. To accomplish the re-evaluation, HDP engaged the services of an ISO-Pacific Nuclear Assay Systems S3 ("S3") Soil Sorting System. Section 6.0 contains a detailed discussion on the implementation and use of the S3 soil sorting system. This operation commenced in November 2013 and continued through March 2014.

As a result of processing these soils through the S3, there was a consolidation of the stockpiles. The following Reuse Stockpiles were combined; Reuse Stockpiles 1 and 2; Reuse Stockpiles 4 and 7; and Reuse Stockpiles 5 and 6. Reuse Stockpile 3 was not combined with another stockpile. Due to contractual time constraints with the S3 soil sorting system not all of the soil in each of the reuse stockpiles was able to be evaluated by processing through the S3. The soils not evaluated (called "leftovers" or "overs" soil) by the S3 were combined to form Reuse Stockpile 9.

HDP communicated to the NRC that upon completion of reevaluation of the soils as a result of utilizing the soil sorting system for processing Reuse Stockpiles 1 through 7 that the data summary reports for the stockpiles would be resubmitted for the NRC's review as Combined Reuse Stockpile 1-2, Reuse Stockpile 3, Combined Reuse Stockpile 4-7 and Combined Reuse Stockpile 5-6.

The application of Ra-226 soil background values for FSS soil samples is discussed in FSSFR Volume 1, Chapter 1, Section 5.1.3. For Reuse Stockpiles 1 through 7, the decision was made by HDP management to base decisions on the accecptibality of reuse soil on the initially reported Ra-226 values (without ingrowth). This decision was based partially on the need to make timely decisions on the potential suitability of the reuse soil, and on the limited amount of storage space available for the project to store potential reuse soil before combining the soil into a larger reuse soil stockpile. For this reason, since the decision of acceptability was made using the initial 7 day reported Ra-226 results, the Ra-226 background soil value of 0.9 pCi/g (without ingrowth) was applied to all Ra-226 sample results for Reuse Stockpiles 1 through 7.

2.1.2 Reuse Stockpiles 8a, 8b and 9

As remediation continued and there was the need to continue to generate reuse soil stockpiles beyond Reuse Stockpile 7 the site began to generate Reuse Stockpile 8. Based upon the operational experience gained in regards to the discrete item issue, as discussed above, the HDP provided additional general and specific requirements to the decommissioning contractor for processing reuse soil.

The general requirements provided were that:

- If a dump truck has been used to transport waste material or soil, the bed, tires and other potentially contaminated surfaces will be washed to a visibly clean condition prior to transporting re-use soils. Washing efforts will be confirmed by HP using hand-held instruments and large-area wipes, as deemed necessary based on previous use and visual inspection of the truck.
- If a waste consolidation bin slated for storage of potential re-use soils has previously held waste materials, the bin will be cleaned to eliminate the potential for re-use soil contamination. Verification of consolidation bin clean-out will be performed by HP using a combination of surface scans and large-area wipes to show that there is insignificant potential for cross contamination when used for storage of re-use soils.

- Compliance with established HDP FSS policies and procedures for reuse soil remained.

The specific requirements provided a risk based approach in determining the depth of the lift to be assessed and excavated. The specific requirements were as follows:

- Re-Use Materials with High Potential for Discrete High-Activity Items

  This material is generated from remediation activities associated with former burial pits, surface soils from radioactive material storage areas, and other areas that have been determined to have a potential for containing non-soil, high activity materials (e.g., fuel pellets, or other discrete items of high activity).

  Characterization Method: The characterization effort for this material will require 3-inch deep excavations be performed, followed by a GWS to the established FSS methodology.

  An alternative to scanning during excavation will be to spread the soils after excavation in an established "lay down" area to a 3-inch lift (with verification by grade tender or HP Tech). After thickness is verified, HP Technicians will then perform a GWS to the FSS methodology.

- Re-Use Materials with Medium Potential for Discrete High-Activity Items

  The definition of High Potential Areas was later modified to state that surface soils from radioactive material storage areas would be considered Medium Potential, and would be handled in the same manner as High Potential soils until the top 12 inches of soil had been removed, at which time the area would then be considered Low Potential.

- Re-Use Materials with Low Potential for Discrete High-Activity Items

  Examples of this material include native soils excavated to expose piping systems, native soils excavated to remediate Volatile Organic Compounds, and other remediation work in areas other than what is described above.

  Characterization Method: Since these areas have a low probability for pellets and other high activity items, the characterization effort for this material will require 6-inch deep excavations be performed, followed by a GWS to the established FSS methodology.

  An alternative to scanning during excavation will be to spread the soils after excavation in an established "lay down" area to a 6-inch lift (with verification by grade tender or HP Technician). After thickness is verified, HP Technicians will then perform a GWS to the FSS methodology.

Continuing remediation in the Burial Pit Area, Former Process Building Slabs Area, and the Former Evaporation Pond Area resulted in the generation of Reuse Stockpile 8a in June 2014. Close out of Reuse Stockpile 8a was completed on May 29, 2015.

In preparation to remediate the Site Pond it was necessary to construct a diversion channel/canal west of the Site Pond such that the flow from the Site Spring could be

diverted downstream. The Site Pond could then be drained and remediation of the Site Pond Area could proceed. Reuse Stockpile 8b was generated from the soil excavated to construct the diversion. The area where the soil originated from is a Class 3 area which was a partially wooded area which had never experienced any site operations other than lawn maintenance. Generation of Reuse Stockpile 8b commenced in September 2014 and was completed in October 2014.

As stated in section 2.1.1, Reuse Stockpile 9 was generated as a result of combining the soil that was not processed through the S3.

As of May 2015, remediation progress was such that generation of potential reuse soil was discontinued. No other reuse stockpiles were generated.

The application of Ra-226 soil background values for FSS soil samples is discussed in FSSFR Volume 1, Chapter 1, Section 5.1.3. For Reuse Stockpiles 8a, 8b, and 9, the decision was made by HDP management to base decisions on the accecptibality of reuse soil on the 21 day reported Ra-226 values (with ingrowth). For this reason, since the decision of acceptability was made using the final 21 day reported Ra-226 results, the Ra-226 background soil value of 1.07 pCi/g (without ingrowth) was applied to all Ra-226 sample results for Reuse Stockpiles 8a, 8b, and 9.

2.2 Reuse Material Screening Action Level (RML)

As a component of the survey methodology for determining the acceptability of potential reuse soil the DP acknowledged that "*The objectives of the gamma scan surveys performed during the excavation of soil potentially suitable for re-use as backfill (e.g., overburden in the Burial Pit Area) include the identification of discrete locations of elevated concentrations (as indicated by count rate) for segregation from the balance of the soil. These surveys also serve to confirm that the count rates associated with the remaining soil intended for re-use as backfill are relatively uniform, and below those typically associated with soil containing concentrations in excess of the DCGL.*"

For processing potential reuse soil the site utilized a "Reuse Material Screening Action Level" (a count rate) as the basis for segregation of potential reuse soil from waste material. Westinghouse at the time of submittal and approval of the DP did not specify the screening value for reuse soil within the DP or any other document.

The RSO (to support segregation of waste material from potential reuse soil material) developed the Reuse Material Screening Action Level values using sound radiological engineering practices and judgments. The method of communicating the RML to the Health Physics staff would be by the use of Form HDP-PO-HP-100-2, *HDP Effluent and Site Release Limits*.

2.2.1 History of the Determination and Use of the Reuse Material Screening Action Level

The initial generation of Reuse Stockpile 1 began in January 2012 with the processing of two truckloads of off-site borrow soil. During site operations Westinghouse had a

commitment with the NRC to fill in depressions in the overburden in the Burial Pit area caused by settling. The site maintained a stockpile of off-site borrow material to use on an as needed basis to fill the depressions. With the approval by the NRC to commence remediation of the site it was no longer necessary to fill depressions in the Burial Pit. As a matter of preparation for the start of remediation and to demonstrate that the stockpile had not been radiologically impacted while on-site it was determined that the appropriate disposition of the material would be as potential reuse soil. This activity predated the issuance of HDP-PR-HP-601, Revision 0 and establishment of the RML via Form HDP-PO-HP-100-2. To complete the processing of the two truckloads of off-site soil the RSO established a screening level of 2,000 cpm for the two truckloads of off-site soil. No other reuse soil was generated until May 2012.

By the issuance of Form HDP-PO-HP-100-2 dated March 29, 2012, the RSO authorized the use of a Reuse Material Screening Action Level of 2,000 cpm. The establishment of the RML was in anticipation of the commencement of excavation activities which first encompassed the removal of overburden soil.

HDP-PR-HP-601, *Remedial Action Support Surveys*, Revision 0 was issued on February 22, 2012, to provide direction to the HP staff for performing radiological surveys of soil and debris during excavation during remediation activities. Revision 1 to procedure HDP-PR-HP-601 was issued on April 9, 2012. This revision added a step to the procedure that the screening level for reuse soil (the RML) would be indicated on Form HDP-PO-HP-100-2.

The RSO performed an assessment of the radiological survey data from the initiation of overburden removal in March 2012 including the first week of April 2012. The RSO ascertained that the inherent fluctuations in background level readings at the surface of the overburden dictated a change to the RML. On April 10, 2012, the RSO authorized the use of a Reuse Material Screening Action Level of 4,000 cpm which addressed the inherent fluctuations in background readings while still ensuring the potential reuse soil generated would be acceptable for future backfill.

As excavation continued to the point that overburden was removed and waste was being encountered the RSO determined that it would be appropriate to elevate the RML to 12,000 cpm to adjust for the influence of contaminated waste at the surface of the excavation. On July 30, 2012, the RSO authorized the use of a Reuse Material Screening Action Level of 12,000 cpm.

By January of 2013 significant excavation work had occurred. This provided a substantial amount of potential reuse soil sample data for benchmarking the amount of potential reuse soil that was unnecessarily entering the waste stream. Based upon the RSO's assessment on January 9, 2013, the RSO authorized the use of a Reuse Material Screening Action Level of 25,000 cpm.

Effective March 27, 2013, the RSO authorized the use of a Reuse Material Screening Action Level of in the Burial Pit of 25,000 cpm and in the Reuse Soil Laydown Area of 4,000 cpm.

On April 2, 2013, the RSO authorized the use of a Reuse Material Screening Action Level of in the Burial Pit of 12,000 cpm and a Reuse Material Screening Action Level in the Reuse Soil Laydown Area of 4,000 cpm.

Although there were multiple changes in the authorized value for the Reuse Material Screening Action Level during the generation of the Reuse Stockpiles it is important to note that Reuse Stockpiles 1 through 7 were subsequently processed through the S3 Sorting System. Reuse Stockpiles 8a, and 8b were subsequently processed using Approach 1 as described in section 4.3, and Reuse Stockpile 9 was subsequently processed using Approach 3 as described in section 4.4.

3.0 REUSE SOIL CRITERIA

The objective of the reuse stockpile soil characterization is to demonstrate that the average radioactivity concentration (expressed as the sum contribution from all radionuclides) within a stockpile of soil intended for use as backfill does not exceed the DCGL that is applicable to the depth of backfill placement relative to the final grade. Placement of reuse soil and the dose summation for a survey unit as it applies to the depth of the backfill is discussed in Section 7.0 and FSSFR Volume 3, Chapter 1.

3.1 Radionuclides of Concern

FSSFR Volume 1, Chapter 1 section titled "*Radionuclides of Concern*" provides a discussion of the radionuclides of concern and the disposition of insignificant radionuclides of concern for the Hematite Site. The radionuclides of concern are listed below:

- Uranium-234 (U-234);
- Uranium-235 (U-235+D)[1];
- Uranium-238 (U-238+D)[1];
- Technetium-99 (Tc-99);
- Americium-241 (Am-241);
- Neptunium-237 (Np-237+D)[1];
- Plutonium-239/240 (Pu-239/240);
- Thorium-232 (Th-232+C)[1]; and
- Radium-226 (Ra-226+C)[1].

3.2 Derived Concentration Guideline Levels

In order to demonstrate that the site meets requirements for unrestricted site release, site-specific release criteria (Derived Concentration Guideline Levels) were developed using dose modeling for the Conceptual Site Models (CSM) described in the DP. These

[1] The nomenclature "+D" indicates that the dose contribution of the short-lived progeny are accounted for by the parent and "+C" indicates that the dose contribution of the entire decay chain (progeny) in secular equilibrium are accounted for by the parent.

