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Our ref: HEM-16-59
Date: June 6, 2016

Subject: Westinghouse Hematite Decommissioning Project - Request for NRC Review of Final Status Survey Final Report Volume 5, Chapter 1, Revision 1 - Final Status Survey Final Report, Piping Survey Areas (PSA) Overview (License No. SNM-00033, Docket No. 070-00036)

References: 1) Westinghouse letter HEM-16-31 (Fussell) to NRC (Document Control Desk) dated March 16, 2016, "Request for NRC Review of Final Status Survey Final Report Volume 5, Chapter 1 – Piping Survey Areas Overview"

The purpose of this letter is to provide for the U.S. Nuclear Regulatory Commission (NRC) review of the FSS overview document Final Status Survey Final Report Volume 5, Chapter 1, Revision 1 – Piping Survey Areas (PSA) Overview.

In Reference 1, Westinghouse submitted for NRC review the overview document Final Status Survey Final Report Volume 5, Chapter 1. The NRC provided via email a Pre-Audit Submittal Table for Final Status Survey Final Report Volume 5, Chapter 1 on May 9, 2016, which contained comments generated by the review. During a subsequent recurring weekly publicly noticed teleconference Westinghouse and the NRC discussed the path forward and resolution of the NRC comments for Final Status Survey Final Report Volume 5, Chapter 1.

Attachment 1 contains Final Status Survey Final Report Volume 5, Chapter 1, Revision 1. Attachment 2 contains a track change version of Final Status Survey Final Report Volume 5, Chapter 1, Revision 1, for ease of review which identifies revisions made as a result of responses to the NRC's comments. Attachment 3 contains the Pre-Audit Submittal Table for Final Status Survey Final Report Volume 5, Chapter 1 with Westinghouse's response.

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 5, Chapter 1, Revision 1, Piping Survey Areas (PSA) Overview (HDP-RPT-FSS-400)
2) Track change version of Final Status Survey Final Report Volume 5, Chapter 1, Revision 1, Piping Survey Areas (PSA) Overview (HDP-RPT-FSS-400)
3) Pre-Audit Submittal Table for Final Status Survey Final Report Volume 5, Chapter 1

cc: J. W. Smetanka, Westinghouse
M. R. Meyer, NRC/DUWP/MDB
J. A. Smith, NRC/DUWP/MDB

Attachment 1

Final Status Survey Final Report Volume 5, Chapter 1, Revision 1

Piping Survey Areas (PSA) 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 5, Chapter 1

TITLE: **Piping Survey Areas (PSA) Overview**

REVISION: **1**

EFFECTIVE DATE: JUN 0 6 2016

Approvals:

Author:	Kenneth E. Pallagi	Date: 6-6-2016
Reviewed By:	Scott G. Zoller (W. Clark Evers for Scott Zoller)	Date: 6/6/16
Owner/Manager:	W. Clark Evers	Date: 6/6/16

HDP-RPT-FSS-400

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LIST OF ACRONYMS AND SYMBOLS

Am	Americium
CFR	Code of Federal Regulations
CSM	Conceptual Site Model
DCGL	Derived Concentration Guideline Level
$DCGL_{PD}$	DCGL ("PD" suffix denotes "Pipe Diameter")
$DCGL_{SO}$	DCGL ("SO" suffix denotes "Small Office")
DP	Hematite Decommissioning Plan
DQA	Data Quality Assessment
DQO	Data Quality Objective
FSS	Final Status Survey
FSSFR	Final Status Survey Final Report
HDP	Hematite Decommissioning Project
HP	Health Physics
MeV	Megaelectron Volts
NGP	Natural Gas Pipeline
NIST	National Institute of Standards and Technology
Np	Neptunium
NRC	U.S. Nuclear Regulatory Commission
Pu	Plutonium
QA	Quality Assurance
QC	Quality Control
Ra	Radium
RAI	Request for Additional Information
SWTP	Sanitary Wastewater Treatment Plant
Tc	Technetium
TEDE	Total Effective Dose Equivalent
Th	Thorium
U	Uranium

1.0 PIPING SURVEY AREAS INTRODUCTION

The purpose of this document, Final Status Survey Final Report (FSSFR) Volume 5, Chapter 1, *Piping Survey Areas (PSA) Overview,* is to provide a general description of the processes used in planning, designing, implementing, evaluating and reporting the results of final status surveys (FSS) performed of subterranean piping that will remain at the Hematite Site following license termination. Information specific to each remaining area of piping will be provided in a subsequent Volume 5 chapter.

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 surveying piping areas that remain following license termination.

During the approval process for the DP the U. S. Nuclear Regulatory Commission (NRC) issued Request for Additional Information (RAI) HDPC-14-Q6 which provided the expectation that the NRC would review and approve the methodology for embedded pipe characterization. In Westinghouse letter HEM-11-96, dated July 5, 2011 {ML111880290}, in response to Request for Additional Information (RAI) HDPC-14-Q6 Westinghouse provided the following resolution "*The method for final status surveys of piping will be submitted for NRC review and approval, with approval received prior to implementation of final surveys of piping.*"

As stated in the response to RAI HDPC-14-Q6 Westinghouse submitted letter HEM-12-73, *Request for Approval of the Hematite Final Status Survey Plan for Piping Remaining After Decommissioning, dated July 3, 2012* {ML12187A121}, which contained HDP-PO-FSS-800, *Final Status Survey Plan for Piping, Revision 0,* for NRC review and approval. NRC letter dated April 5, 2013, *U.S. Nuclear Regulatory Commission Review of Westinghouse Hematite's Final Status Survey Plan for Piping, HDP-PO-FSS-800* {ML13031A452}, provided that "*the proposed Plan, modified in accordance with the staffs comments, appears to provide a reasonable path forward in the final status survey of piping at the site; however, NRC staff review and comment on the Plan does not equate to an automatic approval of the overall final status survey results. The NRC will review the Final Status Survey Report once the final status survey is complete. Once the Final Status Survey Report is submitted to the NRC, dose assessments, survey results, and evaluations related to final status survey coverage (for accessible and inaccessible areas) will be evaluated by the staff. In addition, the NRC may also choose to conduct confirmatory surveys and in-process surveys, as necessary.*"

Subsequently, on June 15, 2015, HDP-PO-FSS-800, Revision 1 was issued that contained resolution of the NRC comments contained within the April 5, 2013, NRC letter. The guidance contained in the following regulatory documents was used in the development of HDP-PO-FSS-800 to demonstrate that the dose contribution from residual activity remaining in the piping meets the dose criterion for license termination specified in 10 CFR 20.1402 (Reference 9.2).

- DO-08-004, Hematite Decommissioning Plan,
- NUREG-1507, Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions (Reference 9.3),
- NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), (Reference 9.4),
- NUREG-1757, Volume 2, Consolidated NMSS Decommissioning Guidance - Characterization, Survey, and Determination of Radiological Criteria (Reference 9.5),
- ISO Standard 7503-1 Evaluation of Surface Contamination – Part 1: Beta Emitters (Maximum Beta Energy Greater than 0.15 MeV) and Alpha Emitters, (Reference 9.6).

The conduct of FSS activities for PSAs was carried out through the implementation of the following HDP procedures:

- HDP-PO-FSS-700, Final Status Survey Program
- HDP-PO-FSS-800, Final Status Survey Plan for Piping
- HDP-PR-FSS-701, Final Status Survey Plan Development
- HDP-PR-FSS-703, Final Status Survey Quality Control
- HDP-PR-FSS-720, Final Status Survey Data Integrity and Database Management
- HDP-PR-FSS-722, Final Status Survey Reporting

A procedure revision history for the above procedures is provided in Appendix A.

2.0 REMEDIATION ACTIVITIES

Site characterization data for the DP provided a preliminary assessment of the piping sections that were expected to be decontaminated and subjected to FSS or simply subjected to FSS and remain at the time of license termination. The piping sections are summarized in Table 2-1, *Pre-Remediation Piping Inventory*. As submitted to the NRC in HDP-PO-FSS-800 Revision 0, the piping identified as Class 1 are illustrated in Figure 2-1, *Hematite Class 1 Piping (Storm Drains, Sanitary/Gray Drains)*, and the piping identified as Class 3 are illustrated in Figure 2-2, *Hematite Class 3 Piping (Public Water)*. Class 1 piping had the potential to be radiologically contaminated and included all gray water piping and drains, storm sewer water piping and drains, and piping from the Sanitary Wastewater Treatment Plant (SWTP).

2.1 Remediation Planning

The following is a description of the general piping remediation plan employed to support site remediation efforts.

Process piping was piping associated with Special Nuclear Material operational processes, and as such was confined to the Process Buildings area and was designated for removal and disposal.

Gray water piping was piping containing non-potable water; water that for example originated from laboratory sinks, washing machines or shower facilities. This piping was designated for removal and disposal.
Piping from the SWTP contained sanitary or gray waste water that had been treated and was being discharged to the Site Creek below the Site Dam. This piping was designated as candidate Class 1 piping for FSS.

Raw Water System piping was for the distribution of water formerly supplied by the site well, with pressure maintained by using a storage tank on the hill north of State Road P. The Raw Water System supplied potable water to the site and supplied water to the emergency fire pump in Building 115. Subsequently, as Public Water District Number 5 ran a water main past the site the site was connected to the public water supply. The portions of the Raw Water System that remained in service along with the newly installed water supply lines were henceforth known as the Public Water system. This piping was designated as Class 3 piping.

Storm water drains and piping collected rainfall/runoff from rooftops and ground surfaces throughout the site for discharge to the Site Pond or streams. This piping was designated as candidate Class 1 piping for FSS.

2.1.1 Preliminary Piping Access, Visual Inspection and Survey

As a function of piping remediation planning and FSS preplanning, portions of the piping (Class 1) that was expected to be final status surveyed was accessed, to the extent practical, for visual inspection by remote camera and radiation survey equipment. The preliminary piping access and visual inspection campaign was conducted during October 2010.

