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Our ref: HEM-15-129
Date: December 16, 2015

Subject: Westinghouse Hematite Decommissioning Project - Request for NRC Review of Final Status Survey Final Report Volume 2, Chapter 1 – Reuse Soil and Off-site Borrow Material Overview (License No. SNM-00033, Docket No. 070-00036)

References:

1) Westinghouse letter HEM-15-52 (Fussell) to NRC (Document Control Desk) dated May 29, 2015, "Submittal of Technical Report HDP-RPT-FSS-202, Survey Area Release Record for Land Survey Area 10, Survey Units 01 and 02 (LSA 10-01 and LSA 10-02) in Support of Hematite Decommissioning Project License Termination" (ML15183A485)
2) NRC (Norato) letter to Westinghouse (Fussell), dated August 11, 2015, "NRC Review of Westinghouse Hematite Technical Report HDP-RPT-FSS-202, Survey Area Release Record for Land Survey Area 10, Survey Units 01 and 02 (LSA 10-01 and LSA10-02)" (ML15218A402)
3) NRC Memorandum dated September 2, 2015, Pinkston to Norato – Publicly Noticed Teleconference Summary (ML15238B032)

During the February 12, 2015, on-site meeting between Westinghouse Electric Company LLC (Westinghouse) and the U.S. Nuclear Regulatory Commission (NRC) in regards to submittal of Final Status Survey (FSS) reports to the NRC, the NRC staff communicated that the reports should be standalone documents providing the public the capability to understand the content. At that meeting, Westinghouse and the NRC agreed that Westinghouse would submit an initial FSS report on the docket which would encompass survey units LSA 10-01 and LSA 10-02 to serve as a template for future FSS Reports. The NRC would then review the report and provide feedback in regards to format, quality and content. In Reference 1, Westinghouse submitted the FSS Technical Report for survey units LSA 10-01 and LSA 10-02.

In Reference 2, the NRC completed an acceptance review, stating that the report was unacceptable and subsequently providing feedback in the enclosure titled "Comments on HDP-RPT-FSS-202. The NRC and Westinghouse discussed the comments during the June 11, 2015, teleconference. Although Westinghouse understood that the reports were to be standalone

documents, the NRC indicated that it was not necessary to repeat information common to all reports in each survey unit report. The NRC stated that the information could be provided in an overview document.

As a result of the NRC feedback, Westinghouse and the NRC agreed that Westinghouse would develop an outline presenting the format and content of FSS documents required for NRC review. Westinghouse provided the outline to the NRC for discussion during the August 19, 2015, publicly noticed teleconference; reference 3 provides the outcome of the discussion.

The purpose of this letter, as discussed in the August 19, 2015, publicly noticed teleconference, is to provide for NRC review the FSS overview document Final Status Survey Final Report Volume 2, Chapter 1 – Reuse Soil and Off-site Borrow Material Overview.

Please contact Kenneth Pallagi at 314-810-3353, should you have questions or need additional information.

Sincerely,

Gay M. Fussell
Deputy Director,
Hematite Decommissioning Project

Attachment: 1) Final Status Survey Final Report Volume 2, Chapter 1 – Final Status Survey Final Report Overview (HDP-RPT-FSS-100)

cc: J. W. Smetanka, Westinghouse
A. Persinko, NRC/NMSS/DUWP
M. A. Norato, NRC/DUWP/MDB
J. A. Smith, NRC/DUWP/MDB

Attachment 1

Final Status Survey Final Report Volume 2, Chapter 1

Reuse Soil and Off-site Borrow Material Overview

Westinghouse Electric Company LLC, Hematite Decommissioning Project

Docket No. 070-00036

Westinghouse Non-Proprietary Class 3

Westinghouse

Final Status Survey Report

Hematite Decommissioning Project

Final Status Survey Final Report Volume 2, Chapter 1

TITLE: **Reuse Soil and Off-site Borrow Material Overview**

REVISION: **0**

EFFECTIVE DATE: DEC 16 2015

Approvals:

Author:	Kenneth E. Pallagi	12-16-2015 Date
Reviewed By:	Scott G. Zoller	12/16/15 Date
Owner/Manager:	W. Clark Evers	12/16/15 Date

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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
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.

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 9.1) {ML092330123} and associated documents contain the requirements for reuse soil (backfill).

The purpose of this document is to 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 has been to identify and separate soil that could be used for reuse soil from the soils that exceed the site cleanup criteria. The soil that exceeds the site cleanup criteria is 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 methodology for reuse soil is described in detail in section 3.0. 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. 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 2 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 2 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.

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 an HP using hand-held instruments and large-area wipes, as deemed necessary based on previous use and visual inspection.
- 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 Gamma Walkover Survey (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.

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 2 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 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 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 $DCGL_{WS}$ by CSM for the HDP.

[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.

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 discussions with the NRC in regards to reuse soil in April 2015, the NRC reached a conclusion that the reuse stockpiles would only be suitable for use as backfill when evaluating against the Uniform DCGLw criteria if the evaluation of the analytical results included the application of a Modified Investigation Level (MIL) for Tc-99 {ML15279A066}. The NRC determined that the evalaution methodology was necessary as Tc-99 is a hard to detect nuclide that cannot be readily identified using conventional field instrumentation. The MIL is applied when aliquots are collected to form a composite sample. The MIL was 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.