DCGLs are then used as the Reuse Soil Criteria. A discussion of the development and implementation of the CSMs and DCGLs is provided in FSSFR Volume 1, Chapter 1 section titled "*Soil CSM and DCGLs*". The table below provides the Adjusted Soil $DCGL_W$s by CSM for the HDP.

Table 3-1
Adjusted Soil $DCGL_W$s by CSM[a]

Radionuclide	Three Layer Approach $DCGL_W$ Values (pCi/g)[b]			Uniform Stratum (pCi/g)
	Surface Stratum	Root Stratum	Excavation Scenario	
Radium-226+C[d]	5.0	2.1	5.4	1.9
Technetium-99	151.0	30.1	74.0	25.1
Thorium-232+C[d]	4.7	2.0	5.2	2.0
Uranium-234	508.5	235.6	872.4	195.4
Uranium-235+D[c]	102.3	64.1	208.1	51.6
Uranium-238+D[c]	297.6	183.3	551.1	168.8

[a] Table adapted from HDP-PR-FSS-701, Final Status Survey Plan Development, Appendix A.
[b] The reported $DCGL_W$s are the activities for the parent radionuclide and were calculated to account for the dose contribution from insignificant radionuclides.
[c] +D indicates the $DCGL_W$ includes short-lived (half-life ≤ 6 mo.) decay products.
[d] +C indicates the $DCGL_W$ includes all radionuclides in the associated decay chain.

3.3 Modified Investigation Level (MIL)

During the approval process for the HDP DP the NRC provided to Westinghouse RAI HDPC-14-Q3, "*Surrogate Radionuclides appears to provide an acceptable method for in inferring ROCs when U-235 is present but it is not clear how Surrogate will be determined when U-235 is not present.*" In Westinghouse letter HEM-10-80 (Reference 10.15), Westinghuse committed to the following; "*To confirm that the amount of Tc-99 as residual radioactivity is accurately quantified, HDP intends to analyze for Tc-99 in all samples taken for demonstrating compliance with the dose-based unrestricted release criteria during FSS.*" As such, in Westinghouse letter HEM-11-96 (Reference 10.16), Westinghouse indicated that DP Section 14.1.5.1.3, *Sample-Infer Tc-99*, was deleted. Westinghouse also indicated that DP Section 14.1.5.1.2, *Sample Measure-Tc-99*, would be revised to read as follows; "*When measuring Tc-99, the SOF will be calculated based on the ratio of the radioactivity concentrations (in pCi/g) of U-234, U-235, U-238, Tc-99, Ra-226 and Th-232 (Ra-226 and Th-232 will be corrected for background when calculating dose), and their respective soil DCGLw values using the following equation, based on Equation 4-3 of MARSSIM.*"

As indicated by the content of Westinghouse letter HEM-11-96 (Reference 10.16) during the NRC review of DP Chapter 14 there were no requests for additional information regarding DP section 14.3.2.3, *Survey Methodologies During Removal of Soil Intended to be Used as Backfill*, or DP Section 14.3.2.4 which states; "*For each stockpile of soil, the average concentration of the stockpile will be calculated and accounted based on a*

weighted average of each lift or container as the material is added to the stockpile. This average value will then be used to evaluate the dose impacts of using that particular stockpile of soil as backfill."

With the NRC review of the DP complete Westinghouse implemented procedure HDP-PR-FSS-710, *Final Status Survey and Radiological Sampling of Re-Use Soil*, based upon the above commitment and DP guidance in regards to Tc-99. With the commencment of remediation of the site in 2012, Westinghouse commenced the generation of re-use soil.

As generation and closeout of re-use soil stockpiles progressed Westinghouse submitted to the NRC Westinghouse letter HEM-12-162, dated December 20, 2012, *Request for NRC Review of Report HDP-RPT-FSS-101, Data Summary Report for Reuse Stockpile 2* (Reference 10.17). Westinghouse letter HEM-13-20, dated February 20, 2013, *Request for NRC Review of Reports HDP-RPT-FSS-102, Data Summary Report for Reuse Stockpile 1, and HDP-RPT-FSS-103, Data Summary Report for Reuse Stockpile 3* (Reference 10.18). Subsequently the NRC issued letters dated March 21, 2013, *U.S. Nuclear Regulatory Commission Assessment of Westinghouse Hematite's Report HDP-RPT-FSS-101, Data Summary Report for Reuse Stockpile #2* (Reference 10.19) and dated June 14, 2013, *U.S. Nuclear Regulatory Commission Assessment of Westinghouse Hematite's Report HDP-RPT-FSS-102, Data Summary Report for Reuse Stockpile 1, and HDP-RPT-FSS-103, Data Summary Report for Reuse Stockpile 3* (Reference 10.20). To summarize, the NRC states that Reuse Stockpiles 1, 2 and 3 may be utilized for backfill in an excavation as consistent with the depths and configurations approved for the applicable Uniform, Root, or Excavation DCGLs.

In June 2013, there was a discovery of a fuel pellet fragment in a Barns Area survey unit LSA 05-02 while undergoing a confirmatory survey by ORAU for the NRC (see Section 2.1.1 for description of the occurrence). Although Reuse Stockpiles 1, 2 and 3 had previously been authorized to be used as backfill, as a corrective action to the identification of fuel pellets in potential reuse soil, Westinghouse chose to further demonstrate acceptability of the reuse soil by processing these stockpiles through the ISO-Pacific S3 Soil Sorter (see Section 6.0).

After processing of Reuse Stockpiles 1, 2 and 3 through S3 Sorter, Westinghouse submitted Westinghouse letters HEM-14-92, dated Decemebr 16, 2014, *Request for NRC Review of Report HDP-RPT-FSS-106, Data Summary Report for Combined Reuse Stockpile 1-2* (Reference 10.21), and HEM-15-1, dated January 7, 2015, *Request for NRC Review of Report HDP-RPT-FSS-107, Data Summary Report for Reuse Stockpile 3* (Reerence 9.22).

During the NRC review of Combined Reuse Stockpile 1-2 and Resuse Stockpile 3 the NRC staff determined that the previous approach to demonstrate acceptability of resue soil was not adequate to account for potential hot spots of "hard to detect" Tc-99. As stated during Public Teleconferences, "The current NRC position on usage of composite samples when no surrogate is available is to demonstrate compliance with radiological release criteria is to use MILs for comparison."

The NRC then provided to Westinghouse three potential paths forward to address the issue;

"*1) WEC could only place re-use soils in a layer where the results (using the MIL for Tc-99) are below the associated DCGL. In other words, the current re-use piles (Combined 1 & 2, and 3) would not be acceptable per the uniform DCGL model. They may be acceptable for surface or deep (excavation DCGL) layers.*

2) WEC could rely on mixing of soils to physically dilute the hot spots. Mixing was not approved in their DP, nor mentioned in their DP, and WEC asserts that the mixing is not intentional. Regardless of the original intent, if WEC wishes to rely on mixing to meet a lower DCGL, it seems appropriate that they follow the current guidance in NUREG-1757, Vol l, Section 15.13, with regard to intentional mixing to meet the LTR.

3) WEC could evaluate potential hot spots on a per truckload bases and account for the contribution of that dose in the survey unit where the affected re-use soils are ultimately placed."

Westinghouse performed an assessment of the potential paths forward and conlcuded that the optimal path forward of the three options was to place soil in a layer where the MIL for Tc-99 is below the associate DCGL.

During the discussions with the NRC it was determined that the MIL is to be applied when aliquots are collected to form a composite sample. The MIL is derived by dividing the DCGLw of 25.1 pCi/g for Tc-99 by the number of aliquots (4) that were collected from each truckload of reuse material consigned to each stockpile. This resolved the issue of potential Tc-99 hot spots and provided a path forward for placement of the reuse soil as backfill.

In September 2015, during the review of HDP-RPT-FSS-109, Data Summary Report for Combined Reuse Stockpile 4-7, the NRC conveyed an additional current position, that "*All radionuclides of concern, when assessed via composite sampling, should typically have an associated MIL to identify a DCGL hot spot of concern unless other surveys are used. It is understood that the gamma walkover surveys and ISO-Pacific Soil Screening are intended to identify locations that could present a DCGL hot spot concern for all radionuclides of concern except for Tc-99.*"

As it is understood that gamma walkover surveys and ISO-Pacific Soil Screening were utilized to identify locations that could present a DCGL hot spot concern for all of the HDP radionuclides of concern except Tc-99, the MIL evaluation is therefore confined to Tc-99. The table below provides the Tc-99 MIL for the HDP.

Table 3-2
HDP Tc-99 MIL by CSM

CSM	Tc-99 DCGLw (pCi/g)	4 aliquot Tc-99 MIL (pCi/g)
Uniform	25.1	6.3
Surface	151.0	37.8
Root	30.1	7.5
Excavation	74.0	18.5

3.4 Weighted Average Calculation

When performing weighted average calculations the following formula is utilized;

$$\textit{Individual Weighted SOF} = ((\textit{Net Individual Truckload Weight})/(\textit{Total Combined Stockpile Weight})) \times \textit{Total \# of Truckloads in Stockpile} \times \textit{Individual Truckload SOF}$$

$$\textit{Stockpile Weighted Average SOF} = \textit{Average of all Individual Weighted SOF results}$$

Equation 3-1

The weighted average SOF (considering the net weight of each truckload of soil) was provided in the HDP DP in an effort to ensure that the average SOF for the stockpile of soil is not skewed low or high by abnormally light or heavy individual truckloads of soil. However upon final review of the reuse stockpile data sets it is apparent that the weighted average SOF, and the un-weighted arethemetic average for all of the reuse soil stockpiles is the same. The weighting of individual truckloads had no effect on the overall average result of the SOF for each stockpile.

Furthermore, discussions with NRC Headquarters reviewers revealed that the NRC may not consider the weighted average SOF to be the most appropriate measure of the overall acceptability of the soil stockpile for on-site reuse backfill. For this reason, both the weighted (as required by the HDP DP) and un-weighted (as indicated by NRC review) SOF results will be reported for each reuse stockpile.

3.5 Data Presentation

To demonstrate reuse soil has met the reuse soil criteria, data within a resuse stockpile report will be presented as follows:

- Data population (total # of samples)
- Mean SOF (unweighted)

- Mean SOF (weighted)
- Mean Upper Confidence Interval (95th percentile)
- Median SOF (weighted)
- Maximum SOF (unweighted)
- Maximum SOF (weighted)
- Standard Deviation of data set

Additionally, statistical data will be presented as a histogram and line plot of the SOF for the data population comprising each Reuse Soil Stockpile including an evaluation to determine if the data follows a discernible distribution (e.g., a normal distribution at the 95% confidence level).

4.0 SURVEY METHODOLOGY GENERAL DESCRIPTION

The DP Section 14.3.2.3, "*Survey Methodologies during Removal of Soil Intended to Be Used as Backfill*", provides the approved methodologies for surveying potential reuse soil. There were two proposed methodologies provided in DP Chapter 14; 1) survey methodologies utilizing high resolution gamma spectroscopy, and 2) survey methodologies when high resolution gamma spectroscopy is not utilized.

HDP Procedure HDP-PR-FSS-710, *Final Status Survey and Radiological Sampling of Reuse Soil*, implements the DP criteria for guidance during field survey activities as Approach 1 (Approach 1 of the DP); Approach 2 and Approach 3 (Approach 2 of the DP). Approach 1 was used when the box counter (or equivalent) was utilized. Approaches 2 and 3 were used when the box counter was not used, or the box counter did not have adequate sensitivity such that the Minimum Detectable Concentration (MDC) was greater than the applicable DCGLw.

In general, candidate soil for reuse was initially identified based on field measurements of gamma radiation level and then processed by the selected approach. Candidate soil acceptability was then confirmed through subsequent sampling and laboratory analysis.

Also, as described in section 6.0, in November 2013, HDP engaged the services of an ISO-Pacific Nuclear Assay Systems S3 Soil Sorting System. To ensure that the survey methodology accounted for identification of discrete hot spots after the soil sorting system was demobilized, the HDP implemented additional risk based screening criteria to the survey methodology for the stockpiles generated after soil sorting operations. The following steps summarize the three approaches for the stockpiles prior to soil sorting operations and post soil sorting operations:

4.1 Survey Methodology for Reuse Stockpiles 1 through 4 and Reuse Stockpile 7

Approach 1 was the survey methodology used for demonstrating compliance for Reuse Stockpiles 1 through 4 and Reuse Stockpile 7.