The purpose of the visual inspection was to determine if piping could be adequately accessed for FSS and to ascertain the general condition of the piping by identification of obstruction, residual deposits of sediment/scale, and breaks or cracks in the piping. None of the Class 1 piping included charged systems that required isolation and draining prior to accessing. The results of the visual inspection indicated that with the ability to access the piping with the remote camera that there would be a high degree of confidence that a significant percentage of the piping could be successfully surveyed. The visual inspection also indicated that, as expected, in storm drains there was soil, sediment and rocks that would be required to be removed to allow for an adequate FSS. It also confirmed that specific areas of piping would be difficult to access.

Radiological survey equipment was inserted and positioned in the piping by using a flexible rod or a tether (or equivalent) to push or pull the survey instrumentation through the piping. The purpose of the radiological survey was to determine the need/extent of

decontamination that may be necessary. The results of the radiological survey indicated that minimal if any decontamination would be required.

Scale or sediment samples were also collected from drain traps, manholes and piping for sample analysis. The laboratory analyses of these samples were used to confirm the isotopic distribution.

2.1.2 Remediation Planning Summary

In general, during remediation, little attempt was made to decontaminate and save the majority of subterranean piping throughout the site as much of it was located in soil that was to be remediated by removal for disposal. For piping located in soil that did not need to be remediated, because of the time and difficulty to hydrolaze (decontaminate) and FSS the piping, it was more cost effective and expedient to remove the piping and send it offsite for disposal.

For the larger diameter storm water piping that had little to no contamination, cleaning and surveying would be cost effective, enabling the pipe to either be abandoned in place or placed back into use.

It is anticipated, based on radiological conditions, that no onsite subterranean piping of any kind would be required to be grouted and left in place.

2.2 Process Piping

The Process Buildings were the only buildings to contain process system drains and piping. Following demolition and the disposition of the above ground portions of the Process Buildings as waste, the below ground process piping and drains remained within and under the concrete floor slabs and foundations. All of these process drains and piping were removed and disposed of as waste during the demolition of the Process Building slabs and foundation. In addition to the process piping, all other non-process related drains and piping (i.e., storm, gray, sanitary) associated with the Process Buildings were removed and disposed of as waste. No significant areas of contamination were identified in any of the drains or piping dispositioned as waste during the removal of the Process Buildings or its slabs and foundations.

2.3 Class 1 Piping (Storm Water, Sanitary/Gray Waste Water)

As described in the DP, four buildings will remain on the Hematite site at license termination: Building 110, Administration and Security (security, conference rooms, offices); Building 115, Fire Pump House (generator and fire pump); Building 230, Rod Loading (fuel rod loading plant); and Building 231, Warehouse (shipping container storage). Neither Building 115 nor Building 231 ever contained any process, storm, gray or sewer drains or piping. Buildings 110 and 230 contained only storm and sanitary/gray sewer drains and lines.

2.3.1 Storm Water Drain System

All the storm water drains and piping have either been removed or final status surveyed to demonstrate meeting the release criterion. The underground storm water drain piping that had originated near Building 110 and flowed to the north end of the Site Pond has been abandoned in place. In preparation for the abandonment of this storm water piping surface soil was contoured to form a swale that directs the surface water runoff from the parking lot and area near Building 110 to bypass the storm water drains. Also, the storm water downspouts associated with Buildings 110 and the north and west sides of Building 230 that had previously drained into this same storm water drain piping were redirected to divert rainwater to this diversion swale.

On the east and south sides of Building 230 the downspouts have also been diverted to flow onto the ground surface. These areas have been graded for storm water to flow to a low area southeast of Building 230 or directly towards the Site Pond. A drain has been installed in this low area to collect storm water runoff and divert it to the Site Pond via storm water drain piping. This storm water drain piping is the only previously existing storm water drain piping that has been placed back into service following the completion of FSS.

Prior to FSS of the storm water drain piping, a contractor that specializes in storm water drain piping clean out was utilized to flush/clean all of the storm water drain piping that will remain at license termination. Figure 2-4 through Figure 2-6 are photographs of the contractor performing storm water drain piping cleaning. Figure 2-7 through Figure 2-10 are photographs that provide examples of the pre and post cleaning condition of the storm drain manholes and piping.

The Storm Water Drain System piping cleanout was very effective in that minimal to no residues or sediments remained in the piping. Therefore, radiation attenuation is not a concern for FSS of the piping. Based upon the piping FSS completed to date, the results of surveys indicate there has been no evidence of removable contamination in the piping.

The visual inspection conducted post cleaning indicated that all piping to undergo FSS was intact and that the internal condition of the piping was such that detectors would be able to pass through the entirety of the piping. No internally inaccessible areas or sections were identified.

2.3.2 Sanitary and Gray Waste Water Systems

All sanitary and gray waste water lines were removed within Building 110 and Building 230 and disposed of. All of the sanitary and gray water lines from Building 110 and Building 230 to the SWTP were removed and disposed of.

The SWTP was demolished and shipped off site as waste. The SWTP discharge line carried treated water from the SWTP to the Site Creek. A section of the SWTP discharge line was removed downstream from the SWTP and a section of the SWTP discharge line was removed upstream from its discharge point below the Site Dam. The remaining

"mid-section" of SWTP piping (SAN-1 on Figure2-3) is 293 feet in length and has been abandoned in place. This section of piping was cleaned by the contractor performing the storm water drain piping. Figure 2-11 is a photograph showing the access point of the SWTP pipe for cleaning and FSS.

The SWTP pipe cleanout was very effective in that minimal to no residues or sediments remained in the piping. Therefore, radiation attenuation is not a concern for FSS of the pipe. Based upon the pipe FSS completed, the results of surveys indicate there has been no evidence of removable contamination in the piping.

The visual inspection of the SWTP pipe conducted post cleaning indicated that the pipe internal condition was intact and that detectors would be able to pass through the entirety of the pipe. No internally inaccessible areas or sections were identified.

2.4 Class 3 Piping (Raw Water System, Public Water System)

The Raw Water System was formerly supplied by the site well, with system pressure being maintained by using the storage tank located on Westinghouse property on the hill north of State Road P. The Raw Water System supplied potable water to the site and supplied water to the emergency fire pump in Building 115, which in turn supplied pressurized water to the fire hydrants. In order to separate the Process Building from Buildings 110 and 230, the site well was abandoned, the emergency fire pump removed and the piping isolated. The piping to the Process Building was severed. Approximately half of the Raw Water System piping was utilized by the Public Water System.

The Public Water supply remains available at the Hematite site but portions of the on-site system (e.g., restrooms and cafeteria) were abandoned at the initiation of remediation to facilitate remediation activities. The public water supply to the onsite fire hydrants have remained in service. Since the water supply system is a public water source originating offsite, it was designated as a Class 3 system indicating there should be no associated radiological contamination. As site remediation took place, several fire hydrants had to be removed and supply line piping uncovered in a number of locations.

There are no former Raw Water Systems or Public Water Systems residing in or traversing through Building 231 with the exception of a sprinkler supply line which was roughed in (capped at the floor) but never activated. The sprinkler line is part of the Public Water System.

Although remediation/decontamination of the Raw Water Systems and Public Water Systems was not necessary, radiological surveys were conducted on the exposed exterior of the supply lines to verify that no radiological contamination had collected along the lines. No contamination was identified in any of the surveys. The public supply of water will remain in place and pressurized at license termination to maintain the viability of the fire hydrants in the event of onsite fire.

2.5 Natural Gas Pipeline (NGP)

An 8 inch diameter high pressure natural gas transmission pipe line runs the length of the southeast border of the Hematite Site. The NGP was installed in 1956 and is a sole source of natural gas for local communities. Soil impacted by former Site operations was located near the NGP and was remediated. As the NGP has been active since its installation it does not present a condition in which the internals of the NGP would have become contaminated. Figure 2-12 is a photograph of the NGP during soil remediation operations.

2.6 Piping Remediation Summary

Overall, the approach applied in regards to disposition of piping by the HDP resulted in a minimal amount of remaining subterranean piping. Due to the amount and types of piping removed for disposal, the piping that did remain provided the added advantage of limiting the type of survey instrumentation and complexity required to perform FSS.

A large percentage of the storm water drain piping and a portion of the SWTP discharge line will remain at license termination and will meet the release criterion. All other Class 1 piping and SWTP piping was removed and disposed of as waste. The smallest diameters of these remaining lines is 12 inches for the storm water drain piping and 6 ¾ inches for the SWTP discharge line piping. The size of these lines allowed for adequate surveys and visual inspections to be conducted without costly or unduly sophisticated equipment.

Figure 2-3, *Storm and Sanitary Piping Remaining at License Termination*, illustrates the piping that will undergo FSS and will remain at license termination.

3.0 RELEASE CRITERIA

Section 5.1 of FSSFR Volume 1, Chapter 1 provides a discussion of the radionuclides of significance at Hematite. Radionuclide-specific derived concentration guideline levels (DCGLs) for residual surface contamination on buildings, structural surfaces and piping were developed as described in Chapter 5 of the DP using the RESRAD-BUILD computer code, Version 3.4. The exposure scenarios included building occupancy under two conceptual site models (CSM) having different room sizes (i.e., Small Offices and Large Warehouse). Piping DCGLs ($DCGL_{PD}$) were also derived using RESRAD, version 6.4 for a range of pipe diameters. For simplicity and conservatism, the small office DCGL ($DCGL_{SO}$) is applied to piping as the release criteria. A summary of the $DCGL_{SO}$ is provided as Table 3-1.

Since these values are radionuclide-specific release criterion, the values could not be applied directly to field measurements of gross activity. To account for this, gross activity limits (alpha-plus-beta, or beta only depending upon the detector) were derived based on the isotopic distribution of radionuclides that can be measured using field instrumentation, and accounting for the distribution of all other undetected radionuclides that could be present. Table 4-1 of the DP provides the initial isotopic distribution based on previously collected samples of pipe scale and debris. This distribution is reproduced

in Table 3-3. These initial isotopic distributions were used to determine a gross activity value that was equivalent to the $DCGL_{SO}$ using Equation 4-4 of MARSSIM (Reference 9.3). The resultant gross activity $DCGL_{SO}$ is provided in Table 3-4.

