Draft

ADVISORY BOARD ON
RADIATION AND WORKER HEALTH

National Institute for Occupational Safety and Health

REVIEW OF THE NIOSH SITE PROFILE FOR THE WEST VALLEY DEMONSTRATION PROJECT IN WEST VALLEY, NEW YORK

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Prepared by

Ron Buchanan, PhD, CHP

S. Cohen & Associates
1608 Spring Hill Road, Suite 400
Vienna, Virginia 22182

Saliant, Inc.
5579 Catholic Church Road
Jefferson, Maryland 21755

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Task Manager: _____ Date: _____ Joseph Fitzgerald	Supersedes: Rev. 0
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Record of Revisions

Revision Number	Effective Date	Description of Revision
0 (Draft)	04/13/3011	Initial issue
1 (Draft)	12/05/2013	Some descriptive background information on the EEOICPA and/or other government regulations has been deleted from this document to satisfy potential legal concerns. None of the technical or site-specific information has been deleted for this Privacy Act-cleared version. Attachment 1, "Site Expert Interview Summary," has been added and the "Acronyms and Abbreviations" list has been updated accordingly. The current Project Manager is now noted above. Some redactions have been made to Attachment 1 in accordance with Privacy Act concerns.

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ACRONYMS AND ABBREVIATIONS

ACL	Administrative Control Limit
Advisory Board	Advisory Board on Radiation and Worker Health
ALARA	As Low As Reasonably Achievable
ARPR	Acid Recovery Pump Room
BSW	Bulk Storage Warehouse
BZ	Breathing Zone
CAM	Continuous Air Monitor
CCR	Chemical Process Cell Crane Room
CMR	Crane Maintenance Room
CDC	Center for Disease Control
CEDE	Committed Effective Dose Equivalent
CFR	*Code of Federal Regulations*
Ci	Curies
CPC	Chemical Process Cell
CPCWSA	Chemical Process Cell Waste Storage Area
cpm	counts per minute
DAC	Derived Air Concentration
DCF	Dose Conversion Factor
DD	Deep Dose
D&D	Decontamination and Decommissioning
DOE	Department of Energy
DOELAP	DOE Laboratory Accreditation Program
dpm	disintegrations per minute
DR	Dose Reconstruction
ED	Electronic Dosimeter
EEOICPA	Energy Employees Occupational Illness Compensation Program Act of 2000
FBI	Federal Bureau of Investigation
FRS	Fuel Receiving and Storage
GM	Geiger-Mueller
GPC	General Purpose Cell
HPGe	High-Purity Germanium

HLW	High-Level (Radioactive) Waste
ICRP	International Committee on Radiation Protection
INEL	Idaho National Engineering Laboratory
keV	kilo electron volt
kg	kilogram
LAT	Lateral
LLW	Low-Level Waste
LLWT	Low-Level Waste Treatment (facility)
LOD	Limit of Detection
MDL	Minimum Detectable Level
MeV	million electron volts
MFAP	Mixed Fission and Activation Product
MFP	Mixed Fusion Product
MPC	maximum permissible concentration
MPPB	Main Plant Process Building
mR	milliroentgen
mrem	millirem
NDA	NRC-licensed Disposal Area
NFS	Nuclear Fuel Services
NIOSH	National Institute for Occupational Safety and Health
NOCTS	NIOSH-Office of Compensation Analysis and Support Claims Tracking System
NP	Non-Penetrating
NRC	Nuclear Regulatory Commission
NTA	Eastman Kodak Nuclear Track film Type A
NYS	New York State
NYSERDA	New York State Energy Research and Development Authority
NYU	New York University
OCAS	Office of Compensation Analysis and Support
ORAUT	Oak Ridge Associated Universities Team
OTIB	ORAU Technical Information Bulletin
PA	Posterior-Anterior

PAPR	Powered Air Purifying Respirator
PCM	Personnel Contamination Monitor
PFG	Photofluorography
PIC	Personal Ionization Chamber
PMC	Process Mechanical Cell
POC	Probability of Causation
PPC	Product Purification Cell
PPE	Personal Protective Equipment
PPH	Product Packaging and Handling
PPS	Product Packaging and Shipping
PSF	Plutonium Storage Facility
PUREX	Plutonium-Uranium Extraction
R	Roentgen
RadCon	Radiological Control
RBA	Radiological Buffer Area
RCT	Radiological Control Technician
RHWF	Remote Handled Waste Facility
RWP	Radiation Work Permit
SC&A	S. Cohen and Associates
SDA	State-licensed Disposal Area
SNM	Special Nuclear Material
SP	Storage Pool
SRDB	Site Research Database
TBD	Technical Basis Document
THOREX	Thorium Extraction
TIB	NIOSH Technical Information Bulletin
TLD	Thermoluminescent Dosimeter
ULO	Uranium Loadout Area
URS	United Research Services
WBC	Whole Body Counter, or Count
WNYNSC	Western New York Nuclear Service Center
WVDP	West Valley Demonstration Project