Approach 1 Utilizing the box counter (or equivalent)

- Prior to excavation, areas to be excavated were surveyed by GWS in accordance with HDP-PR-HP-601. Areas of potential reuse soil as indicated by the GWS as areas of soil less than the RML were identified. Areas that were to be segregated from the potential reuse soil were marked by the use of green paint to indicate that area was not potential reuse soil. Also, any area less than the RML but exhibiting visual indication of debris was also marked with green paint and no longer considered potential reuse soil.
- The soil was then removed to the intended cut depth and loaded into a truck to be assessed with the gamma spectroscopy box counter system (or equivalent) that achieves an MDC that is less than the Uniform DCGL. Any truckload that exceeded the Uniform DCGL was rejected, and the truckload was sent to the Waste Holding Area (WHA) for waste processing and disposal.
- Soil that indicated less than the Uniform DCGL was dumped and spread out at the material lay down area and a GWS was performed on the surface of the pile. The GWS was conducted to identify locations of elevated count rate that exceed the RML and that required removal and disposition as waste. The gamma scan also served to demonstrate that the radioactivity in the truckload of spread-out soil was uniformly distributed.
- Following the scan survey, a composite sample, consisting of four aliquots collected at random, was obtained and submitted for laboratory analysis. The soil was then pushed into a pile and kept separate from the larger stockpile until the results of the laboratory analysis was received and reviewed.
- Dependent on the results of the laboratory analysis of the composite sample, if acceptable the soil pile was then consolidated into the appropriate stockpile. If not acceptable the soil pile was diverted to waste disposal.
- Subsequently, the stockpiles were then processed through the S3 Soil Sorter as described in section 6.0. Failed soil was transferred to the WHA for disposal. Soil that successfully passed was stockpiled for reuse as either Combined Reuse Stockpile 1-2, Reuse Stockpile 3, or Combined Reuse Stockpile 4-7.

4.2 Survey Methodology for Reuse Stockpile 5 and Reuse Stockpile 6

Approach 3 was the survey methodology used for demonstrating compliance for Reuse Stockpile 5 and Reuse Stockpile 6 as follows:

Approach 3 Survey Methodologies When HRGS Is Not Utilized

- Reuse Stockpile 5 and Reuse Stockpile 6 were processed through the box counter with the expectation to process the potential reuse soil utilizing Approach 1, see the discussion in Section 2.1.1 and Section 4.5. Any truckload that exceeded the Uniform DCGL was rejected, and the truckload was sent to the WHA for waste processing and disposal.

- Upon the determination to utilize Approach 3 the excavated potential reuse soil was dumped and spread out at the material lay down area in an even layer to allow the surface of the pile to be surveyed in approximate 6 inch lifts. A 100% GWS was performed on the surface of the spread out soil pile. The gamma scan was conducted to identify locations of elevated count rate that exceed the RML that required removal and disposition as waste. The gamma scan also served to demonstrate that the radioactivity in the spread out soil was uniformly distributed.
- A FSS survey was then designed in accordance with HDP-PR-FSS-701. FSS was conducted on the lift of soil which included a 100% GWS, collection and laboratory analysis of 14 systematic samples, including at least 5% quality control (QC) duplicate.
- Each lift generated from the total stockpile volume was considered a separate survey unit pursuant to the GWS and sampling requirements. After each lift of soil was determined to meet the FSS requirements for reuse as backfill, it was added to the stockpile.
- Subsequently, the stockpiles were then processed through the S3 Soil Sorter as described in section 6.0. Failed soil was transferred to the WHA for disposal. Soil that successfully passed was stockpiled for reuse as Combined Reuse Stockpile 5-6.

4.3 Survey Methodology for Reuse Stockpiles 8a and 8b

Approach 1 was the survey methodology used for demonstrating compliance for Reuse Stockpiles 8a and 8b as follows:

Approach 1 Utilizing the box counter (or equivalent)

- Prior to excavation, areas to be excavated were surveyed by GWS in accordance with HDP-PR-HP-601. Areas of potential reuse soil as indicated by the GWS as areas of soil less than the RML were identified. Areas that were to be segregated from the potential reuse soil were marked by the use of green paint to indicate that area was not potential reuse soil. Also, any area less than the RML but exhibiting visual indication of debris was also marked with green paint and no longer considered potential reuse soil.
- The soil was then removed to the intended cut depth and transferred to the box counter or placed in the required geometry and assayed in place by the ISOCS Gamma Spectroscopy System. The box counter and the ISOCS system achieve an MDC that is less than the Uniform $DCGL_W$. Both the box counter and the ISOCS were utilized to process Reuse Stockpile 8a. The box counter was utilized up until such time that it was demobilized from the site. At that time ISOCS was used for the remainder of Stockpile 8a. Reuse Stockpile 8b was generated and processed after the box counter was demobilized. Therefore, only the ISOCS Gamma Spectroscopy System was used to process Reuse Stockpile 8b.

Regardless of the use of the box counter or the ISOCS the volume of soil counted was a truckload of soil.

- Soil was dumped at the material lay down area and spread out. A gamma scan was performed on the surface of the spread out pile to identify locations of elevated count rate for subsequent removal.
- Following the scan survey, a composite sample, consisting of four or more aliquots was collected at random location and submitted for laboratory analysis. The soil piles remained separate from each other until the laboratory analysis results were received.
- Dependent on the results of the laboratory analysis of the composite sample, the pile was either was rejected, and the soil pile was sent to the WHA for waste processing and disposal, or if accepted the soil pile was then consolidated within the appropriate stockpile.
- The soil stockpiles were then subject to a GWS of every 3 inch layer of soil generated from High and Medium Potential areas, and of every 6 inch layer of soil generated from Low Potential areas. Any soil exceeding the RML of 4,000 ncpm above background was removed for disposal, and all soil less than the RML was consigned for reuse.

4.4 Survey Methodology for Reuse Stockpile 9

As described in section 4.1, Approach 1 was the initial survey methodology used for the soils that combined to make up Reuse Stockpile 9. As Reuse Stockpile 9 consisted solely of the "leftover" soil from Reuse Stockpiles 1 through 7 that followed the survey methodology of Approach 1, but was not processed through the ISO-Pacific Nuclear Assay Systems S3 soil sorting system, the survey methodology utilized to demonstrate compliance was to perform a FSS of the stockpile soil following Approach 3.

4.5 Individual Reuse Stockpile Survey Methodology Description

4.5.1 Stockpile 1-2

The box counter was utilized for all truckloads of soil added to both Reuse Stockpile 1 and Reuse Stockpile 2. Therefore, Approach 1 discussed above in section 4.1 was applied. In summary, this approach provided for: (1) a 100% GWS of the surface prior to excavation at 3 inches above the surface, including marking for removal sections which exceeded the GWS action level; (2) bulk analysis of the entire volume of soil intended for reuse as backfill by the box counter; and (3) laboratory analysis of composite soil samples collected at random as the stockpile was accumulated.

In addition to the surveys described above, most of the reuse soil in Reuse Stockpile 1 and Reuse Stockpile 2 was processed through the S3 soil sorter. The small portion of Reuse Stockpile 1 and Reuse Stockpile 2 soil that was not processed through the S3 soil sorter was added to the "leftover" soil stockpile, Reuse Stockpile 9. It is noted that

subsequent to the initial NRC approval of Reuse Stockpile 2, but prior to the discovery of the fuel pellet that prompted the corrective actions, one truck load of soil from Reuse Stockpile 2 was placed as backfill into the Tile Barn excavation area (LSA 05-02). This soil was spread out in an approximate 6 inch layer and a GWS was conducted on the truck load of soil before it was covered by off-site backfill soil. This volume of soil from Reuse Stockpile 2 and its dose consequence to the survey unit will be addressed in the Volume 3 FSS Survey Area Release Record for the survey unit.

The combined mass of the Reuse Stockpile 1 and Reuse Stockpile 2 was approximately 10,305 tons, or approximately 8,000 cubic yards (cyd), prior to soil sorting operations. Of the 10,305 tons of soil, approximately 83.2 tons of soil from Reuse Stockpile 1 and Reuse Stockpile 2 were diverted for disposition to the waste stream and disposed of offsite. Processing through the S3 resulted in approximately 99% of the soil fed into the S3 from Reuse Stockpile 1 and Reuse Stockpile 2 being assayed below the pre-determined diversion gate action level. The total clean-side throughput of the S3 from Reuse Stockpile 1 and Reuse Stockpile 2 soil volume was consolidated into a new stockpile identified as Combined Reuse Stockpile 1-2. The volume of Reuse Stockpile 1 and Reuse Stockpile 2 that was not processed through the S3 and that was diverted to Reuse Stockpile 9 for future survey is estimated to be approximately 1,043 cyd.

4.5.2 Stockpile 3

The box counter was utilized for all truckloads of soil added to the original Reuse Stockpile 3. Therefore, Approach 1 discussed above in section 4.1 was applied. In summary, this approach provided for: (1) a 100% GWS of the surface prior to excavation at 3 inches above the surface, including marking for removal sections which exceeded the GWS action level; (2) bulk analysis of the entire volume of soil intended for reuse as backfill by the box counter; and (3) laboratory analysis of composite soil samples collected at random as the stockpile was accumulated.

In addition to the surveys described above, most of the soil in Reuse Stockpile 3 was processed through the S3 soil sorter. The small portion of Stockpile 3 soil that was not processed through the soil sorter was added to the "leftover" soil stockpile, Reuse Stockpile 9.

The soil mass of Reuse Stockpile 3 was approximately 4,705 tons (approximately 3,500 cyd) prior to sorting. During soil sorting operations, approximately 24.9 tons (approximately 19 cyd) of soil from Reuse Stockpile 3 was diverted for disposition to the waste stream and disposed of offsite. Processing through the S3 resulted in more than 99% of soil fed into the S3 from Reuse Stockpile 3 being assayed below the pre-determined diversion gate action level. The total clean-side throughput of the S3 from Reuse Stockpile 3 soil volume was placed into its own stockpile pile in a new location. This processed soil was not combined with any other stockpile soils. The stockpile continued to be designated as Reuse Stockpile 3. The volume of Reuse Stockpile 3 that was not processed through the S3 and that was diverted to Reuse Stockpile 9 for future survey was estimated to be approximately 236 cyd.

4.5.3 Stockpile 4-7

The box counter was utilized for all truckloads of soil added to both Reuse Stockpile 4 and Reuse Stockpile 7. Therefore, Approach 1 as discussed above in section 4.1 was applied. In summary, this approach provided for: (1) a 100% GWS of the surface prior to excavation at 3 inches above the surface, including marking for removal sections which exceeded the GWS action level; (2) bulk analysis of the entire volume of soil intended for reuse as backfill by the box counter; and (3) laboratory analysis of composite soil samples collected at random as the stockpile was accumulated.

In addition to the surveys described above, most of the reuse soil in Reuse Stockpile 4 and Reuse Stockpile 7 was processed through the S3 soil sorter. The small portion of Reuse Stockpile 4 and Reuse Stockpile 7 soil that was not processed through the S3 soil sorter was added to the "leftover" soil stockpile, Reuse Stockpile 9.

The combined mass of the Reuse Stockpile 4 and Reuse Stockpile 7 was approximately 9,123 tons, or approximately 7,000 cubic yards (cyd), prior to soil sorting operations. Of the 9,123 tons of soil approximately 39 tons of soil from Reuse Stockpile 4 and Reuse Stockpile 7 were diverted for disposition to the waste stream and disposed of offsite. Processing through the S3 resulted in approximately 99% of soil fed into the S3 from Reuse Stockpile 4 and Reuse Stockpile 7 being assayed below the pre-determined diversion gate action level. The total clean-side throughput of the S3 from Reuse Stockpile 4 and Reuse Stockpile 7 soil volume was consolidated into a new stockpile identified as Combined Reuse Stockpile 4-7. The volume of Reuse Stockpile 4 and Reuse Stockpile 7 not processed through the S3 was diverted to Reuse Stockpile 9 for future survey was estimated to be approximately 1,091 cyd.

4.5.4 Stockpile 5-6

The box counter was utilized for all truckloads of soil added to both Reuse Stockpile 5 and Reuse Stockpile 6. However, since the soil was not completely evaluated by GWS prior to excavation, Approach 3 as discussed above in section 4.2 was applied. In summary, this approach provided for: (1) a 100% GWS of the surface of the spread out soil pile after excavation, including marking for removal sections which exceeded the GWS action level; (2) bulk analysis of the entire volume of soil intended for reuse as backfill by the box counter; and (3) laboratory analysis of soil samples collected as the stockpile was accumulated.