During the performance of FSS, additional samples of pipe scale and debris were collected for isotopic analysis. The results of the isotopic analysis uphold the initial isotopic distributions used in development of the DCGLs, and the specific isotopic results are provided in the subsequent chapters to this report.

Additionally, a gross activity DCGL ($DCGL_{PD}$) was developed for piping as a function of pipe diameter, and discussed in Chapter 5 of the DP. The buried pipe DCGLs are a function of the pipe diameter since the internal surface area increases proportionally as the radius increases, while the interior volume increases as a square of the radius. Therefore, the DCGL increases as the pipe diameter increases. The $DCGL_{PD}$ from DP Table 5-22 is summarized in Table 3-2. If levels of residual contamination were found to exceed the $DCGL_{SO}$, the $DCGL_{PD}$ for the specific pipe diameter would serve as the comparator for individual measurement results to determine if the piping should have been grouted in-situ to meet the dose-based criterion rather than excavate the piping. In no situation will this be necessary.

The contamination levels in the majority of the piping to remain had been expected to be nonexistent or very low relative to the buried pipe DCGLs. Radiological surveys conducted on the piping confirmed this assessment.

The protocol established to evaluate the piping against the DCGL was as follows:

- If all measurements were less than the gross activity $DCGL_{SO}$ and the Data Quality Objectives (DQOs) were met, then no additional investigation would be required and the piping survey unit could be recommended for unrestricted release.
- If any individual measurement exceeded the gross activity $DCGL_{SO}$ but did not exceed the gross activity piping $DCGL_{PD}$, an investigation would be performed and documented.
- If the average gross activity level within a section(s) of piping containing the elevated result(s) did not exceed the $DCGL_{SO}$, the piping survey unit could be recommended for unrestricted release.
- In the unlikely event buried piping to remain exceeded $DCGL_{SO}$ and could not be practically decontaminated or removed, HDP would verify the piping met the $DCGL_{PD}$ and grout the piping in place. HDP would evaluate the specific dose from piping to be left and accounted for that dose in the affected piping survey unit. The specific dose from piping to be left would be determined on a case-by-

case basis using specific piping characteristics and a modeling program (e.g., MicroShield®[1]).

- If any individual measurement exceeded the gross activity $DCGL_{PD}$, that section of piping containing the individual measurements exceeding the piping $DCGL_{PD}$ would be further decontaminated and re-surveyed, or excavated and removed.

For piping scan surveys, the Sign test is applied using a direct comparison to the $DCGL_{SO}$. In the event that a piping survey unit could not meet the release criterion, a retrospective power analysis would be used to determine if it was due to excess residual radioactivity or if it was due to an inadequate sample size. The retrospective power analyses would be performed following the methods of MARSSIM Appendix I.9 (Reference 9.4). As of this time, no piping is expected to exceed the release criteria, however if a retrospective power analysis is required it will be noted in the respective piping survey release record Volume 5 Chapter.

FSSFR Volume 3, Chapter 1, Section 3.2, *Demonstrating Compliance with the Dose Criteria*, provides a discussion on how the dose attributed to a piping survey will be added to the Total Dose for a land survey area survey unit.

4.0 DATA QUALITY OBJECTIVES

The FSS process consists of the following principal elements to which the DQO are applied: Planning and Design, Implementation, and Data Assessment. DQO allow for systematic planning, address situations that require a decision to be made, and provide a framework for selecting actions that result in obtaining data of sufficient quantity and quality. The DQO process is iterative and allows for incorporation of newly gained knowledge to enhance the effectiveness of subsequent actions. The seven steps of the DQO process are as follows:

1. State the problem,
2. Identify the decision,
3. Identify inputs to the decision,
4. Define the study boundaries,
5. Develop a decision rule,
6. Specify limits on decision errors, and
7. Optimize the design for obtaining data.

The DQO process is described below as it applies to the HDP.

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1. **State the Problem**

The problem is the potential presence of residual radioactivity associated with licensed activities within piping. The primary radionuclides of concern (ROC) and the extent of contamination were assessed in the Historical Site Assessment (HSA), (Reference 9.7) and the Hematite Radiological Characterization Report (HRCR), (Reference 9.8). The primary ROC are uranium-234 (U-234), uranium-235 (U- 235+D), uranium-238 (U-238+D), technetium-99 (Tc-99), and thorium-232 (Th-232+C). Additionally, trace amounts of americium-241 (Am-241), neptunium-237 (Np-237+D) and plutonium-239/240 (Pu-239/240) may be present, however the latter are insignificant contributors to potential dose. Although Radium-226 (Ra-226+C) was identified as an ROC site-wide, it was not identified as an ROC in the buildings and associated piping.

2. **Identify the Decision**

The DP, in conjunction with the associated implementing procedures, was used to demonstrate that the piping met the criteria for unrestricted release (25 millirem per year total effective dose equivalent [TEDE]) as specified in 10 CFR 20.1402. Compliance with the release criteria was satisfied using the guidance provided in MARSSIM, the DP, and associated Hematite approved procedures.

Radionuclide-specific DCGLs for piping were developed as described in Chapter 5 of the DP. The exposure scenarios included building occupancy under two CSMs having different room sizes (i.e., Small Offices and Large Warehouse). Piping DCGL ($DCGL_{PD}$) was also derived using RESRAD, version 6.4 for a range of pipe diameters. For simplicity and conservatism, the small office DCGL ($DCGL_{SO}$) was initially applied to piping as the release criteria.

Since these values are radionuclide-specific release criterion, the values cannot be applied directly to field measurements of gross activity. To account for this, gross activity limits (alpha-plus-beta, or beta only depending upon the detector) were derived based on the isotopic distribution of radionuclides that could be measured using field instrumentation, and accounting for the distribution of all other undetected radionuclides that may be present. These initial isotopic distributions were used to determine a gross activity value that was equivalent to the $DCGL_{SO}$. The resultant gross activity $DCGL_{SO}$ is provided in Table 3-3.

Additionally, a gross activity DCGL ($DCGL_{PD}$) was developed for piping as a function of pipe diameter. In the event that levels of residual contamination were found to exceed the $DCGL_{SO}$, the $DCGL_{PD}$ for the specific pipe diameter would serve as the comparator for individual measurement results to determine if the piping may be grouted in-situ and meet the dose-based criterion rather than excavate the piping.

3. **Identify Inputs to the Decision**

Decision inputs determine the acceptable risk of a decision error in the release of piping systems onsite. To minimize risk, the MARSSIM process applies the graded approach

that places greater survey efforts on areas with the highest potential of contamination. Inputs to the decision process were based on:

- A comparison of scanning surveys (gross activity, alpha + beta, or beta depending on the detector) to the $DCGL_{SO}$ or $DCGL_{PD}$,
- Results from statistical testing of data obtained by static measurements measuring total activity including fixed and removable contamination, and
- A determination of whether data are of sufficient quality and quantity.

The appropriate DCGL is used as the comparator to the data collected by these activities in the decision making process.

4. Define the Study Boundaries

The study boundaries consisted of piping that existed prior to surveying and remediation that had the potential to remain at the time of license termination. This included sections of the piping indicated in Table 2-1.

Not all piping systems had the same potential for contamination and therefore did not require the same level of survey coverage to achieve an acceptable level of confidence that it met the release criteria. As provided in Westinghouse's response to RAI HDPC-14-Q6 Westinghouse letter HEM-12-73 {ML12187A121}, the piping systems were sub-divided based on potential for contamination and identified as either Class 1 or Class 3 as indicated in Table 2-1.

The piping was further sub-divided into three survey areas based on physical arrangement. These survey areas were comprised of the Storm Drains, Sanitary/Gray Water Drain Systems and the Public Water System as indicated in Table 2-1. The Storm Drains and Sanitary/Gray Water Drain Systems were identified as Class 1 piping survey units, while the Public Water System was considered Class 3 piping survey unit. As shown in Table 2-1, each Class 1 survey area was to be further subdivided based on the amount and size of the piping, such that the total estimated surface area inside the piping within each piping survey unit was well within the suggested survey unit maximum sizes by classification as recommended by MARSSIM.

5. Develop a Decision Rule

The decision rule is the determination of whether residual activity exceeds the DCGL.

- If all measurements are less than the gross activity $DCGL_{SO}$ and the DQO have been met, then no additional investigation is required and the piping survey unit is recommended for unrestricted release.
- If any individual measurement exceeds the gross activity $DCGL_{SO}$ but does not exceed gross activity piping $DCGL_{PD}$, an investigation is performed and documented.

- If the average gross activity level within a section(s) of piping containing the elevated result(s) does not exceed the $DCGL_{SO}$, the piping survey unit is recommended for unrestricted release.
- In the unlikely event buried piping to remain exceeded the $DCGL_{SO}$ and could not be practically decontaminated or removed, HDP was to verify the piping met $DCGL_{PD}$ and grout the piping in place. HDP would evaluate the specific dose from piping to be left and account for this dose in the affected piping survey unit. The specific dose from piping to be left would be determined on a case-by-case basis using specific piping characteristics and a modeling program (e.g., MicroShield®[1]).

– If any individual measurement exceeded the gross activity $DCGL_{PD}$, the section of piping containing individual measurements exceeding the piping $DCGL_{PD}$ would be further decontaminated and re-surveyed, or excavated and removed. For piping surveys, the Sign test was applied using a direct comparison to the $DCGL_{SO}$. In the event that a piping survey unit did not meet the release criterion, a retrospective power analysis was used to determine if this is due to excess residual radioactivity or if it is due to an inadequate sample size. Retrospective power analyses, if necessary, was performed following the methods of MARSSIM Appendix I.9, *Power Calculations for the Statistical Tests*.