In September 2015 during the review of HDP-RPT-FSS-109, Data Summary Report for Combined Reuse Stockpile 4-7, the NRC conveyed 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

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 2 and Approach 3. 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 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 are surveyed by gamma walk over survey in accordance with HDP-PR-HP-601 and areas of potential reuse soil area identified.
- The soil is then removed to the intended cut depth and assessed with the gamma spectroscopy box counter system (or equivalent) that achieves an MDC that is less than the applicable DCGLw for the stratum where the material will be placed as backfill.
- Soil is dumped at the material lay down area and a gamma scan is performed on the surface of the pile to identify locations of elevated count rate for subsequent removal.
- Following the scan survey, a composite sample, consisting of four aliquots collected at random, is obtained and submitted for laboratory analysis.
- Dependent on the results of the gamma scan survey and/or laboratory analysis of the composite sample, the pile will then be consolidated to the appropriate stockpile.
- Stockpiles are then processed through the S3 as described in section 6.0. Failed soil is transferred to the Waste Holding Area for disposal. Soil that successfully passed is stockpiled for reuse.

4.2 Survey Methodology for Reuse Stockpile 5 and Reuse Stockpile 6

Approach 2 was the survey methodology used for demonstrating compliance for Reuse Stockpile 5 and Reuse Stockpile 6 as follows:

Approach 2 Survey Methodologies When HRGS Is Not Utilized

- Soil was dumped at the material lay down area and spread out. A 100% gamma walkover survey was performed on the surface of the spread out pile to identify locations of elevated count rate for subsequent removal.
- Following the scan survey, collection and laboratory analysis of 14 systematic samples, including at least 5% quality control (QC) duplicate, and, if necessary, biased soil samples collected from the lift.
- Each lift 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.

Prior to the implementation of Approach 2 the soil for Reuse Stockpile 5 and Reuse Stockpile 6 was processed through the box counter.

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 are surveyed by gamma walk over survey in accordance with HDP-PR-HP-601 and areas of potential reuse soil area identified.
- The soil was then removed to the intended cut depth and transferred to the box counter or assayed in place by the ISOCS Gamma Spectroscopy System. The box counter and the ISOCS system achieve an MDC that is less than the applicable $DCGL_w$ for the stratum where the material will be placed as backfill. Both the box counter and the ISOCS were utilized to process Reuse Stockpile 8a. Only the ISOCS Gamma Spectroscopy System was used to process Reuse Stockpile 8b.
- 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.
- Dependent on the results of the gamma scan survey and/or laboratory analysis of the composite sample, the 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 FFS of the stockpile soil following Approach 2.

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 was not processed through the S3 and 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 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 2 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 being 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. At the time of developing this document Reuse Stockpile 9 is being processed. The final volume will be provided in the Volume 2 Chapter 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.

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 $\overline{x} <$ DCGL:

Statistic: $\left| x_1 - x_2 \right|$

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

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

$$\text{Statistic: } \text{RPD}(\%) = \frac{\left| x_1 - x_2 \right|}{\overline{x}}(100\%)$$

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

x_1 = activity of sample
x_2 = activity of field duplicate sample
$\overline{x}$ = 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, 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 inspectors 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 inspectors 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. ln 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.

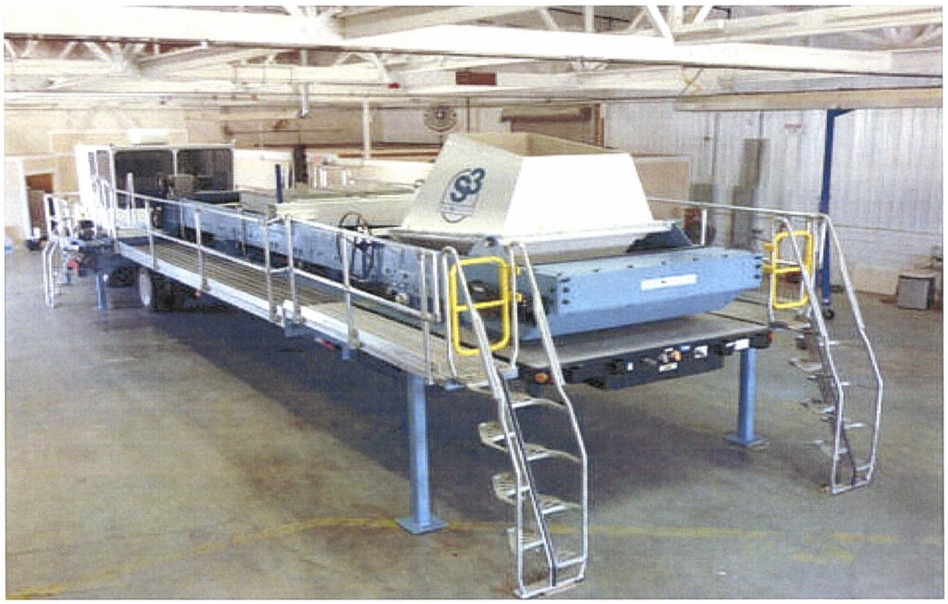
The evaluation determined that S3 offered a number of advantages which complemented the HDP FSS *in situ* gamma walkover scanning requirements for reuse soils, as follows:

- 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. Back ground 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 15, 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 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, public 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*."

ln a March 19, 2015, 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.

8.0 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.

9.0 REFERENCES

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

9.2 Resolution Table for Report HDP-RPT-FFS-109 {ML15279A066}

9.3 NRC Inspection Report 07000036/2015001 {ML15118A946}

9.4 NRC Inspection report 07000036/2013002 {ML13241A252}

9.5 NRC Inspection Report 07000036/2014001 {ML14084A566}

9.6 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}

9.7 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}

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

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

9.10 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}

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

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

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

9.14 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}

10.0 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)