The combined mass of the Reuse Stockpile 5 and Reuse Stockpile 6 was approximately 1,150 tons or approximately 1,500 cyd prior to soil sorting operations. Of the 1,150 tons of soil approximately 10 tons of soil from Reuse Stockpile 5 and Reuse Stockpile 6 were diverted for disposition to the waste stream and disposed of offsite. With the entire mass of both Reuse Stockpile 5 and Reuse Stockpile 6 soils processed through the S3, more than 99% of this total combined quantity of soil was assayed below the pre-determined diversion gate action level. The total clean-side throughput of the S3 from Reuse Stockpile 5 and Reuse Stockpile 6 soil volume was consolidated into a new stockpile identified as Combined Reuse Stockpile 5-6.

4.5.5 Stockpile 8a

Because soil comprising Reuse Stockpile 8a came from the Burial Pits Area, Process Building (sub-slab) Area, and the Evaporation Pond Area, the potential for a discrete item being identified varied. Approach 1 as discussed above in section 4.2 was applied. In summary, this approach provided for: (1) a 100% GWS of the surface prior to excavation as close to the surface as possible but not to exceed 3 inches, including marking for removal sections which exceeded the GWS action level; (2) bulk analysis of the entire volume of soil intended for reuse as backfill by the box counter or ISOCS Gamma Spectroscopy System (3) a secondary GWS of spread out soil in a designated Lay-down Area; (4) laboratory analysis of composite soil samples collected at random from each truckload as the stockpile was accumulated; and (5) to perform an equivalent survey to the ISO Pacific S3 process the final stockpiles were then subjected to walkover surveys with the exposed lens removed from the stockpile in nominal 3 inch layers for materials that were excavated within high and medium potential areas, and 6 inch layers for materials that were excavated from low potential areas once the walkover surveys were completed and any areas of elevated activity removed or sampled. This process was adequate to demonstrate the acceptability of this soil for reuse as backfill without the added use of the S3 system. The soil mass of reuse Stockpile 8a was approximately 5,164 tons (or about 4,500 cyd).

4.5.6 Stockpile 8b

Because the soil comprising reuse Stockpile 8b came from an area of the site where no historic operations or decommissioning activities may have impacted the area, the potential for an errant fuel pellet to be found was very remote. Approach 1 was performed in accordance with procedures of: (1) a 100% GWS of the surface prior to excavation, including marking for removal sections which exceeded the GWS action level; (2) after excavation, a bulk analysis of the entire volume of soil intended for reuse as backfill by gamma spectroscopy; (3) a secondary GWS of spread out soil in a designated Lay-down Area; (4) laboratory analysis of composite soil samples collected at random as the stockpile was accumulated; and (5) to perform an equivalent survey to the ISO Pacific S3 process the final stockpiles were then subjected to walkover surveys with the exposed lens removed from the stockpile in nominal 6 inch layers for materials once the walkover surveys were completed and any areas of elevated activity removed or sampled. This process was adequate to demonstrate the acceptability of this soil for reuse as backfill without the added use of the S3 system. The soil mass of reuse Stockpile 8b was approximately 1,800 tons (or about 1,569 cyd).

4.5.7 Stockpile 9

As previously discussed, all of the soil that was designated as "left overs" during the ISO Pacific S3 sorting operation that comprises Reuse Stockpile 9 was originally processed using Approach 1. To complete the process to evaluate this soil for discrete items such as fuel pellet fragments and demonstrate acceptability as reuse soil, a Final Status Survey is was performed on Reuse Stockpile 9.

For Reuse Stockpile 9 an FSS design is documented using HDP-PR-FSS-701, with the scan surveys being performed on each 3 inch layer of soil for the purposes of identifying discrete high activity items such as fuel pellets. As summary of the FSS design is as follows; (1) the top layer of soil of the stockpile from 0-6 inches depth is sampled systematically as designed by the FSS Plan; (2) then the top 3 inch layer of the stockpile is surveyed and any areas of elevated activity were removed, then Operations removes the 3 inch layer for survey of the subsequent layer; (3) the next 3 inch layer of the stockpile is surveyed and any areas of elevated activity removed, then Operations removes the 3 inch layer for sampling and survey of the subsequent layer; This process is repeated for each layer of Reuse Stockpile 9 and is adequate to demonstrate the acceptability of this soil for reuse as backfill without the added use of the S3 system. The final volume will be provided in the Volume 2 Chapter 7 report for Reuse Stockpile 9.

4.6 Minimum Detectable Concentration (MDC)

The MDC applicable to Stockpiles 1 through 7 is detailed in HDP-TBD-HP-406, *Preliminary Evaluation and Test Plan for ISO 3 for Assaying and Segregating Soil at HDP that is Potentially Contaminated with Uranium*, with a scan MDC of 46% of the Uniform DCGL. HDP-TBD-HP-406 is provided in Appendix B.

The scan MDCs applicable to Stockpiles 8 and 9 is detailed in HDP-TBD-FSS-002, *Evaluation and Documentation of the Scanning Minimum Detectable Concentrations (MDC) for Final Status Surveys (FSS)*, with a scan MDC less than all the DCGLs other than the total Uranium value for inferred Tc-99 within the Tc-99 SEA. HDP-TBD-FSS-002 is provided in Appendix C.

4.7 Reuse Soil Sampling

Standard industry protocols are used for reuse soil sampling and provided in the applicable procedure. In general;

- Equipment and supplies (such as hand spades, augers, sample containers) are obtained.
- The number of samples to be taken and the locations are determined by following the applicable procedure.
- Appropriate radiological and contamination controls are utilized during the sampling process.
- The soil samples are placed in the sample containers.
- The soil sample information (date, time, location, sample ID, initials of sampling person) is documented and the sample is controlled utilizing the chain of custody process.
- The soil samples are transferred to the designated laboratory for analysis.

4.7.1 Reuse Soil Sampling Approach 1

For reuse soil sample collection when using Approach 1 as provided in HDP-PR-FSS-710, *Final Status Surveys and Radiological Sampling of Re-Use Soil*, after each truck load of potential reuse soil was assessed utilizing a box counter it was dumped and spread out in a laydown area in an approximate 6 inch lift for radiological survey. Following the

guidance of HDP-PR-FSS-710, four (or more) random aliquots are then collected and composited as described in Section 4.7.

4.7.2 Reuse Soil Sampling Approach 2 and Approach 3

For reuse soil sample collection when using Approach 2 and Approach 3 as provided in HDP-PR-FSS-701, the procedure directs that sample locations are determined by performing a FSS survey design in accordance with HDP-PR-FSS-701, *Final Status Survey Plan Development.*

5.0 QUALITY CONTROL

5.1 Selection and Training of Personnel

A description of the HDP Staff Organization and training of FSS personnel is provided in FSSFR Volume 1, Chapter section titles "*HDP Staff Organization*" and "*FSS Organization.*"

Health Physics personnel who perform FSS tasks meet the qualifications listed for Health Physics Technician Training and have received training and instruction commensurate with their duties. The RSO has approved all FSS personnel to perform work associated with their individual roles and responsibilities. Training records are documented in accordance with site requirements.

ISO-Pacific personnel, however, were not required to be trained to the existing HDP FSS procedures in effect during the time frame of soil sorting operation as their responsibilities were confined to the operation of the ISO-Pacific S3 Soil Sorting System.

Health Physics Technician Training materials and records are available for inspection. NRC Inspection Report 07000036/2015001 {ML15118A946} provides the most recent NRC inspection activities related to FSS Program training.

5.2 Instrumentation Operation and Daily Quality Control Checks

The instruments used for survey of reuse soil are operated in accordance with procedure HDP-PR-HP-416, *Operation of the Ludlum 2221 for Final Status Survey.* Prior to and after use, a daily source check is performed to verify instrument response is within ±20% of the calculated mean based on the initial set-up of the instrument per HDP-PR-HP-411, *Radiological Instrumentation.* All Quality Control (QC) check logs are reviewed for the appropriate dates and verified to have been both pre- and post-checked in accordance with the procedure with no discrepancies noted. All meters used are verified to be within their valid calibration date range.

5.3 Laboratory Quality Control Measurements

Duplicate samples are to be collected at a 5% frequency in accordance with HDP-PR-FSS-703, *Final Status Survey Quality Control*. Duplicate samples were evaluated per subsection 7.4.1.1 of the *Multi-Agency Radiological Laboratory Analytical Protocols, NUREG-1576*, using the following equations:

If $\bar{x} <$ DCGL:

Statistic: $|x_1 - x_2|$

Warning limit: 0.1415 (DCGL)
Control limit: 0.2120 (DCGL)

Equation 5-1

If $\bar{x} \geq$ DCGL:

Statistic: $RPD(\%) = \frac{|x_1 - x_2|}{\bar{x}}(100\%)$

Equation 5-2

Warning limit: 14.15%
Control limit: 21.20%
where:

x_1 = activity of sample
x_2 = activity of field duplicate sample
$\bar{x}$ = average activity
RPD = Relative Percent Difference

5.4 Data Quality Assessment

Sample results for the reuse soil data summary reports are independently reviewed and validated in accordance with HDP-PR-FSS-721, *Final Status Survey Data Evaluation.* Results with a Sum-Of-Fractions value greater than 1 when compared to the ***Uniform*** DCGL are then compared to the ***Root*** and ***Excavation*** DCGL values in accordance with Section 14.3.2.4 of the DP.

The following outcomes are reviewed to determine if the reuse soil stockpile is indicative of fairly homogeneous soils and a consistent implementation of the survey and sampling methodology required by FSS procedure HDP-PR-FSS-710, *Final Status Survey and Radiological Sampling of Reuse Soil* and the DP was performed:

- All samples sent for analysis at the approved off-site laboratory (TestAmerica) were tracked on a chain of custody form in accordance with HDP-PR-QA-006, *Chain of Custody.*

- Samples were collected at random locations and gamma scan surveys were performed in accordance with procedure HDP-PR-FSS-710, *Final Status Survey and Radiological Sampling of Reuse Soil.*
- Duplicate samples were collected in accordance with HDP-PR-FSS-703, *Final Status Survey Quality Control.* QC Sample Results were verified to meet the acceptance criteria as specified in HDP-PR-FSS-703, *Final Status Survey Quality Control.*
- Field and laboratory instruments were capable of detecting activity at an MDC less than the appropriate investigation level and were verified to be operable prior to and after use in accordance with HDP-PR-HP-416, *Operation of the Ludlum 2221 for Final Status Survey.*

5.5 Isolation and Control of Reuse Soil Stockpiles

An important aspect of preserving the data quality of a reuse soil stockpile is the isolation and control of the soil within a given reuse soil stockpile. For this reason DP Chapter 8 described a process approach that incorporated isolation and control throughout the process of determining the acceptability of potential reuse soil as follows:

- The excavation area is such that it provides sufficient space for heavy equipment to operate and maximizes the ability to segregate the potential re-use soil from the waste, thus discouraging cross-contamination.
- Potential reuse soil is transferred from the excavation area for further radiological assessment.
- If the potential reuse soil is determined to be acceptable as reuse soil it is transferred to a designated laydown area away from remediation activities.
- Once in the designated laydown area FSS isolation and control is implemented.

5.5.1 NRC Issuance of Non-Cited Violation for Isolation and Control of Reuse Stockpiles

During the generation and processing of reuse soil the NRC issued one Non-Cited Violation in regards to the isolation and control of reuse soil stockpiles.

As noted in NRC Inspection Report 07000036/2013002(DNMS) {ML13241A252} on June 4, 2013, the NRC Inspector noted that the site established a lay down area for placement of the reuse soil stockpile. At the time of the inspection there were four soil reuse piles present in the Reuse Soil Laydown Area with an adequate separation distance between the stockpiles to ensure the soil in each pile did not mix with another. The site staff had been processing reuse soil for transfer into the lay down area in a stockpile that was still open to receipt of additional soil. The inspector noted that the soil for this open reuse stockpile was being laid down in very close relation to the already completed Reuse Stockpile 1 and Reuse Stockpile 3. After that soil was laid down, it was transported to the reuse pile open to receiving additional soil.

After all of the new soil had been transported to the open stockpile (Reuse Stockpile 3), the Inspector observed remnants of the soil that was just laid down near Reuse

Stockpile 1 was comingling with Reuse Stockpile 1 contents. In addition, the Inspector observed that there were no signs, postings, or physical barriers controlling access or isolating Reuse Stockpile 1 and Reuse Stockpile 3 that would ensure that cross-contamination would not occur with the material that had already been processed. The NRC noted that as Reuse Stockpile 1 was already completed and the final contents analyzed for how it would be used as backfill, any additional material comingling with their current content could potentially affect where the material could be used and invalidate the analysis. As a result, the NRC issued a Severity Level IV Non-Cited Violation.