6. Specify Limits on Decision Errors

The probability of making decision errors is part of the DQO process in establishing performance goals for the data collection design and could be controlled by adopting a scientific approach through hypothesis testing. In this approach, the survey results were used to select between the null hypothesis or the alternate condition (the alternative hypothesis) as defined and shown below:

– Null Hypothesis (Ho) – The piping survey unit does not meet the release criterion; and,

– Alternate Hypothesis (Ha) – The piping survey unit does meet the release criterion.

The Type I decision error (α) would result in the release of a piping survey unit containing residual radioactivity above the release criterion or a false negative. This occurs when the null hypothesis is rejected when in fact it is true.

The Type II decision error (β) would result in the failure to release a piping survey unit when the residual activity is below the release criterion or a false positive. This occurs when the null hypothesis is accepted when in fact it is not true.

– Following the guidance in NUREG-1757 (Reference 9.4), the decision error rates for FSSs designed at the HDP are established as follows: The α value will be set at 0.05 unless prior NRC approval is granted for using a less restrictive value; and,

– The β value is nominally set at 0.10, but may be modified, as necessary, after

weighing the resulting change in the number of required sampling and measurement locations against the risk of unnecessarily investigating and/or remediating piping survey units that are truly below the release criterion.

An index of sensitivity (d') represents the distance between the means of the background and background plus signal. For surface scanning, 1.38 was used as the value for d' based on a true positive proportion of 0.95 and a false positive proportion of 0.60. This value is based on data contained in Table 6.5 of MARSSIM .

7. Optimize the Design for Obtaining Data

The first six steps of the DQO process are used to develop the performance goals of the FSS. The final step in the process leads to the development of an adequate survey design. In order to optimize the survey and to meet the DQOs, any available information is reviewed. This may include previous characterization surveys or preliminary survey data collected near the onset of the FSS. In the absence of data, assumptions are made in accordance with the guidance as provided in MARSSIM. This allows for proper survey planning and design as well as aids in ensuring piping survey units are established properly and that adequate data are collected.

5.0 FINAL STATUS SURVEY DESIGN

The output for the FSS planning and design phase is the FSS piping plan. The general approach prescribed by MARSSIM for FSS requires that a minimum number of measurements or samples be collected within a survey unit so that statistical tests can be applied with adequate confidence. Decisions regarding whether a piping survey unit meets the applicable release criterion are described in the following sections.

Sample Size Determination

The level of survey effort required for a given piping survey unit is determined by the potential for contamination as indicated by its classification. The number of systematic measurement locations is dependent upon the anticipated statistical variation of the final data set such as the standard deviation, the decision errors, and a function of the gray region as well as the statistical tests to be applied. The number of measurements is determined, using the sign test sample size values, (Table I.2 of MARSSIM) to establish the relative shift using the decision errors.

<u>Reference Grid</u>

A one-dimensional reference grid will be used within the piping (e.g. a straight line down the bottom center of the pipe). The measurement spacing within each Class 1 piping survey unit is established by dividing the overall length of the pipe to be surveyed as part of the piping survey unit by the number of measurements required by the FSS plan. This results in a systematic (static) measurement frequency per unit length of piping.

As described above, the number of systematic measurements for all Class 1 piping has been calculated to be a minimum of 11 systematic locations. This value is based on the sign test with a predicted relative shift of 3. As part of the FSS planning process the

predicted relative shift is calculated for each survey unit. If the relative shift does not fall between 1 and 3, an adjusted LBGR is calculated to achieve a relative shift between 1 and 3. The adjusted LBGR may be set as low as the MDC for the specific analytical technique to achieve this, if necessary. The actual relative shift, and adjusted LBGR for each survey unit will be reported for each survey unit in subsequent chapters to this report, however as a matter of conservatism, the RSO has directed that 15 systematic locations be specified by the FSS plan for each piping survey unit. A reference grid was not established for the Class 3 piping survey units.

Scan Coverage

The purpose of scan measurements is to confirm that an area was properly classified, and that any areas of elevated activity are identified. Depending upon the calculated sensitivity of the scanning method used, the number of static total surface contamination measurements is increased if the scanning sensitivity is greater than the $DCGL_{SO}$. The scan coverage also depends upon the piping survey unit classification; Class 1 piping requires a higher degree of scan coverage than Class 3 piping.

<u>Class 1 Piping Scan Coverage</u>

For Class 1 piping survey units, surface scans are performed on the interior bottom within the accessible piping to the maximum extent practical. The interior bottom of the piping was selected as the scan location as it is the most probable location that residual contamination would reside. Due to the remote nature of the piping surveys, 100 percent scan coverage is difficult, particularly at greater distances from the access locations. The goal for FSS is to ensure that all accessible piping is subjected to scan coverage and also an evaluation of sections of piping between access locations where full scan coverage is not achieved. The evaluation considers the results of the scanned areas and the static measurements performed within the accessible portions of the piping, and also the information obtained from the visual inspections, to determine if the type and number of measurements are adequate. The evaluation described in this section is consistent with the direction provided in Section 6.4.5 of NUREG/CR-5849.

<u>Class 3 Piping Scan Coverage</u>

Class 3 piping survey units are subjected to judgmental or biased surface scan coverage at access locations identified by the Health Physics (HP) Staff. Given the very low probability of the public water supply containing licensed radioactivity, a minimum of 11 locations of all of the Class 3 piping will be selected for survey.

6.0 FINAL STATUS SURVEY

Final status surveys are conducted to compile data of adequate quantity and quality to demonstrate the annual dose associated with residual activity in piping and the Land Survey Area in which it resides meets the dose criterion for license termination specified in the Code of Federal Regulations (CFR) Title 10, Part 20.1402, "Radiological Criteria for Unrestricted Use".

Instrument Selection

The radiation detection instrumentation selected is based upon the pipe diameter to be surveyed, with the intent to position the face of the detector as close to the piping surface to be surveyed as possible. Due to the size of piping left in place, the only detector selected to perform FSS was a Ludlum Model 43-68 (126 cm^2 flat gas flow proportional detector). This detector was either pushed or pulled through the pipe using the instrument mounted on a sled in areas that could not be reached by hand holding the instrument. In addition, a small remotely operated cart was used with a camera to conduct visual inspections inside the piping.

Instrument Calibration and Efficiency Calculation

Each Ludlum Model 43-68 used to perform FSS was calibrated with sources traceable to the National Institute of Standards and Technology (NIST), and representative of the type and energy of the radiations emitted by the ROC for an 8 inch diameter pipe. The detectors are calibrated in a similar geometry, with a similar cable length, and with the source presented at a distance that approximates the distance to the surface of the piping that was used during the survey. This calibration is applicable to all piping that will remain at the time of license termination with the exception of the SWTP piping. As the SWTP piping is 6.75 inches in diameter, as required by HDP-PO-FSS-800 a weighted detection efficiency was calculated for this piping.

Instrument Detection Sensitivity

Instrument detection sensitivities depend upon the measurement geometry, instrument efficiencies, count times and scan speeds. Both scan and static measurement sensitivities for the various piping detectors were determined using the guidance in Chapter 14 of the DP, and as specified below:

The scan MDC was estimated for a 126 cm^2 gas proportional detector with a thin Mylar window (0.8 mg/cm^2). The surveyor efficiency (*p*) will be 0.5, as recommended by MARSSIM and NUREG-1507. The probe area is 126 cm^2 with a nominal background count rate of 300 cpm for poured concrete. The total weighted efficiency was estimated to be 0.16 based on nominal instrument efficiencies for 4.5 percent U-235 enrichment. The estimated scan MDC for building and structural surfaces (piping is considered a structural surface) is calculated to be 1,299 dpm/100 cm^2 and is illustrated below.

$$Scan\ MDC = \frac{1.38 \times \sqrt{300 \times \frac{1}{60}} \times \frac{60}{1}}{\sqrt{0.5} \times 0.16 \times \left(\frac{126}{100}\right)} = 1{,}299 \text{ dpm/100 cm}^2 \qquad \text{Equation 6.1}$$

The static MDC was estimated for a 126 cm^2 gas proportional detector with a thin Mylar window (0.8 mg/cm^2) and a nominal background count rate of 300 cpm. The total weighted efficiency was calculated to be 0.16 based on nominal instrument efficiencies

for 4.5 percent U-235 enrichment. The estimated static MDC for building surfaces is calculated to be 415 dpm/100 cm^2.

$$MDC = \frac{3 + 3.29 \times \sqrt{300 \times 1 \times \left(1 + \frac{1}{1}\right)}}{0.16 \times 1 \times \left(\frac{126}{100}\right)} = 415 \text{ dpm/100 cm}^2 \qquad \text{Equation 6.2}$$

Piping Isolation and Control

As previously described, based upon the visual inspection results, piping was required to be cleaned in order to remove the buildup of sediment and materials. Prior to commencing FSS on a section of piping it was verified by remote camera inspection to be clean and absent of obstructions that would prevent FSS. To maintain isolation and control of piping, as previously described, in preparation for the abandonment and FSS of storm water drain piping, surface soil was contoured and a swale that directs the surface water runoff from the site parking lot and area near Building 110 to bypass the storm water drains was installed. Figure 2-13 is a photograph of the installed swale that isolates and controls the storm water drain piping designated to undergo FSS. Also, the storm water downspouts associated with Buildings 110 and the north and west sides of Building 230 that had previously drained into this same storm water drain piping were redirected to divert rainwater to this diversion swale. On the east and south sides of Building 230 the downspouts have also been diverted to flow onto the ground surface not requiring remediation. These areas have been graded for storm water to flow to a low area southeast of Building 230 or directly towards the Site Pond.

Additionally some of the piping sections were also ventilated and heated in order to dry surfaces prior to survey. Figure 2-14 is a photograph of a portable ventilation and heating unit in operation drying a section of storm water drain piping.