WVES	West Valley Environmental Services, LLC
WVNSC	West Valley Nuclear Services Company
XC1	Extraction Cell 1
XC2	Extraction Cell 2
XC3	Extraction Cell 3

1.0 EXECUTIVE SUMMARY

This report provides the results of a review conducted by S. Cohen and Associates (SC&A) of the site profile for the West Valley Demonstration Project (WVDP), West Valley, New York, developed by the National Institute for Occupational Safety and Health (NIOSH). This review was conducted during the period from April 2010–February 2011.

The site profile for the WVDP site consists of one document (with 6 sections), ORAUT-TKBS-0057 (ORAUT 2007a). This document will be referred to in this review as the Technical Basis Document (TBD).

In this review, unless specified otherwise, the term "WVDP site" will be used to refer to the West Valley site in general, to include the period of spent fuel processing by Western New York Nuclear Service Center (WNYNSC) with Nuclear Fuel Services (NFS) as contractor (1965–1972); 1973–1982, when the facility was being modified and then remained mostly idle; and from February 26, 1982, through the present when the facility was under the Department of Energy (DOE), with West Valley Nuclear Services Company (WVNSC) and then West Valley Environmental Services LLC (WVES) as the contractors, to vitrify the high-level radioactive waste (HLW) and perform decontamination and decommissioning (D&D) of the facilities and waste management areas. This includes all the facilities, burial sites, and grounds located within the approximate 200 acres inside the 8-ft security fence.

The WVDP site was constructed in 1963–1965 to demonstrate the feasibility of commercially reprocessing spent nuclear reactor fuel. A list of some of the important dates at this facility is provided in Table 1 below.

Table 1. WVDP Timeline of Events

1961:	New York State acquired 3,345 acres for WNYNSC; it was barbed-wire fenced and posted.
1962:	NYSERDA and NFS to build nuclear fuel reprocessing plant on 200 acres, 8-ft security fence.
1963:	June 1963 start of construction, ~ 3 years to complete.
1963–1975:	NFS operated commercial 15-acre state-licensed radioactive waste disposal area (SDA), consisting of covered trenches and LLW to 10k rad/hr; 1983: transferred to NYSERDA.
1965:	May 27, 1965 NFS granted license to receive and store fuel.
1965:	**June 3, 1965**, first fuel received.
1966:	April 19, 1966, received license to reprocess fuel.
1966:	**April 22, 1966**, reprocessing of fuel began.
1966–present:	NRC-licensed disposal area for HLW; holes in ground and covered with soil.
1966–1972:	Reprocessed fuel (630 tons) from 9 reactors for Pu and U by PUREX.
1968–1969:	Nov 1968–Jan 1969, processed thorium by THOREX for Indian Point.
1971:	May 3, 1971, NFS & NYSERDA agreed to store Pu at the PSF on site until 31 Dec 1974.
1972:	**March 1972**, last fuel processed. Plant shut down for modifications (never reopened).
1973:	As of Jan 1, 1973, smoking, eating, drinking, or chewing were prohibited in Zones III & IV.
1973:	After May 4, 1973, decon activities were significantly curtailed.
1973–1975:	756 spent fuel assemblies shipped to the WVDP.
1977:	Plant not to reopen; transferred to the NYSERDA.
1980:	Congress passed the WVDP act to solidify HLW and to D&D.
1982:	**Feb 26, 1982**, DOE assumed operational control with WVNSC as contractor.
1980s:	Early 1980s, decon of main reprocessing plant for HLW vitrification project.
1980s:	Early 1980s, spent fuel assemblies shipped back to points of origin; halted in mid-1980s.