As indicated in the Inspection Report "*The licensee entered this issue into the corrective action program (Issue Report #13-155-W009) and took immediate actions to implement isolation and control measures for reuse piles 1 and 3 that consisted of posted signs and orange snow fencing around both piles. In addition, the licensee remediated the areas of reuse pile 1 that had become cross-contaminated and performed surveys in the general area to ensure the remaining soils did not contain any residual cross contamination.*"

There have been no identified issues relevant to the isolation and control of Reuse Stockpiles since the time of implementation of the corrective actions as stated above.

5.6 Survey Records and Documentation

All sample results that have been independently reviewed are recorded and stored in accordance with procedure HDP-PR-FSS-721 (*Final Status Survey Data Evaluation*). All results from samples associated with reuse stockpiles are loaded into the Hematite FSS database and verified to be in units of picocuries per gram (pCi/g) consistent with the units used for the site DCGL values to which they were compared.

6.0 ISO-PACIFIC S3 SOIL SORTING SYSTEM OPERATIONS

As described in section 2.1.1, to address the issue of identification of fuel pellet fragments in reuse soil Westinghouse evaluated options to address the issue and selected the ISO-Pacific S3 Soil Sorting System.

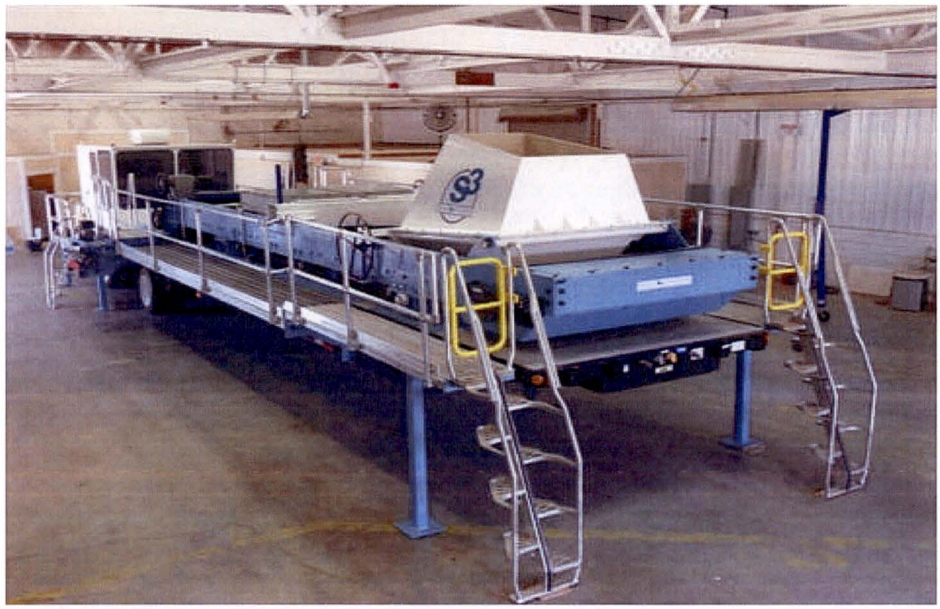
The evaluation determined that S3 offered a number of advantages which complemented the HDP FSS *in situ* gamma walkover scanning requirements for reuse soils, as follows:

- Soil is conveyed below an eleven detector array, in a thin layer whose depth and density can be matched to the photon emission and attenuation characteristics of the radionuclides of concern (U, Th and Ra) for HDP. Below the conveyor belt and directly under the detector array there is a large flat plate "shadow" shield which aids in attenuating any photon emissions reaching the detectors from the ground below the S3. Therefore there are no "estimates" of attenuated subgrade activity that could not be seen as with *in-situ* walkover scanning surveys.
- The height from the soil surface to the S3 detector face was typically less than 4 inches from the soil. Additionally, the detector array above the soil layer has fine adjustment capabilities. This allows the detector array to be set at the optimum height for the best field of view.

- The S3 Soil Sorting System operates as the Ideal Observer. Ideal Observer meaning the S3 provides a 100% surveyor efficiency factor as it relates to scan MDC estimates.
- HDP data validation requirements would be met by the detection system as it is automatically performed via software algorithms. Human errors and bias are removed from the equation.
- The S3 Soil Sorting System operates such that it meets the HDP DP Scan MDC requirements as stated in DP 14.4.4.2.9. This provides a high level of confidence that all areas of elevated activity are identified and the soil containing the elevated activity is rejected.

Upon completion of the evaluation Westinghouse directed ISO-Pacific to mobilize the S3 Soil Sorting System in order to screen the accumulated soils from the seven initial reuse stockpiles. The S3 system used at HDP was designed as a mobile, trailer mounted configuration (see below).

Figure 6-1
Trailer-Mounted S3 Soil Sorting System



Prior to commencement of soil sorting operations, the S3 system was initialized and calibrated in accordance with the procedures required in *ISO-01 "Hematite Calibration Procedure" November 2013, ISO-Pacific*. All equipment calibrations were performed using National Institute of Standards and Technology traceable reference radionuclide standards.

The HDP Radiation Safety Officer issued HDP-TBD-HP-406, *Preliminary Evaluation and Test Plan for ISO 3 for Assaying and Segregating Soil at HDP that is Potentially*

Contaminated with Uranium, which established the technical requirements (data quality objectives) for this system. The technical requirements include the ability to detect uniformly contaminated soil at 50% of the excavation scenario DCGL (a concentration of 15.5 pCi/g of U-235 or 57.7 pCi/g of U-238 based on 4 weight percent U-235); 4 weight percent is based on the site average documented in the DP); and that the system had to have the capability to detect a pellet fragment of uranium containing 0.1 gram (0.21 μCi) of U-235 at 4% enrichment. Such a fragment would also contain about 0.8 μCi of U-238.

The initial action level established for setup, calibration, and pre-operational quality checks for the S3 was set at 96 becquerels per kilogram. Background and pellet fragment testing was conducted between November 11 and November 14, 2013. Based upon the results of the setup, calibration and pre-operational quality checks on November 5, 2013, the initial action level for the S3 operation was set at 157 becquerels per kilogram (Bq/kg) (4.2 picocuries per gram (pCi/g)) total net activity.

At the direction of the NRC, Oak Ridge Associated Universities (ORAU) observed the initial setup and trial run of the S3 in November 2013. As stated in ORAU Report *5184-SR-02-0* {ML14036A282} states; "*The evaluation of the ISO-PACIFIC Soil Sorter System (S3) indicated that in its current configuration and operational set points, that the system was very conservative and diverted all contaminated soil and a substantial amount of "clean" soil*".

The site began S3 soil sorting operations on November 15, 2013. After four weeks of operation, a technical review of the sorting metrics was performed due to the high volume of material being diverted to the waste stream. The review found that approximately 60% of the diversions occurred at activity concentrations less than 175 Bq/kg (4.7 pCi/g). A concentration less than 190 Bq/kg (5.1 pCi/g) was previously determined to be the worst case geometry scan minimum detectable activity (MDA) for a 0.19 μCi U-235 discrete item (pellet fragment). The results of the technical review were documented in Westinghouse memorandum HEM-13-MEMO-102, *Evaluation of the ISO-Pacific S3 Soil Sorting System*. In addition to evaluating the action level set point, "covered pellet" testing in numerous geometries was performed to verify that the action level increase would maintain the same level of confidence and that the S3 would reject a fuel pellet with a minimum activity of 0.19 μCi. As a result of the technical evaluation the action level was raised to 175 Bq/kg.

NRC Region III, during onsite inspection activities reviewed the technical evaluation documented in HEM-13-MEMO-102 to raise the S3 action level. NRC Inspection Report 07000036/2014001 {ML14084A566} provides the following discussion in regards to raising the S3 action level; "*The licensee, in response to the substantial amount of "clean" soil that was being rejected, revised their evaluation of the soil sorting system and changed the alarm set point to a less conservative value. The inspectors noted during the review of the revised evaluation that the licensee had adequately justified the new alarm set point using both analytical and new test data. It would still ensure discrete material (fuel pellets) and localized areas of contamination would be appropriately rejected to the "dirty" pile.*"

Soil sorting operations concluded on March 16, 2014, and the S3 soil sorting system was demobilized.

7.0 MANAGEMENT OF REUSE SOIL USED AS BACKFILL

There are two categories of soil used to backfill excavations and complete final grade contouring of the site. The primary type and source of soil used is Off-site Borrow as discussed in Section 8.0. The second type and source is reuse soil which is soil that has been determined to have met the unrestricted release criteria. As off-site borrow material has been determined to contain no radiological contamination there is no restriction on placement of this material.

Although the reuse soil generated on the site has been determined to be acceptable for unrestricted release, the fact that it does contain residual radioactive contamination it necessitates managing the dose associated with each individual reuse stockpile in relation to the total dose for the survey unit. In addition, placement of the reuse soil within a survey unit also must consider in which stratum the soil is placed.

Placement of reuse soil and off-site borrow is managed by the use of Work Package HDP-WP-ENG-802, Backfill & Site Restoration. In summary, the process for placement of reuse soil is as follow; the RSO evaluates the FSS data and the expected dose contribution from all sources for all survey unit(s) to be backfilled; based upon the evaluation the RSO selects the appropriate survey unit, and if required the stratum, in which the reuse soil is to be placed ensuring the total dose for the survey unit(s) will meet the release criteria; the onsite backfill placement tracking forms are completed which provide the survey unit(s) and depth of excavation in which the reuse soil will be placed; and, in addition to the directions provided by the tracking form to ensure proper placement of the reuse soil, the placement of the reuse soil and the associated elevations are verified by topographical measurements by HDP Engineering.

The following table provides the dose associated with the Reuse Stockpile, SOF, Survey Unit in which the reuse soil was placed and the stratum within the survey unit which the reuse was placed.

Table 7-1
Reuse Soil Placement Data

Reuse Stockpile	Dose (mrem)	SOF	Reuse Soil Placement Survey Unit Location	Survey Unit Stratum
Combined 1-2	2.5	0.10[1]	LSA 10-14 and 05-02[2]	Deep
3	3.5	0.14	LSA 10-13	Deep
Combined 4-7	6.3	0.25[1]	LSA 08-01, 08-02 and 08-08	Deep
Combined 5-6	7.75	0.31[1]	LSA 11-01	Uniform
8a	5.5	0.22	LSA 08-06	Deep
8b	4.25	0.17	LSA 02-03, 03-01 and 05-04	Uniform
9	3.0	0.12	LSA 08-04 and 08-05	Uniform

[1]Weighted Mean SOF of Combined Reuse Stockpiles

[2]One approximate 6 inch layer of Reuse Stockpile 2 was placed in LSA 05-02

Upon review of the original submittal of the Reuse Stockpile reports, the NRC requested additional information for each Reuse Stockpile be provided that was not included in the original reports, such as:

- The 95% UCL of the un-weighted mean
- The distribution used to determine the UCL (un-weighted)
- The 75th percentile of the SOF data
- The volume of each Reuse Soil Stockpile
- The LSA survey unit dose prior to reuse soil contribution in each area where the entire, or portions, of a Reuse Stockpile was used

Table 7-2 below provides the information.