Survey Methods

The survey methods employed by the FSS for piping consisted of a combination of interior surface scans of the bottom accessible portions of the piping, static measurements at judgmental and biased locations and an interior visual inspection. Smear samples and/or sediment and scale samples were collected to confirm, or update the isotopic distribution.

<u>Scan Surveys</u>

For Class 1 piping, scan surveys are performed to the maximum extent practical over the length of the bottom portions of the piping. Surface scans were performed either by pushing the detector into the piping or by pulling the detector through the piping from the opposite end. Figure 2-15 is a photograph of a detector unit at the access point of the SWTP piping. Scan speeds were controlled to ensure detection sensitivities below the $DCGL_{SO}$.

For Class 3 piping, scan surveys were performed only within the immediate vicinity of the access locations.

Static Measurements

For the purposes of FSS, piping surveys units are treated as 'Structures' and piping static measurement locations are determined in a manner similar to that of building structures. For Class 1 piping, static measurements were performed at systematic locations along the length of the piping. The measurement frequency was determined by the overall length of the piping within the piping survey unit and the number of measurements required. Additional static measurements were performed at locations of elevated count rate (biased) that are observed during the scan survey, or at locations where visual inspection identified cracks or breaks in the piping. Biased measurement results were not included in the statistical evaluation, but are directly compared to the $DCGL_{SO}$.

For Class 3 piping, static measurements were collected at the accessible openings of piping.

Smears and Sediment Samples

Each FSS piping plan indicated that smear samples will be collected from the accessible openings of the piping whenever a scan survey is performed. Additional smear surveys were performed on the interior portions of manholes or culverts that provided access to piping. Due to the difficulty in accessing interiors of the piping due to length it was not possible to collect smear surveys beyond the accessible openings of any Class 1 or Class 3 piping.

In regards to sediment samples, due to the effectiveness of the pipe cleaning there was and is not expected to be any sediment available in the piping to take a sediment sample at the time FSS was or is going to be performed. Data from previously collected sediment samples are presented in the piping survey area release record, along with the final survey data, for informational purposes, however sediment sample results were not included in the statistical evaluation.

7.0 DATA QUALITY ASSESSMENT

The Data Quality Assessment (DQA) process is used during the evaluation phase of the FSS of piping to ensure the validity of results and to demonstrate the survey plan objectives have been achieved. The DQA process includes a review of the DQOs, the adequacy of the survey plan, assumptions regarding the isotopic distribution and associated gross activity limit, assumptions regarding the required number of measurements, and the appropriateness of the statistical testing. A summary of the DQA process is provided in the following sections.

Review of the DQOs and Survey Design

Prior to subjecting the data to statistical tests and comparing it to the release criterion, the data was confirmed to have been collected in accordance with applicable procedures,

survey plan and QA/QC requirements. This evaluation included a confirmation, by review of the daily instrument response checks that the instrumentation was operating properly. The survey documentation was reviewed to ensure the prescribed number of measurements were collected, and that the detection sensitivity met the DQO. Any discrepancies between data quality or the data collection process and applicable survey requirements were resolved and documented during data analysis.

Data Review

The net results were then converted to standard units of reporting for comparison to the DCGL by applying the weighted detection efficiency and any correction for the surface area of the detector. Basic statistical quantities were calculated for the sample data set from systematic static measurements including the maximum, mean, median and standard deviation. An initial assessment of the measurement results and any sample data was used to determine whether the survey unit met the release criteria. Interpreting the results for the piping surveys was straightforward with an initial comparison to the $DCGL_{SO}$ or the $DCGL_{PD}$.

- Any individual measurement exceeding the $DCGL_{SO}$ was further evaluated against the piping $DCGL_{PD}$.
- Sections of piping containing individual measurements that exceed the $DCGL_{SO}$, but are less than the $DCGL_{PD}$ were evaluated to determine the need for further decontamination and re-survey, or grouting the portion of the piping containing elevated activity in preparation for leaving in place.
- Sections of piping containing individual measurements exceeding the piping $DCGL_{PD}$ were further decontaminated and re-surveyed, or excavated and removed.

Sign Test

Section 14.4.2.5 of the DP states that the sign test will be used to evaluate surface contamination measurements on building surfaces. The sign test was applied to the piping survey units since the interior of the piping was considered a structural surface and the structural surface $DCGL_{so}$ values was used to evaluate the survey measurements. The Sign Test was applied using the systematic measurements obtained from within piping. The Sign test was based on net FSS results; the net results were obtained by subtracting the instrument response to ambient conditions from the gross results, but did not include a correction for the response due to naturally-occurring radioactivity in construction materials.

The Sign Test was conducted as described below:

1. Each piping survey unit measurement was listed. This consisted of the net radioactivity measurement by subtracting the instrument response to ambient conditions from the gross results. This consisted only of the systematic sampling and measurement locations to avoid bias in the statistical evaluation.
2. Each measurement was subtracted from the $DCGL_{SO}$ (or $DCGL_{PD}$).
3. Differences where the value was exactly zero were discarded and the number of measurements reduced by the number of such zero measurements.

4. The number of positive differences was then totaled. Measurements that were less than the release criteria provided evidence that the piping survey unit met the site release criterion. The resulting total was the test statistic (S+), or critical value.
5. The critical value (S+) was then compared to the critical value as provided in Appendix I, Table I.3 of MARSSIM, for the total number of measurements taken and the corresponding decision error (α), which was set at 0.05. Provided the critical value, S+, was greater than the value as given in the reference table, the null hypothesis was rejected and the piping survey unit met the release criterion. If the critical value, S+, was less than or equal to the value, the piping survey unit failed to meet the release criterion. In the event that the Sign Test failed, the piping survey unit was re-evaluated to determine whether additional remediation was required or the FSS re-designed to collect more data (i.e., a higher frequency of measurements and samples).

Piping Survey Unit Dose Contribution Assessment

Any piping that was to be grouted in place would be further evaluated using MicroShield®[1] modeling as described in Attachment 4 to HEM-10-85, Response to Request for Additional Information Concerning Hematite Decommissioning Plan: Chapter 5, Dose Modeling {ML102290015} to assess any potential exposure to the public in the event that piping is removed following license termination. This dose contribution would have then been summed with the contribution to dose from the soil within the applicable piping survey unit. The assessment of potential exposure to the public was not necessary as no piping was expected to be grouted.

Elevated Measurement Comparison

The Elevated Measurement Comparison (EMC) will not be applied to the results of piping surveys. Any piping that does not meet the $DCGL_{so}$ is further evaluated as described in the following section. Currently all remaining piping is believed to meet the DCGLso.

Data Conclusions

The data evaluation results in one of two conclusions consistent with the decision rules discussed previously.

- If all measurements were less than the gross activity $DCGL_{SO}$ and the DQO were met, then no additional investigation was required and the piping survey unit was recommended for unrestricted release.
- In the event buried piping to remain exceeded $DCGL_{SO}$ and could not be practically decontaminated or removed, HP verified the piping met the $DCGL_{PD}$ and grouted the piping in place. HP evaluates the specific dose from piping to be left and accounts for the dose in the affected piping survey unit. If any individual measurement exceeded the gross activity $DCGL_{PD}$, the section of piping containing individual measurements exceeding the piping $DCGL_{PD}$ was further decontaminated and re-surveyed, or excavated and removed.

The Sign test was applied to the static measurements obtained at systematic locations and compared to the $DCGL_{SO}$. In the event that a piping survey unit did not meet the release criterion, a retrospective power analysis would be used to determine if it was due to excess residual radioactivity or if it was due to an inadequate sample size. Retrospective power analyses, if necessary, were performed following the methods of MARSSIM Appendix I.9, *Power Calculations for the Statistical Tests*.

8.0 SURVEY AREA RELEASE RECORD ORGANIZATION

In accordance with HDP-PO-FSS-700, *Final Status Survey Program*, documentation of the FSS will result in two types of reports, FSS Survey Area Release Records and an FSS Final Report, and will be consistent with Section 8.6 of NUREG-1757, Volume 2, Consolidated Decommissioning Guidance – Characterization, Survey, and Determination of Radiological Criteria.

The FSS Final Report will incorporate multiple Volumes. The first Chapter of Volumes 1 through 6 will include general information and an overview of the FSS Program for that subject area (Volume 2 *Reuse Soil*, Volume 3 *Land Survey Areas*, Volume 4 *Building Survey Areas*, Volume 5 *Piping Survey Areas,* Volume 6, *and Groundwater*). Subsequent Chapters (beginning with Chapter 2) within these Volumes will contain FSS Survey Area Release Records.

Survey Area Release Records are prepared to provide a record of the composition and location of the survey area; the measurements obtained during the FSS; the number and location of any small areas of elevated concentration; and a summary of the data that represents the final radiological condition, including a determination that an individual survey area/unit meets the release criteria.

The Piping Survey Area Release Records will be formatted to contain the following information:

- An Introduction section which will include Piping Survey Area specific information (e.g., geographical location/description, summary of historical radiological data).
- A description of the specifics of FSS Protocol and DQOs, including but not limited to:
- – Piping Survey Unit designation and classification.
- – Background determination.
- – Instrumentation (detector efficiencies, detector sensitivities, instrument maintenance and control and instrument calibration).
- – Survey methodology and protocols.
- – QC surveys.
- A Conclusion section which provides an overall assessment of the FSS of the piping survey unit.
- Supporting documents (e.g., spreadsheets, statistical analyses, figures, tables).