Table 7-2
Additional Reuse Soil Stockpile Information

Reuse Stockpile Number	Reuse Stockpile Mean SOF (unweighted)	Reuse Stockpile 95% UCL of Mean (unweighted)	Pro UCL Recommended Distribution	75% SOF	LSA Survey Unit Where Reuse Stockpile Soil Was Placed	Total Volume of Reuse Stockpile (cu yds)	Volume of SP used in LSA (cu yds)	Projected LSA Survey Unit Dose Without Contribution from the Reuse Stockpile or Groundwater
SP 1	0.10	0.102	95% H-UCL (lognormal)	0.11	N/A	Combined into SP 1-2	N/A	N/A
SP 2	0.10	0.105	95% Approximate Gamma UCL (gamma dist., and lognormal)	0.12	LSA 05-02 (1 layer)	Combined into SP 1-2	275 (est. based on one 6in. layer across LSA)	LSA 05-02 (8.5 mrem)
SP 1-2	0.10	0.102	95% H-UCL (lognormal)	0.12	LSA 10-14	3,673	3,673	LSA 10-14 (3.25 mrem)
SP 3	0.14	0.145	95% H-UCL (approx. lognormal)	0.16	LSA 10-13	2,306	2,306	LSA 10-13 (4.75 mrem)
SP 4	0.27	0.288	95% H-UCL (approx. lognormal)	0.35	N/A	Combined into SP 4-7	N/A	N/A
SP 5	0.33	0.380	95% Student's-t UCL (normal, gamma dist., and lognormal)	0.40	N/A	Combined into SP 5-6	N/A	N/A
SP 6	0.30	0.322	95% Student's-t UCL (normal, gamma dist., and lognormal)	0.34	N/A	Combined into SP 5-6	N/A	N/A
SP 5-6	0.31	0.331	95% Student's-t UCL (normal, gamma dist., and lognormal)	0.36	LSA 11-01	419	419	LSA 11-01 (0.75 mrem)
SP 7	0.23	0.253	95% Approximate Gamma UCL (gamma dist., and approx. lognormal)	0.30	N/A	Combined into SP 4-7	N/A	N/A
SP 4-7	0.25	0.264	95% H-UCL (lognormal)	0.32	LSA 08-01 LSA 08-07 LSA 08-08	5,237	LSA 08-01 (1,478) LSA 08-07 (3,651) LSA 08-08 (108)	LSA 08-01 (1.25 mrem) LSA 08-07 (4.25 mrem) LSA 08-08 (6.25 mrem)
SP 8a	0.22	0.235	95% Approximate Gamma UCL (approx. gamma dist.)	0.31	LSA 08-06	4,500	4,500	LSA 08-06 (4.75 mrem)
SP 8b	0.17	0.186	95% Approximate Gamma UCL (gamma dist.)	0.21	LSA 02-03 LSA 03-01 LSA 03-02 LSA 05-04	1,843	LSA 02-03 (153) LSA 03-01 (1170) LSA 03-02 (282) LSA 05-04 (238)	LSA 02-03 (7.5 mrem) LSA 03-01 (2.25 mrem) LSA 03-02 (5.0 mrem) LSA 05-04 (2.75 mrem)
SP 9	0.12	0.129	95% Student's-t UCL (No Discernible Dist.)	0.15	LSA 08-04 LSA 08-05	4,722	LSA 08-04 (1,000) LSA 08-05 (3,722)	LSA 08-04 (3.5 mrem) LSA 08-05 (4.5 mrem)

8.0 OFF-SITE BORROW MATERIAL

A key component of the restoration of the HDP site has been to identify and procure off-site borrow material to backfill excavations created during the remediation of open land areas. Due to the significantly large volume of off-site borrow material required to backfill excavations Westinghouse has identified multiple sources of off-site borrow.

In the DP, in regards to off-site borrow material the DP states:

- DP Section 8.8 - "*Additional off-site backfill material will be imported from an approved off-site source(s), as needed, and tested to ensure it meets site cover requirements for radiological and chemical constituents.*"
- DP Section 14.4.4.1.6.2 - "*Upon completion of backfill, no further FSS samples or measurements are necessary. This is because 1) soil obtained from an approved off-site borrow location was previously* ***tested and determined to be non-impacted****, or 2) soil originating from the Site.....*"

Based upon the above stated DP requirements, HDP performed radiological testing of off-site borrow material and submitted the results of the testing in letter HEM-14-31, Westinghouse (Fussell) to NRC (Document Control Desk), *Radiological Testing of Backfill Soil from an Off-site Borrow Location* {ML14072A485} dated March 13, 2014. To ensure compliance with the DP requirement as stated above, in the letter, Westinghouse restated the applicable requirements as bulleted items and to ensure clarity provided a third bullet based on the criteria of the soil being "non-impacted" as follows:

> "*The term 'non-impacted' is defined in MARSSIM Section 3.6.2: "Non-impacted areas identified through knowledge of site history or previous survey information - are those areas where there is no reasonable possibility for residual radioactive contamination. The criteria used for this segregation need not be as strict as those used to demonstrate final compliance with the regulations,*"

Also, in letter HEM-14-31, Westinghouse provided the following text in regards to Tc-99 sample results; "*The Tc-99 results were less than the minimum detectable concentrations (MDCs) for 14 of 16 samples. Trace detections in 2 samples were at a concentration that was only slightly above their respective MDCs. The results were 0.89 pCi/g (standard deviation of 0.11 pCi/g and MDC of 0.35 pCi/g), and 0.88 pCi/g (standard deviation of 0.28 and MDC of 0.33 pCi/g). These results are acceptable considering that they are less than 4 percent of the most restrictive DCGL for Tc-99 of 25.1 pCi/g (Uniform scenario). No non-DCGL licensable radionuclides were detected as present by the analytical laboratory.*"

Also letter HEM-14-31 stated "*Consistent with the guidance in Section 3.6.2 of MARSSIM and the preceding analysis, the soil from the off-site backfill locations is non-impacted material.*"

It is presumed by the text that the HDP RSO at the time reviewed the sample data in regards to Tc-99 in the context of the site DCGLs, as the letter indicated that the criteria

was to demonstrate the off-site borrow to be non-impacted, rather than reviewing the sample data in the context of what radionuclides should be found in background soil from a non-NRC licensed location.

During the review of HEM-14-31 the NRC identified that the two sample results which indicated Tc-99, represented an issue of adequacy of the testing of the off-site borrow soil. The NRC communicated that position to Westinghouse during a teleconference on May 22, 2014. In response, Westinghouse Corrective Action Prevention and Learning (CAPAL) Issue #100023039 was generated.

Westinghouse performed numerous audits, assessments and reviews relevant to the issue of the indication of Tc-99 in the off-site borrow soil samples and also relevant to other aspects of the interactions with the laboratory as part of CAPAL Issue #100023039.

Once the issues specific to the indication of Tc-99 in the off-site borrow soil samples were understood and addressed, in an effort to move forward with being prepared to utilize off-site borrow for upcoming excavation backfill operations, HDP performed resampling and statistical evaluation for both HDP site background soils and for the off-site borrow soil. In ongoing discussions with the NRC, Westinghouse understood that the NRC no longer considered the criteria in the DP for demonstrating off-site borrow material to be non-impacted applicable, and that a statistical analysis of the off-site borrow material compared to background soil samples was required. Westinghouse letter HEM-14-89, Westinghouse (Fussell) to NRC (Document Control Desk), *Radiological Testing of Backfill Soil from an Off-site Borrow Location* {ML14323A238} dated November 19, 2014, provided the updated results of the evaluation in HDP-RPT-FSS-301, *Off-Site Borrow Soil Analysis 2112 Horine Road, Festus, Missouri* which was an attachment to the letter. HDP-RPT-FSS-301 concluded that the off-site borrow material at 2112 Horine Road was suitable for use as backfill at the HDP site.

In a March 12, 2015, publicly noticed telephone conference call, the NRC staff stated that removing the outliers from the data set was inconsistent with NRC guidance and provided that Westinghouse needed to perform a revised analysis with the outliers included. A revised analysis was provided by Westinghouse in letter HEM-15-20, Westinghouse (Fussell) to NRC (Document Control Desk), *Additional Radiological Testing of Backfill Soil from an Off-site Borrow Location*, dated March 18, 2015 {ML15077A476}, in which outliers were included and not all statistical tests passed. Westinghouse letter HEM-15-20 concluded that "*The statistical test outcomes for U-234 and U-238 are unchanged with the inclusion of the outliers determined in HDP-RPT-FSS-301. The Wilcoxon-Mann-Whitney test outcome was affected, but the Quantile test outcome was not. However, considering the means of the data set (1.02 for the reference area and 1.18 for the borrow soil) and the standard deviation (0.22 for the reference area and 0.13 for the borrow soil), a conclusion may be drawn that the data sets are comparable. Therefore the soil from the off-site borrow soil is representative native Missouri soil and is suitable for backfill material at the HDP site.*"

In a March 19, 2015, publicly noticed telephone conference call, the NRC staff stated that the statistical analysis performed by Westinghouse needed to be performed according to

the guidance set forth either in NUREG-1505, *A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys*, and/or NUREG-1575 Supplement 1, *Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual*.

Subsequent to the submittal of HEM-14-89 the NRC also indicated that it was necessary to submit the investigation results and corrective actions taken in regards to the Tc-99 identified in the initial off-site borrow soil samples prior to the NRC moving forward with the approval of off-site borrow material. Upon completion of all activities associated with CAPAL Issue #100023039 Westinghouse submitted the CAPAL documentation of those activities in Westinghouse letter HEM-15-19, Westinghouse (Fussell) to NRC (Document Control Desk), *Corrective Actions in Response to Erroneous Tc-99 Results Identified During Radiological Testing of Backfill Soil from an Off-site Borrow Location* {ML15086A090}, dated March 24, 2015. For business purposes Westinghouse considers the CAPAL system software to be proprietary. To ensure all information related to the erroneous Tc-99 results was provided to the NRC for review CAPAL Issue #100023039 was submitted in its entirety. Therefore, HEM-15-19 was submitted to the NRC in accordance with 10 CFR 2.390 as proprietary.

In response to the NRC's request during the March 19, teleconference, Westinghouse performed a re-analysis with the outliers that had been removed in the HDP-RPT-FSS-301 assessment placed back into the data set according to the guidance in NUREG-1505 and NUREG-1575 Supplement 1. The re-analysis was presented in Westinghouse letter HEM-15-25, Westinghouse (Fussell) to NRC (Document Control Desk), *Additional Statistical Analysis of Backfill Soil from an Off-site Borrow Location*, dated April 2, 2015 {ML15092A213}. Westinghouse letter HEM-15-20 concluded that "*The statistical test outcomes for both the WRS and Quantile tests for all radionuclides analyzed (Th-232, RA-226, U-234 and U-238) passed. Therefore the soil from the off-site borrow soil is representative native Missouri soil and is suitable for backfill material at the HDP site.*"

In an April 16, 2015, telephone conference call, the NRC contractor stated that the statistical analysis of the off-site borrow material should be performed with the upper bound of the gray region set as the mean of the reference area results plus three times the associated standard deviation. In Westinghouse letter HEM-15-39, Westinghouse (Fussell) to NRC (Document Control Desk), *Additional Statistical Analysis for Backfill Soil from an Off-site Borrow Location* {ML15117A151}, dated, April 27, 2015, Westinghouse provided the results of the re-analysis with the upper bound of the gray region set as the mean of the reference area results plus three times the associated standard deviation. Westinghouse letter HEM-15-39 concluded that as stated in HEM-14-89, "*A total of 32 samples were taken from the two reference areas, for a total of 63 samples from all three locations. Therefore, the sample population met the minimum sample size as determined by the statistical analysis utilizing the upper bound of the gray region set as the mean of the reference area results plus three times the associated standard deviation.*"

Subsequent to the submittal of Westinghouse letter HEM-15-19 the NRC communicated that it would not be reviewed in the current state of being proprietary as the pertinent

information would not be made publicly available. The NRC requested that Westinghouse summarize the information in HEM-15-19 and submit it without any proprietary information. In Westinghouse letter HEM-15-41, Westinghouse (Fussell) to NRC (Document Control Desk), *Summary of Westinghouse Response to Identification of Tc-99 in Off-site Borrow Soil*, dated May 6, 2015, the NRC was provided a summary of the information contained in HEM-15-19.

In NRC (Norato) letter to Westinghouse (Fussell) dated October 8, 2015, *U.S. Nuclear Regulatory Commission Conclusions Associated with the Utilization of Off-site Borrow Material at the Westinghouse Hematite Site*, the NRC provided approval of the off-site borrow referenced in HEM-15-39 (the Horine Road site). The NRC also stated that "*The conclusions presented in this letter are also applicable to any other source of off-site borrow material. Westinghouse informed the NRC on September 24, 2015, that they have procured access to two other sources of off-site borrow. Westinghouse should consider the conclusions contained in this letter as they may apply to these two resources.*" Westinghouse will consider the conclusions for other sources of off-site borrow material.

9.0 HDP PROCEDURES

As discussed in various sections of this document, HDP utilizes site procedures to implement regulatory requirments and to guide work by providing instructions to the work force. All HDP procedures and subsequent revisions have been provided to the NRC during on-site inspections and when requested. To facilitate NRC review Appendix A provides the revision history and summary of those HDP procedures discussed in this document and that have been previously provided to the NRC.

10.0 REFERENCES

10.1 DO-08-004, Hematite Decommissioning Plan (DP) {ML092330123}

10.2 Resolution Table for Report HDP-RPT-FSS-109 {ML15279A066}

10.3 NRC Inspection Report 07000036/2015001 {ML15118A946}

10.4 NRC Inspection report 07000036/2013002 {ML13241A252}

10.5 NRC Inspection Report 07000036/2014001 {ML14084A566}

10.6 ORAU, DCN:5184-SR-02-0, dated January 14, 2014, Final Report for Independent Confirmatory Survey Summary and Results of Reuse Stockpiles 1, 2, and 3 for the Hematite Decommissioning Project, Festus, Missouri {ML14036A282}

10.7 Westinghouse letter HEM-11-37, dated March 21, 2011, "Response to Remaining NRC Request for Additional Information on the Hematite Decommissioning Plan Chapter 9 {ML110810978}

10.8 Westinghouse letter HEM-14-31, dated March 13, 2014, "*Radiological Testing of Backfill Soil from an Off-site Borrow Location*" {ML14072A485}

10.9 Westinghouse letter HEM-14-89, dated November 19, 2014, "*Radiological Testing of Backfill Soil from an Off-site Borrow Location"* {ML14323A238}

10.10 Westinghouse letter HEM-15-19, dated March 24, 2015, "*Corrective Actions in Response to Erroneous Tc-99 Results Identified During Radiological Testing of Backfill Soil from an Off-site Borrow Location"* {ML15086A090}

10.11 Westinghouse letter HEM-15-20, dated March 18, 2015, "*Additional Radiological Testing of Backfill Soil from an Off-site Borrow Location"* {ML15077A476}

10.12 Westinghouse letter HEM-15-25, dated April 2, 2015, "*Additional Statistical Analysis of Backfill Soil from an Off-site Borrow Location"*{ML15092A213}

10.13 Westinghouse letter HEM-15-39, dated April 27, 2015, "*Additional Statistical Analysis for Backfill Soil from an Off-site Borrow Location"* {ML15117A151}

10.14 Westinghouse letter HEM-15-41, dated May 6, 2015, "*Summary of Westinghouse Response to Identification of Tc-99 in Off-site Borrow Soil"* {No Accession Number Identified}

10.15 Westinghouse letter HEM-10-80, dated July 30, 2010, "*Response to Request for Additional Information Concerning Hematite Decommissioning Plan: Chapter 14, Characterization Report and Surrogates Report"* {ML102140158}

10.16 Westinghouse letter HEM-11-96, dated July 5, 2011, "*Final Supplemental Response to NRC Request for Additional Information on the Hematite Decommissioning Plan and Related Revision to a Pending License Amendment Request* " {ML111880292}

10.17 Westinghouse letter HEM-12-162, dated December 20, 2012, "*Request for NRC Review of Report HDP-RPT-FSS-101, Data Summary Report for Reuse Stockpile 2"* {ML12356A056}

10.18 Westinghouse letter HEM-13-20, dated February 20, 2013, "*Request for NRC Review of Reports HDP-RPT-FSS-102, Data Summary Report for Reuse Stockpile 1, and HDP-RPT-FSS-103, Data Summary Report for Reuse Stockpile 3*" {ML13052A187}

10.19 NRC letter dated March 21, 2013, "*U.S. Nuclear Regulatory Commission Assessment of Westinghouse Hematite's Report HDP-RPTFSS-101, Data Summary Report for Reuse Stockpile #2*" {ML13032A582}

10.20 NRC letter dated June 14, 2013, "*U.S. Nuclear Regulatory Commission Assessment of Westinghouse Hematite's Report HDP-RPTFSS-102, Data Summary Report for Reuse Stockpile 1, and HDP-RPTFSS-103, Data Summary Report for Reuse Stockpile 3*" {ML13119A218}

10.21 Westinghouse letter HEM-14-92, dated Decemebr 16, 2014, "*Request for NRC Review of Report HDP-RPT-FSS-106, Data Summary Report for Combined Reuse Stockpile 1-2*" {ML14350A230}

10.22 Westinghouse letter HEM-15-1, dated January 7, 2015, "*Request for NRC Review of Report HDP-RPT-FSS-107, Data Summary Report for Reuse Stockpile 3*" {ML15007A535}

11.0 APPENDICES

Appendix A HDP Procedure Revision History

Appendix B HDP-TBD-HP-406 Preliminary Evaluation and Test Plan for ISO 3 for Assaying and Segregating Soil at HDP that is Potentially Contaminated with Uranium

Appendix C HDP-TBD-FSS-002 Evaluation and Documentation of the Scanning Minimum Detectable Concentrations (MDC) for Final Status Surveys (FSS)

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HDP-PR-FSS-701 Final Status Survey Plan Development		
Revision Number	**Effective Date**	**Summary of the Revision**
0	01/16/2012	Initial issuance of the procedure.
1	02/04/2013	Provided clarification on soil sampling by stratum as indicated in Decommissioning Plan Table 14-24.
2	02/12/2013	Provided additional instructions for creating FSS Plans for Reuse Soil.
3	11/26/2014	Significant revision for clarification and minor corrections.
4	01/07/2015	Subsequent to comments received by NRC Region III regarding content of this procedure a technical readiness review was performed and the procedure revised accordingly.
5	02/11/2015	Updated the scan MDCs for U, Th-232 and Ra-226.
6	03/25/2015	Clarification of guidance for background ranges including acceptable ranges for use of a 10,000 cpm background for calculations and direction when background values are outside that range or survey parameters differ from those in HDP-TBD-FSS-002.
7	06/15/2015	Added information regarding piping survey plans, updated Ra-226 in-growth background value, clarified mean of SO equation, added direction on adjusting grid spacing to account for potential Tc-99 hotspots.
8	08/21/2015	The revision is initiated upon an agreement between the NRC and Westinghouse HDP in regards to Tc-99 sidewall sampling. The agreement was reached during a NRC Public Teleconference Meetings held on August 12, 2015, and August 19, 2015
9	10/28/2015	Changed procedure to Westinghouse Proprietary Class 2. No technical changes.
10	11/19/2015	Resolution and clarification of 100% GWS based on discussions with NRC Headquarters.

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HDP-PR-FSS-703 Final Status Survey Quality Control		
Revision Number	**Effective Date**	**Summary of the Revision**
0	01/16/2012	Initial issuance of the procedure.
1	11/26/2014	Clarification for SSC Survey units.
2	10/28/2015	Changed procedure to Westinghouse Proprietary Class 2. No technical changes.

HDP-PR-FSS-710 Final Status Surveys and Radiological Sampling of Re-use Soil		
Revision Number	**Effective Date**	**Summary of the Revision**
0	01/16/2012	Initial issuance of the procedure.
1	01/31/2012	Revised step 8.1.2 from collect a general area background "at approximately waist level in the area of the survey" to "near the surface of clean soil".
2	05/03/2012	Procedure revised to allow material disposition at the direction of the RSO, move direction on action levels to Form HDP-PO-HP-100-2, and to allow for random sampling of cohesive materials.
3	05/14/2012	Procedure revised to clarify that a pile did not have to be marked with the sample ID # when the RSO has authorized for combining piles prior to receiving sample results.
4	02/04/2013	Added steps which describe the 3 approaches for performing surveys and sampling of potential re-use soil.
5	05/19/2014	Incorporated the requirements of Memo HEM-13-MEMO-099, Radiological Requirements for the Handling of Re-Use Soils During Development of Stockpile 8
6	11/26/2014	Applicability review revision that includes clarification to the approaches implemented in revision 4, typographical and formatting revisions.
7	03/18/2015	Procedure revised to discuss an alternative for approach 3 to allow surveying and sampling a re-use pile in layers and then remove each layer rather than spread each layer out

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HDP-PR-FSS-710 Final Status Surveys and Radiological Sampling of Re-use Soil		
Revision Number	**Effective Date**	**Summary of the Revision**
		individually. Clarified wording to better describe requirements for sampling and survey of high, low and medium areas.
8	10/28/2015	Changed procedure to Westinghouse Proprietary Class 2. No technical changes.

HDP-PR-FSS-711 Final Status Surveys and Sampling of Soil and Sediment		
Revision Number	**Effective Date**	**Summary of the Revision**
0	01/16/2012	Initial issuance of the procedure.
1	02/04/2013	Updated reference to HDP-PR-FSS-701.
2	02/13/2013	Typographical correction. The procedure still had "Draft A, Proposed 1" listed under the revision heading on the title page when it was placed onto SharePoint.
3	04/25/2013	Provided clarification when survey instructions cannot be followed as written.
4	11/26/2014	Added instructions for notifications when working in or near physical security structures and components.
5	02/09/2015	Added steps to provide further details on where to document background readings and how to apply the backgrounds during the survey.
6	04/15/2015	Added detail for the notification and direction in the event that isolation controls are breached in a survey unit.
7	10/28/2015	Changed procedure to Westinghouse Proprietary Class 2. No technical changes.
8	11/19/2015	Added clarification to Step 8.4.3 that a 100% GWS is required in Class 1 areas, and that professional judgment may be used to scan additional areas than the minimum requirements for Class 2 and Class 3 areas.

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HDP-PR-FSS-721 Final Status Survey Data Evaluation		
Revision Number	**Effective Date**	**Summary of the Revision**
0	01/16/2012	Initial issuance of the procedure.
1	02/06/2013	Administrative revision only, forms changed to appendices.
2	02/20/2013	Administrative revision only, references updated.
3	11/26/2014	Provided clarification SOF, Corrected typographical error in SOF equation and other steps.
4	01/06/2015	Minor revision to insert procedure number in front of procedure title in Section 5.0 References.
5	02/09/2015	Clarifications on the calculation of statistics in Section 8.3 and SOF in Section 8.4, Additional guidance on completion of the WRS test and correct terminology used for the Test Statistic, Clarifications between the requirements for soil and structural survey units, added notes to clarify using the DCGLs used to develop the FSS plan unless instructed otherwise by the RSO, added step to Appendix G-1 to verify Laboratory quality control parameters are within acceptable limits.
6	03/25/2015	Clarifications on the calculation of statistics to correct negative values to zero when listing basic statistical data and listing the background values. Replaced Appendix C with table 14-4 from Attachment 4 to HEM-11-96 as this table is more appropriate since inferred Tc-99 is prohibited for use to demonstrate compliance. Added a note to clarify that it is prohibited to use U-235 to infer Tc-99 to demonstrate compliance. Removed references to SEA in the procedure and in the acronym list. Various terminology corrections. Added the calculation to use for obtaining a U-234 value when not measured for the calculation. Changed scan action level for Class 1 to be consistent with change to HDP-PR-FSS-701. Added underground piping.
7	04/15/2015	Added detail in Step 7.5.4 as to notification and direction in the event that isolation controls are breached in a survey unit.
8	06/15/2015	Updated the Ra-226 soil background value. Added instruction for use of other DCGL conceptual site models

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HDP-PR-FSS-721 Final Status Survey Data Evaluation		
Revision Number	**Effective Date**	**Summary of the Revision**
		rather than only the uniform DCGL.
9	08/13/2015	This revision implements clarification on the determination of dose for survey units. The changes are based upon an agreement between the U.S. NRC and Westinghouse in regards to calculating dose. The technical changes were agreed upon during the NRC-Westinghouse teleconference held on August 12, 2015.
10	10/28/2015	Changed procedure to Westinghouse Proprietary Class 2. No technical changes.

HDP-PR-HP-411 Radiological Instrumentation		
Revision Number	**Effective Date**	**Summary of the Revision**
0	12/01/2010	Initial issuance of the procedure. This procedure superseded HDP-PR-HP-028.
1	12/20/2010	This revision provides clarifications regarding MDA and requirements when instruments are used for FSS.
2	04/01/2011	Provided additional information for set up of instrumentation.
3	10/25/2011	Updated Appendix A to be consistent with the DP.
4	11/21/2011	Administrative changes.
5	11/30/2011	Administrative changes.
6	07/22/2013	Added instruction For NaI 2x2 survey instruments designated for FSS Surveys to ensure that the High Voltage (HV) is set to the calibrated "GROSS" setting, the threshold is set at 100 keV, and the window is in the "Out" position.
7	06/13/2014	Clarified the requirements for using NIST traceable sources.
8	11/19/2014	Updated the Operating Instruction sheet for the Ludlum

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HDP-PR-HP-411 Radiological Instrumentation		
Revision Number	**Effective Date**	**Summary of the Revision**
		3030 to also include the Ludlum 2929.
9	11/19/2015	Changed procedure to Westinghouse Proprietary Class 2.

HDP-PR-HP-416 Operation of the Ludlum 2221 for Final Status Survey		
Revision Number	**Effective Date**	**Summary of the Revision**
0	01/16/2012	Initial issuance of the procedure.
1	02/09/2015	Clarified instruction that the probe be kept as close to the ground as possible, nominally 1 inch from the surface and not to exceed 3 inches. Clarified instruction to scan at 1 foot per second and that head phones should be used when it is noisy and interferes with hearing audible count rate. Revised wording consistent with current wording in FSS instructions. Added a step to stop and pause when elevated count rates are identified to determine if further investigation is needed. Added clarification that documentation using HDP-PR-FSS-701 is following directions as specified in the FSS instructions.
2	11/19/2015	Administrative changes. Changed procedure to Westinghouse Proprietary Class 2. No technical changes.