9.0 REFERENCES

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

9.2 Code of Federal Regulations, Title 10, Part 20.1402, "Radiological Criteria for Unrestricted Use"

9.3 U.S. Nuclear Regulatory Commission, NUREG-1507, Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions

9.4 NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)

9.5 NUREG-1757, Volume 2, Consolidated NMSS Decommissioning Guidance - Characterization, Survey, and Determination of Radiological Criteria

9.6 ISO Standard 7503-1 Evaluation of Surface Contamination – Part 1: Beta Emitters (Maximum Beta Energy Greater than 0.15 MeV) and Alpha Emitters

9.7 DO-08-005, Historical Site Assessment (HSA), July 2009 {ML092870417}

9.8 DO-08-003, Radiological Characterization Report, July 2009 {ML092870496}

9.9 Westinghouse Letter HEM-10-85, Response to Request for Additional Information Concerning Hematite Decommissioning Plan: Chapter 5, Dose Modeling {ML102290015}

10.0 APPENDICES

Appendix A HDP Procedure Revision History

Appendix B HDP FSSFR PSA Document Matrix

Table 2-1
Pre-Remediation Piping Inventory

System	Figure 2-1 Reference ID#	Survey Unit #	Depth BGS (inches)	Cover	Length (feet)	Diameter (inches)	Surface Area (m^2)
Storm Drain(s) – Class 1 Survey Area #1							
Bldg. 110 SE	STM-1	1	60	asphalt	172	12	50.2
Bldg. 110 NW and West	STM-2	2	60	soil/asphalt	209	15	76.2
Bldg. 230 SE	STM-3	3	60	concrete	237	18	103.8
Bldg. 230 South	STM-4	4	60	asphalt/soil	235	18	102.9
Bldg. 230 North Corner	STM-5	5	60	asphalt	26	30	19
Bldg. 230 NW **	STM-6	6	60	asphalt	249	36	218
Bldg. 230 – 101 Leg	STM-7	7	60	soil/asphalt	71	15	25.9
Bldg. 240 North Corner	STM-8	8	60	asphalt	22	18	9.6
Bldg. 240 NW	STM-9	9	60	asphalt	140	24	81.7
Bldg. 230 South Interior Drains	STM-10	10	36	concrete	155	4	15.1
Bldg. 230 NE	STM-11	11	60	soil	58	24	33.9
Bldg. 230 NE	STM-12	12	60	soil	15	18	6.6
Discharge Leg	STM-13	13	60	soil	59	36	51.7
Discharge Leg Outlet	STM-14	14	60	soil	59	42	60.3
				Survey Area #1 Totals:	1,707	n/a	854.9
Sanitary / Gray Water Drains – Class 1 Survey Area #2							
Bldg. 110 Sanitary	SAN-1	1	48	concrete/asphalt	124	4	12.1
Bldg. 230 north Sanitary	SAN-2	2	36	concrete/soil	130	4	12.6
Bldg. 230 north Gray	SAN-3	3	36	concrete/soil	155	4	15.1
Bldg. 230 south Sanitary	SAN-4	4	60	concrete/soil	80	4	7.8
Bldg. 240 NW – Gray	SAN-5	5	48	asphalt	297	8	57.8
Bldg. 240 NW – Sanitary	SAN-6	6	60	asphalt	291	8	56.6
Bldg. 240 South – Gray to Sanitary Connection	SAN-7	7	48	asphalt	207	8	40.3
Bldg. 240 south – Sanitary to Treatment Plant	SAN-8	8	60	asphalt	301	8	58.6
				Survey Area #2 Totals:	1,585	n/a	260.9

Table 2-1 (Continued)
Pre-Remediation Piping Inventory

System	Figure 2-1 Reference ID#	Survey Unit #	Depth BGS (inches)	Cover	Length (feet)	Diameter (inches)	Surface Area (m^2)
Public Water System (County Water District) and Raw Water System - Class 3 Survey Area #3							
to Building 110	WAT-1	1	36	soil	266	2	12.9
to Building 230	WAT-2	1	48	asphalt	252	2	12.2
to Building 231	WAT-3	1	60	concrete/soil	355	8	69.0
to Building 115	WAT-4	1	48	soil	94	10	23.0
to Hydrants	WAT-5	1	60	soil/asphalt	1,761	8	342.6
Main along Hwy. P, within right of way	WAT-6	1	60	soil	2,733	6	398.9
Old Main along Hwy. P, north parking lot	WAT-7	1	60	soil	1,034	10	251.6
Raw Water	WAT-8	1	60	soil	639	10	155.4
				Survey Area #3 Totals:	7,134	n/a	1,265

Table 2-2
Post-Remediation Piping Inventory

System	Figure 2-3 Reference ID#	Survey Unit #	Depth BGS (inches)	Cover	Length (feet)	Diameter (inches)	Surface Area (m^2)
Storm Drain(s) – Class 1 Survey Area #1							
Bldg. 110 N, W (CO to MH-19 to MH-07 to MH-25)	STM-1	01	60	Soil/asphalt	137/76	12/15	68
Bldg. 110 S (MH-18 to East	STM-2	02	60	soil/asphalt	170/101	12/18	94
Parking Lot S (West breach to 50' past MH-24)	STM-3	03	60	Concrete/ asphalt	44/25/50	24/30/36	89
Parking Lot S (50' past MH-24 to C124B)	STM-4	04	60	asphalt	105	36	92
Parking Lot S (C124B to MH-02)	STM-5	05	60	asphalt	95	36	84
MH-02 to Outfall	STM-6	06	60	Asphalt/soil	55/50	36/42	100
MH-31 South to MH-02	STM-7	07	60	asphalt	73	15	27
Bldg. 230 W (MH-02 to MH-01)	STM-8	08	60	asphalt	230	18	101
Bldg. 230 S (MH-01 to MH-22)	STM-9	09	60	concrete	206	18	90
Survey Area #1 Totals:					1,417	N/A	745

System	Figure Reference ID#	Survey Unit #	Depth BGS (inches)	Cover	Length (feet)	Diameter (inches)	Surface Area (m^2)
Sanitary / Gray Water Drains – Class 1 Survey Area #2							
Former SWTP Discharge Line	SAN-1	01	60	Concrete/soil	293	6.75	46.5
Survey Area #2 Totals:					293	n/a	46.5

System	Figure Reference ID#	Survey Unit #	Depth BGS (inches)	Cover	Length (feet)	Diameter (inches)	Surface Area (m^2)
Public Water System (County Water District) and Raw Water System - Class 3 Survey Area #3							
to Building 110	WAT-1	1	36	soil	266	2	12.9
to Building 230	WAT-2	1	48	asphalt	252	2	12.2
to Building 231	WAT-3	1	60	concrete/soil	355	8	69.0
to Building 115	WAT-4	1	48	soil	94	10	23.0
to Hydrants	WAT-5	1	60	soil/asphalt	1,761	8	342.6
Main along Hwy. P, within right of way	WAT-6	1	60	soil	2,733	6	398.9
Old Main along Hwy. P, north parking lot	WAT-7	1	60	soil	1,034	10	251.6
Raw Water	WAT-8	1	60	soil	639	10	155.4
Bldg. 110 / 230 Downspouts	DRN-X	02	Varies	Soil/varies	Varies	Varies	Varies
Survey Area #3 Totals:					7,134	n/a	1,265

Table 3-1
Site Specific Building and Structural Surface DCGLs

Radionuclide	Occupancy $DCGL_w$ (dpm/100 cm^2)[a] By Conceptual Site Model	
	Small Office	Large Warehouse
U-234	20,000	49,000
U-235 + D [b]	19,000	37,000
U-238 + D [b]	21,000	49,000
Tc-99	13,000,000	13,000,000
Th-232 + C [c]	1,200	2,200
Np-237 + D [b]	2,700	4,000
Pu-239/240	3,500	5,300
Am-241	3,400	5,100

a The reported building DCGLs are in gross radioactivity limits rounded down (truncated) to two significant figures.
b "+ D" = plus short-lived decay products.
c "+ C" = plus the entire decay chain (progeny) in secular equilibrium.

Table 3-2
Buried Pipe Gross Activity DCGLs

Buried Pipe Diameter (inches)	Gross Activity DCGL (dpm/100cm^2)[a]
2	81,086
4	162,172
6	243,258
8	324,344
10	405,430
12	486,516
14	567,602
16	648,689
18	729,775
20	810,861
22	891,947
24	973,033
26	1,054,119
28	1,135,205
30	1,216,291
32	1,297,377
34	1,378,463
36	1,459,549
38	1,540,635
40	1,621,721
48	1,946,066

[a] The Gross Activity DCGL is based on the Root DCGLs for soil and the Activity Fractions from building drain samples.

Note: To ensure conservatism, HDP will utilize the Building DCGLs (Small Office) as release criteria for buried piping to remain in place. In the unlikely event buried piping to remain exceeds Building DCGLs and cannot be decontaminated or removed, HDP will verify the piping meets Buried Pipe DCGLs (above) and grout the piping in place.

Table 3-3
Initial Isotopic Distribution

Radionuclide	Radioactivity Fraction [a]
U-234	8.27E-01
U-235 + D [b]	3.72E-02
U-238 + D [b]	1.27E-01
Tc-99	2.83E-03
Th-232 + C [c]	3.21E-03
Np-237 + D [b]	5.57E-05
Pu-239/240	2.03E-06
Am-241	2.68E-03
Sum of fractions for Uranium Only	**9.91E-01**
Sum of fractions for all Radionuclides	**1.00E+00**

[a] Values are as reported in Table 4-1 of the DP, Reference 9.1.

Table 3-4
Gross Activity $DCGL_{SO}$ for Small Offices

Radionuclide	$DCGL_{SO}$ (dpm/100 cm^2)	f_i	f_i / $DCGL_{SO}$ [a]
U-234	20,000	8.27E-01	4.14E-05
U-235 + D	19,000	3.72E-02	1.96E-06
U-238 + D	21,000	1.27E-01	6.05E-06
Tc-99	13,000,000	2.83E-03	2.18E-10
Th-232 + C	1,200	3.21E-03	2.68E-06
Np-237 + D	2,700	5.57E-05	2.06E-08
Pu-239/240	3,500	2.03E-06	5.80E-10
Am-241	3,400	2.68E-03	7.88E-07
$\sum(f_i / DCGL_{SO})$ [a]			**5.28E-05**
Gross DCGL = $(1 / (\sum (f_i / DCGL_{SO,i}))$ [a] (dpm/100 cm^2)			**18,925**

[a] Values are calculated using Equation 4-4 of MARSSIM, Reference 9.4.

Figure 2-1
Hematite Class 1 Piping (Storm, Sanitary/Gray)

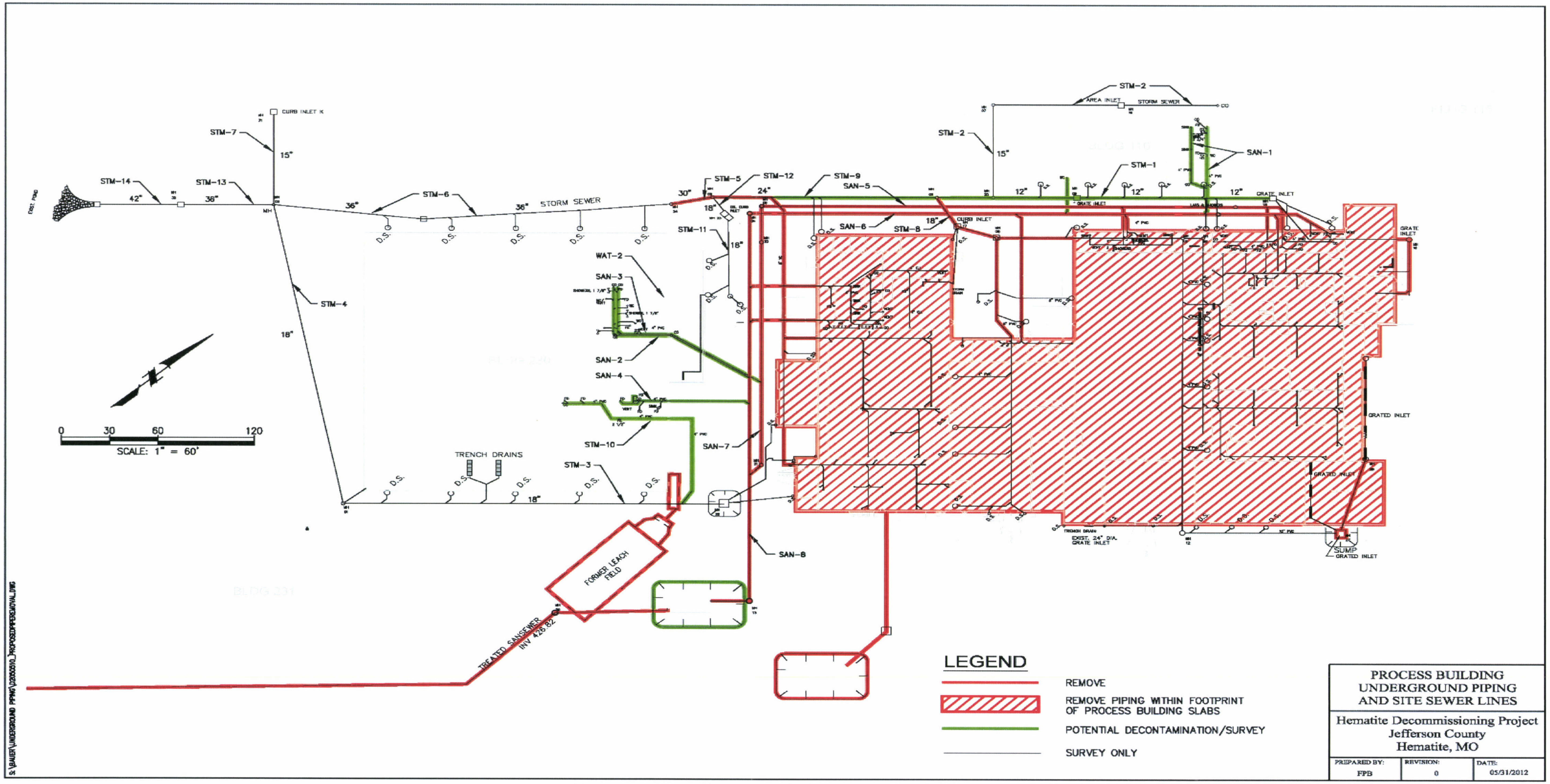

Figure 2-2
Hematite Class 3 Piping (Public Water)

Figure 2-3
Storm and Sanitary Piping Remaining at License Termination

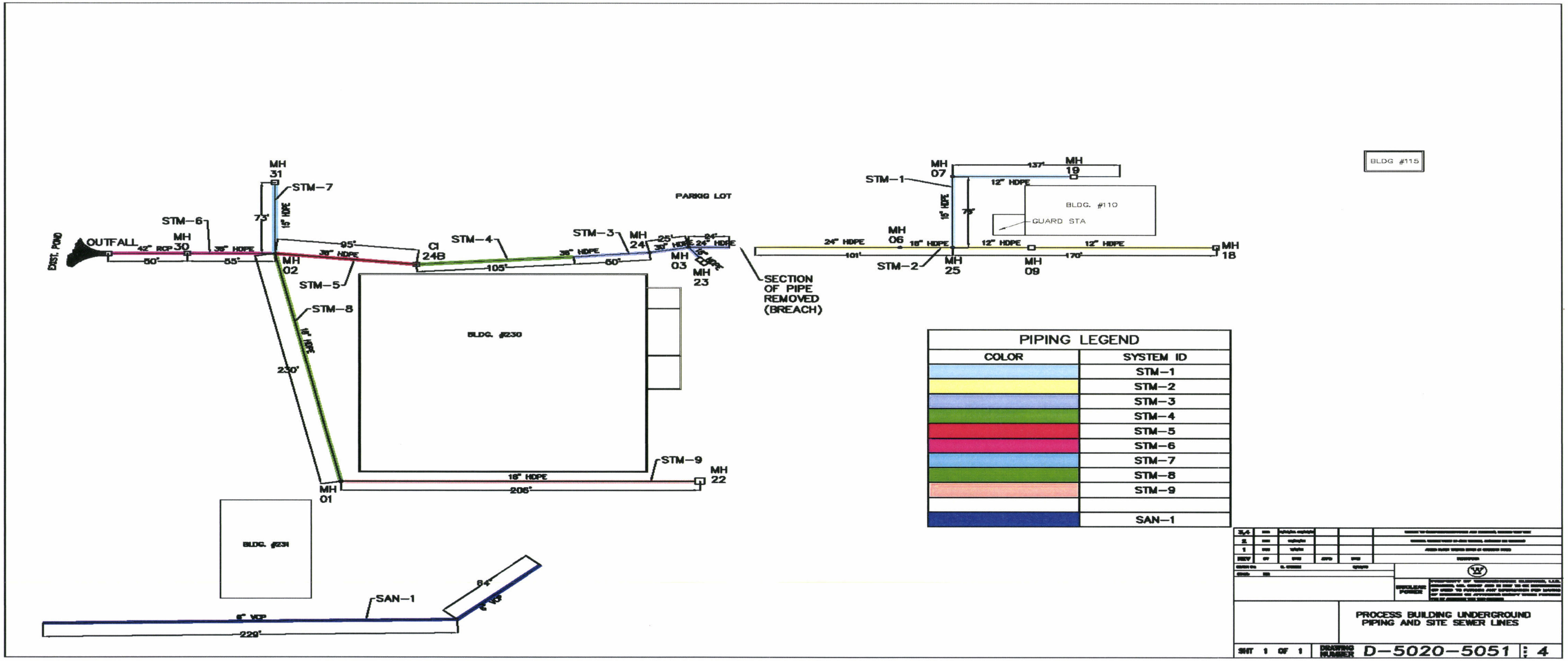

Figure 2-4
Pipe Cleaning Contractor

Figure 2-5
Pipe Cleaning Crawler Unit

Figure 2-6
Pipe Cleaning of Storm Water Drain Piping

Figure 2-7
Example of Storm Drain Manhole Prior to Cleaning

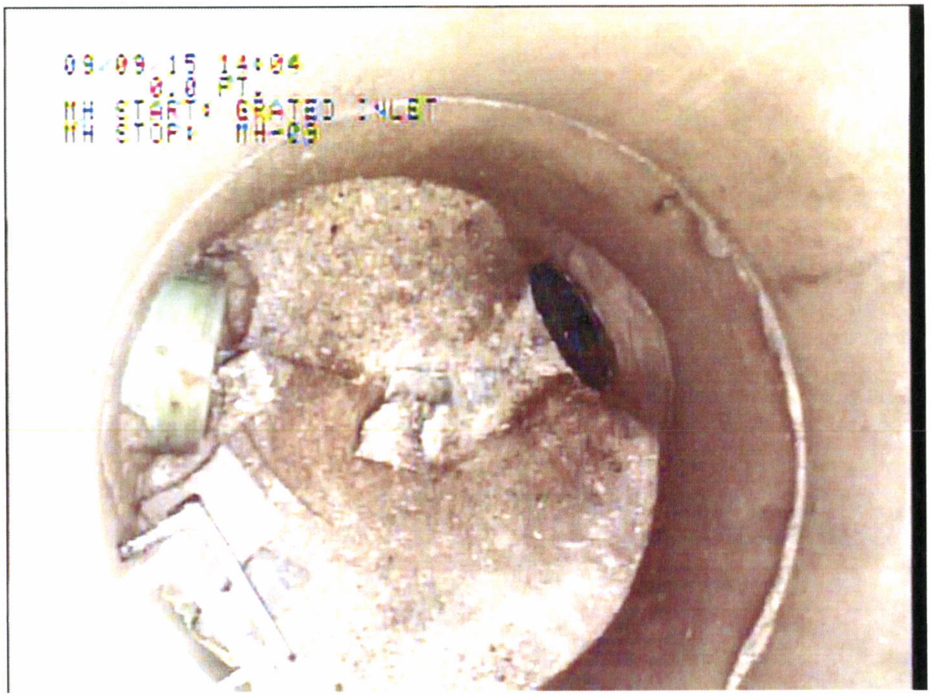

Figure 2-8
Example of Storm Water Drain Manhole After Cleaning
(Remaining sediment removed manually)