HDP-PR-HP-601 Remedial Action Support Surveys		
Revision Number	**Effective Date**	**Summary of the Revision**
0	03/14/2012	Initial issuance of the procedure.
1	04/09/2012	Updated procedure to accommodate performing 6 inch excavation lifts instead of 12 inch excavation lifts, updated Table 1 Column B screening count rate to 46k cpm for saturated soil, which is more conservative than the 58k cpm and is associated with a lump of material, Updated flow chart

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HDP-PR-HP-601 **Remedial Action Support Surveys**		
Revision Number	**Effective Date**	**Summary of the Revision**
		in Appendix B to move evaluation of items after the initial survey, and to include pipe surveys, Section 8.1.6.2 updated to identify items for further evaluation and evaluate them after the initial survey to determine if they are NCS Exempt. Clarifications for the count rates are less than or equal to (≤) instead of "less than", consistent with wording in Section 8.7 of this procedure and the applicable NCSA, removed "general area" to clarify that the background count rate used will be obtained from the daily background check. Added reference to NSA-TR-HDP-11-06 for surveys of pipe and added section for surveying piping to determine if it is NCS Exempt. Specified that the screening level for reuse is on Form HDP-PR-HP-100-2.
2	06/11/2012	Administrative changes and clarifications.
3	06/26/2012	Updated procedure to use the general area background count rate when performing surveys or items and containers and Sections 8.4.3 and 8.7 to specify the external surfaces of containers need to be surveyed, not only the bottom of the containers.
4	07/05/2012	Updated Section 8.2 to clarify that the radiological surveys do not need to be formally documented prior to determining if an area meets NCS Exempt criteria and can be excavated. Additionally, 2 independent HP Technicians can verify all hotspots/items have been evaluated and handled required to ensure the surveyed area meets NCS Exempt Material criteria. Updated Section 8.4.3 to remove the requirement to have intact containers in a vertical position when surveying them because this is not required as all external surfaces of the container are surveyed. Updated Section 8.7 to clarify the criteria for Field Containers with net count rates between 300,000 and 1,400,000 cpm.
5	08/14/2012	The requirement to identify areas that are NCS Exempt for a 12 inch cut depth (i.e., areas that are 19k ≤ ncpm < 66k dry soil, marked as blue) was removed because the maximum permitted cut depth will be 6 inches. Blue will no longer be used to mark areas as it is no longer applicable since it is

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HDP-PR-HP-601 Remedial Action Support Surveys		
Revision Number	**Effective Date**	**Summary of the Revision**
		associated with the NCS Exempt criteria for a 12 inch cut depth. This change includes the removal of Column A in Table 1. Updated the count rates in Table 1 for Columns C & D, and in associated locations throughout the procedure. These count rates were previously based on a cut depth of 7 inches (an extra 1 inch greater than the cut depth for conservatism). The count rates were adjusted in this revision to the count rates associated with a cut depth of 6 inches. Based on operational experience and the current maximum permitted cut depth (i.e., 6 inches), an extra 1 inch of conservatism is not necessary. Updated the NCS Field Container Loading Limit from 1,400k ncpm to 1,500k ncpm. 1,400 ncpm was based on 102 g235U, assuming up to 3 field containers in a collared drum (total mass in a collared drum <350 g235U). Since only 2 field containers can fit into a collared drum, the count rate was increased to 1,500k based on 150 g 235U.
6	08/23/2012	Corrected misnumbered step references.
7	09/06/2012	Added note to include the segregation of material with substantially differing characteristics (i.e., radiological, media type) when loading a field container.
8	12/03/2012	NSA-TR-09-15 Revision 4 was issued. Changes to the CSCs in Revision 4 were incorporated throughout the procedure. Sections 7.12 and 8.9 were revised to include instructions on assigning a 235U gram quantity based on close proximity radiological survey results.
9	03/07/2013	This was a significant revision which incorporated nuclear criticality information and requirements based upon NSA-TR-09-08, NCS of Subsurface Structure Decommissioning at Hematite Site and NSA-TR-11-11, NCS Assessment of the USEI Site for Landfill disposal of Additional Decommissioning Waste from Hematite Site.
10	04/08/2013	Added to Step 8.1.7.2 "NOTE: Sections of subterranean pipe less than the NCS Exempt Piping Limit may be crushed and treated as soils, in accordance with HDP-PR-HP-607 (Reference 5.18); however, depending on the size, thickness and material type of the subterranean piping pieces (i.e., Bulky pieces with linear dimensions exceeding the permitted

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HDP-PR-HP-601 **Remedial Action Support Surveys**		
Revision Number	**Effective Date**	**Summary of the Revision**
		cut depth, and thick metallic items) should be treated as Non-Conforming Items. (NSA-TR-09-08 CSC 11)".
11	05/01/2013	Instructions were added for evaluating hot spots using the LaBr3 probe.
12	05/22/2013	A clarification was made in regards to evaluating intact containers.
13	06/21/2013	Added instruction to ensure Pre and Post Assay QC checks are performed in accordance with HDP-PR-NC-008, Probe, when the LaBr3probe is used to determine if an area meets NCS Exempt requirements.
14	07/22/2013	Added instruction to allow for Ex-situ scanning of soil in less than 6 inch layers. Added instruction for surveying material underneath the Former Building 240 Slab to allow excavation of material up to 0.8 g235U/L as NCS Exempt.
15	07/25/2013	Instructions added for performing measurements using a NaI 2x2 detector with a "Closed Window" setting of 75 to 250 keV and added option to survey a greater than 5L container to less than or equal to 34k to determine if it meets NCS exempt criteria.
16	08/07/2013	Revised to incorporate the requirements of HEM-13-MEMO-067, Remediation of Soil Under the Concrete Slabs.
17	08/15/2013	Revised to allow the survey of piping from discovered Burial Pits to be performed in one foot increments.
18	09/11/2013	Redundant FSS design requirements were removed from as they are captured in FFS procedure. Introduced the terms "Large Volume Container" and "Small Volume Container" throughout procedure. Removed all instructions for Inspector 1000 with LaBr3 probe as it will no longer be used to evaluate "hot spots" as part of the initial radiological survey. Extensive changes were made to this procedure to remove directions on performing measurements using a NaI 2x2 detector with a "Closed Window" setting of 75 to 250 keV.

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HDP-PR-HP-601 Remedial Action Support Surveys		
Revision Number	**Effective Date**	**Summary of the Revision**
		Steps were added to Section 8.5 to satisfy expanded NCS Controls to perform a visual inspection of Ex-situ excavated material in layers prior to consolidation at the WCA.
19	09/12/2013	Step 8.5.2 was revised to clarify the requirement of NSA-TR-09-15 CSC 25, to "Identify and demarcate an area, using paint, flags, or other appropriate means, adjacent to the excavation area that does not contain any Non-NCS Exempt Material (identified in accordance with Section 8.1)".
20	09/30/2013	The term Inspection Items was introduced. References to the use of GPS in section 8.1 were removed since GPS use is considered optional. References to DCGL were replaced with Reuse Material Screening Level (RML) and a count rate of 12k ncpm is now specified. Section 8.4 was revised to include detailed direction on how intact containers are to be emptied in the field. Section 8.9 title was changed to "Surveys of Non-Conforming Items or Items Potentially Containing Fissile Material"
21	10/01/2013	Minor typographical errors were corrected from the previous revision.
22	10/23/2013	Step added to "Identify the area to be excavated" prior to excavation of an area. Added that the adjacent working surface should be demarcated with pink paint or flags. Step was revised to specify that a GWS with Visual Inspection will be performed of the ex-situ soil layer regardless if visible Non- Conforming Items were identified.
23	11/22/2013	Added instruction for remediation of soils surrounding radium filter press plates in the Burial Pits.
24	01/10/2014	Revised the scope of Section 8.10 to apply to all pavement and building slabs covering soil under NCS controls. Added saturated soil numbers to Sections 8.11 and 8.12. Added step to address the use of ISOCS measurements performed in the field as part of evaluation of radium contaminated soil areas.
25	05/19/2014	Incorporated the requirements of Memo HEM-13-MEMO-099, Radiological Requirements for the Handling of Re-Use Soils During Development of Stockpile 8. Added the requirements of NSA-TR-09-08 CSC 17, and CSC 20 and

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HDP-PR-HP-601 Remedial Action Support Surveys		
Revision Number	**Effective Date**	**Summary of the Revision**
		NSATR- HDP-11-11 CSC 15 related to septic and sewage treatment tanks. Removed references to remediation contractor.
26	06/02/2014	Updated work package references throughout procedure, as work package numbers have changed.
27	07/10/2014	Added potential NCS Evaluation for Non-Conforming Items which are > 0.1 g U-235/L to Appendix C.
28	08/11/2014	Clarified the requirements for excavation cut depth outside of NCS controlled areas. Clarified how "areas where buried debris has been identified" is defined by NCS.
29	09/18/2014	Added instruction to allow the third visual inspection and processing of potentially NCS exempt material to take place on a working surface that will no longer be required to be located adjacent to the excavation area.
30	11/05/2014	A step was added to provide guidance when performing surveys and visual inspections under artificial lighting.
31	11/06/2014	Administrative changes.
32	12/05/2014	Added instruction to implement the enhanced work controls developed to ensure compliance with the USEI WAC when excavation in the Site Pond. Added Reference to HEM-14-MEMO-112, NCS Analysis of the HDP Site Pond Remediation Activities.
33	02/04/2015	Added instruction on the direct loading of waste for disposal at a NRC licensed burial facility up to a concentration of 0.8 g235U/L.
34	11/19/2015	Changed procedure to Westinghouse Proprietary Class 2. No technical changes.

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HDP-PR-QA-006 Chain of Custody		
Revision Number	**Effective Date**	**Summary of the Revision**
0	04/29/2010	Initial issuance of the procedure.
1	02/07/2011	Added allowance to write sample information directly on the sample bottle for flexibility of completion of requirement. Added exception to assignment of unique sample number to each sample to provide for routine, location-specific samples. Removed documentation storage requirements as the storage of samples occurs at the laboratory and not locally, therefore documentation of storage cannot be maintained. Clarified process of where the original chain of custody is placed. Clarified how the laboratory/end user returns the chain of custody form(s) to HDP. Added specification that the procedure is applicable to samples that are intended for offsite analysis.
2	02/29/2012	Administrative change.
3	12/19/2012	Minor clarification changes.
4	11/18/2015	Changed procedure to Westinghouse Proprietary Class 2. No technical changes.

HDP-WP-ENG-802 Backfill & Site Restoration		
Revision Number	**Effective Date**	**Summary of the Revision**
0	05/22/2014	Initial issuance of the procedure.
1	06/25/2015	Revision to define compaction, notification of immediate backfill to MDNR, removed wording regarding former contractor, instruction on backfilling in groundwater recharge zone.
2	08/20/2015	Clarification of "standard proctor" and documentation of placement of reuse soil.
3	10/28/2015	Implemented requirement to perform GWS no more than 72 hours prior to backfill.

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HDP-WP-ENG-802 **Backfill & Site Restoration**		
Revision Number	**Effective Date**	**Summary of the Revision**
4	11/19/2015	Changed work package to Westinghouse Proprietary Class 2. No technical changes.
5	01/21/2016	Clarification on implementation of compaction requirements.

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HDP-TBD-HP-406 Preliminary Evaluation and Test Plan for ISO 3 for Assaying and Segregating Soil at HDP that is Potentially Contaminated with Uranium

This document was previously submitted to the NRC by Westinghouse letter HEM-15-129, *Request for NRC Review of Final Status Survey Final Report Volume 2, Chapter I - Reuse Soil and Off-site Borrow Material Overview*, dated December 16, 2015. There is no change to this document.

Volume 2 Chapter 1 – Appendix C

HDP-TBD-FSS-002 Evaluation and Documentation of the Scanning Minimum Detectable Concentrations (MDC) for Final Status Surveys (FSS)

This document was previously submitted to the NRC by Westinghouse letter HEM-15-129, *Request for NRC Review of Final Status Survey Final Report Volume 2, Chapter I - Reuse Soil and Off-site Borrow Material Overview*, dated December 16, 2015. There is no change to this document.