Figure 2-9
Example of Storm Water Drain Piping Prior to Cleaning

Figure 2-10
Example of Storm Water Drain Piping After Cleaning

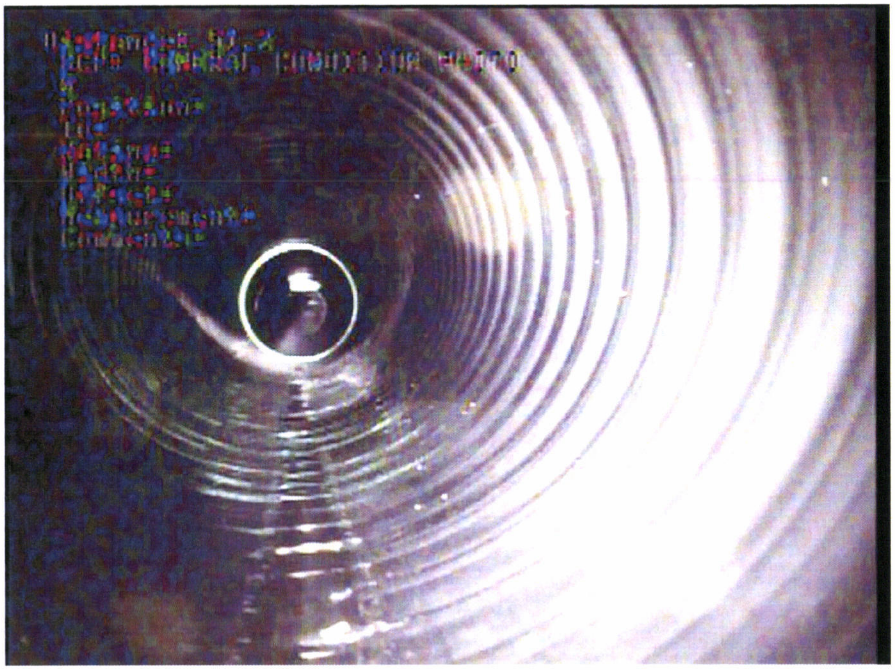

Figure 2-11
Access to the SWTP Piping

Figure 2-12
Natural Gas Pipe Line (during soil remediation)

Figure 2-13
Swale that Isolates and Controls a Section of Storm Water Drain Piping

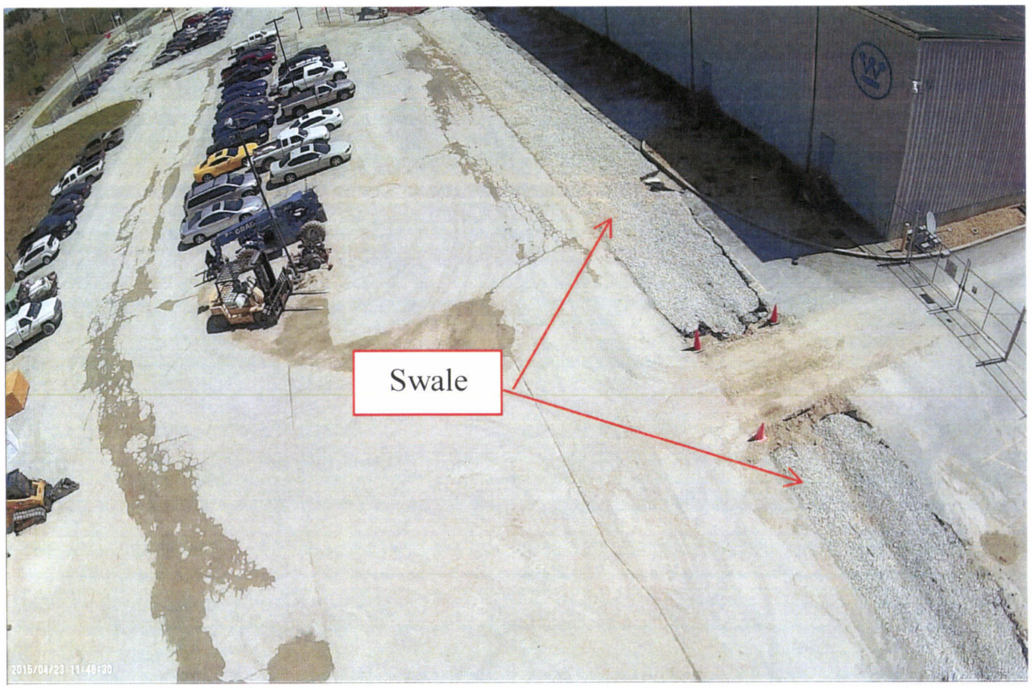

Figure 2-14
Heating/Ventilation Unit Drying a Section of Storm Water Drain Piping

Figure 2-15
Detector Unit Accessing the SWTP Piping

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HDP Procedure Revision History

HDP-PO-FSS-700 Final Status Survey Program		
Revision Number	**Effective Date**	**Summary of the Revision**
0	01/16/2012	Initial issuance of the policy. Implements the requirements of the Final Status Survey plan contained within the DP.
1	12/04/2012	Updated policy to include soil sampling requirements during the abandonment of hybrid wells, per Section 14.4.3.4.2 of the DP.
2	01/31/2013	Updated Section 13, Final Status Survey Reporting to reflect the changes of Section 14.6 in the DP.
3	11/26/2014	Revision included clarifications and enhancements.
4	02/19/2015	Added information regarding scan MDCs and revised wording to be consistent with Westinghouse letter HEM-11-56.
5	10/28/2015	Changed policy to Westinghouse Proprietary Class 2. No technical changes.
6	04/07/2016	The revision incorporates a new section 15 “SURVEILLANCE FOLLOWING FSS” as a component of a corrective action to a Notice of Violation. Clarifications have been made to section 9.7 regarding isolation and control.

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HDP Procedure Revision History

HDP-PO-FSS-800 Final Status Survey Plan for Piping		
Revision Number	**Effective Date**	**Summary of the Revision**
0	*N/A	*HDP-PO-FSS-800 Revision 0 was approved but never Implemented. Rev. 0 received HDP managerial approval (HDP-PO-FSS-800 R0 Record Note) in order to be transmitted to the NRC in request of comments on this document (HEM-12-73). Comments were received from the NRC (HEM-13-NRC-0405-282), and will be incorporated into Revision 1 (below). HDP-PO-FSS-800 Revision 0 will be posthumously approved in EDMS on the Effective date of Revision 1 in order to complete Form 36 archive requirements resulting from interconnecting the Form 36 to Rev. 0 of the Policy instead of the transmitting correspondence.
1	06/15/2015	Revision incorporates changes in response to NRC comments received on April 5, 2013; specifically: Section 9.4.2 and accompanying Table A-1 revised to divide survey units into appropriate sized areas based on MARSSIM guidance for structural survey units. Section 12.3 revised to provide additional clarification on the basis for use of the sign test for evaluation of systematic measurements. Administrative and formatting corrections.
2	10/28/2015	Changed policy to Westinghouse Proprietary Class 2. No technical changes.
3	03/11/2016	Updated the table containing the piping that will undergo FSS. Updated text in section 14.5.1 to be compliant with HDP-PR-FSS-3

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HDP Procedure Revision History

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 Procedure Revision History

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-720 Final Status Survey Data Integrity and Database Management		
Revision Number	**Effective Date**	**Summary of the Revision**
0	09/13/2011	Initial issuance of the procedure.
1	01/13/2015	Revised section for Data Download to update the process for downloading data to a FSS computer that is password protected. Inclusion of a section to review and store GWS data. Addition of new Data Download Report Form. Changed back up of FSS data from being backed up as part of the routine site media backup process to being backed up on a password protected external hard drive and included a minimum frequency of weekly for hard drive backup.
2	10/28/2015	Changed procedure to Westinghouse Proprietary Class 2. No technical changes.

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HDP Procedure Revision History

HDP-PR-FSS-722 **Final Status Survey Reporting**		
Revision Number	**Effective Date**	**Summary of the Revision**
0	09/13/2011	Initial issuance of the procedure.
1	02/05/2015	Updated to reflect changes to HDP-PO-FFS -700 regarding FSS reporting.
2	01/31/2014	Removed the formatting guidelines which were contained in Appendix A and B.
3	01/13/2015	Editorial corrections.
4	11/06/2015	Changed procedure to Westinghouse Proprietary Class 2. No technical changes.

Appendix B
HDP FSSFR PSA Document Matrix

Survey Unit	Description	FSS Class	FSS Complete Date	Assigned FSSFR Volume 5 Chapter Number	Date Submitted to NRC
PSA-01 Storm Drains					
PSA-01-01	Building 110 Storm Drain (STM-1)	1	11/24/15	3	
PSA-01-02	Building 110 to Building 230 Storm Drain (STM-2)	1	02/11/16	3	
PSA-01-03	Building 230 North Storm Drain (STM-3)	1	01/29/16	3	
PSA-01-04	Building 230 North Storm Drain (STM-4)	1		3	
PSA-01-05	Building 230 North Storm Drain (STM-5)	1		3	
PSA-01-06	Building 230 North Storm Drain (STM-6)	1		3	
PSA-01-07	Building 230 North Storm Drain (STM-7)	1		3	
PSA-01-08	Building 230 West Storm Drain (STM-8)	1	02/17/16	3	
PSA-01-09	Building 230 South Storm Drain (STM-9)	1	12/3/15	3	
PSA-02 Sanitary Treatment Piping					
PSA-02-01	Former SWTP Discharge Line (SAN-1)	1	11/15/15	2	
PSA-03 Utility Piping / Public Water System					
PSA-03-01	Water Supply Lines (WAT 1-8)	3	03/23/16	4	
PSA-03-02	Building 110/230 Downspouts (DRN-X)	3	01/25/16	4	