Table 1. WVDP Timeline of Events

1980s:	Mid-1980s, work to remove major empty fuel canisters and storage racks in pool.
1982–1987:	Decon of a number of process cells.
1988–1995:	Pretreatment of HLW; cesium and strontium from other constituents. LLW solids in 20,000 barrels, LLW liquids to cement, others to HLW for vitrification.
1996–2001:	Vitrification of HLW into 275 glass logs of 2000 kg (~2 tons) each, with ~87k Ci each in individual canisters; each canister read ~2600 rem/hr on contact in 2003; stored in CPC.
1999:	Vitrification expended processing initiated for unserviceable equipment.
2000:	RHWF construction began as focus shifted to D&D.
2001:	**Spring 2001**, all spent fuel removed from site.
2001:	Late 2001, remaining canisters and storage racks removed and decon of SP began.
2003:	Removal of wastewater from underground tanks, decon of plutonium process cell, vitrification cell dismantlement began.
2004:	Shipping of LLW, removal of 20 trailers, decon of 4 processing cells, Vitrification melter removal completed in mid-2005.
2005:	LLW shipments increased, site area decreased and some employees to offsite buildings.
2007:	WVES became DOE's contractor on the WVDP site.

The WVDP essentially had three major phases of operations:

(1) **Reprocessing Plant Operations Era, 1965–1972:** Spent nuclear reactor fuel assemblies were received and reprocessed to extract the plutonium and uranium for sale and reuse. Large amounts of HLW and low-level waste (LLW) were generated during this process.

(2) **Residual Era, 1973–Feb 25, 1982:** Some modifications to the plant and miscellaneous decontamination activities took place in the mid-1970s. Some spent fuel was received, but ceased by 1980.

(3) **DOE Era, Feb 26, 1982–present:** DOE took over operations, with WVNSC as contractors. The major effort was to demonstrate the vitrification of HLW, and also to address related tasks, such as shipping all the spent fuel off site, removing contents of underground storage tanks, stabilizing and decreasing waste storage areas, and D&D of facilities and grounds.

Reprocessing Plant Operations Era, 1965–1972: The major features of the WVDP during the fuel reprocessing era (1965–1972) were described on pages 20–21 of the TBD:

> *The reprocessing plant consisted of a complex of cells with the various supporting and operating areas grouped around them (Johnson & Higgins 1972, p. 2). The plant was arranged in the shape of a U, with the Fuel Receiving and Storage (FRS) facility on one end and the product removal facilities on the other. The mechanical and chemical processing cells were in the middle (Runion 1970). Most areas of the process building fall into one of three categories: shielded cells, operating aisles, and unshielded rooms (WVDP 2005). The cells consisted of reinforced concrete walls several feet thick. The rest of the plant was of cinderblock construction. Chemical operations were directed from the Control Room, while mechanical operations were directed from operating aisles adjacent to viewing windows in the hot cells (Runion 1970).*

> *Fuel reprocessing involved shearing and leaching of fuel elements on the front end, followed by solvent extraction to remove plutonium and uranium. Fuel arrived at the site in shipping casks. The casks were unloaded under water and the fuel was stored in a SP. These operations took place in the FRS facility. Fuel bundles would be inverted and passed through a transfer canal into the PMC. Shearing and sawing equipment removed hardware and segmented the fuel into fixed lengths. The segmented fuel fell through a chute into baskets in the GPC below. The baskets were then passed into the CPC where the segmented fuel was dissolved in acid. This process, known as leaching, dissolved the fuel, leaving behind the cladding and any structural components. This leftover material, referred to as "hulls," was rinsed and disposed of in the NDA as HLW. The plutonium and uranium in the dissolved fuel were separated from the fission products and purified in a series of extraction cells. The purified products were then sent to their owners as nitrate solutions. After May 1971, plutonium solutions were sometimes also sent to the Plutonium Storage Facility, which was owned and operated by the State of New York on the West Valley site. High-level liquid waste generated in the process was stored in underground tanks. Some of the acids used in the process were recycled for reuse.*
>
> ***Process Summary:***
> - *Fuel receipt and storage*
> - *Mechanical preparation*
> - *Fuel dissolving*
> - *Solvent extraction*
> - *Plutonium product concentration, storage, and loadout*
> - *Uranium product concentration, storage, and loadout*

Radiation levels were extremely high and constant vigilance was required to keep workers' exposures below allowable limits. To meet these requirements (while there were less than 200 permanent employees), the facility utilized about 1,000 temporary laborers per year. Even then, exposure limits were sometimes exceeded. The major emphasis and monitoring efforts were concerned with external exposures during this period, as opposed to internal intakes.

Residual Era, 1973–Feb 25, 1982: Some modifications to the plant and miscellaneous decontamination activities took place. However, the level of activity was not near as great as when the plant was operational, or during the initial shutdown period from March 1972 to May 1973. Some spent fuel was received and stored, but ceased by 1980. By spring 2001, all unprocessed spent fuel had been removed from the site.

DOE Era, Feb 26, 1982–Present: DOE took over operations with WVNSC as contractor. DOE took control of the processing plant site and the NRC-licensed Disposal Area (NDA). The LLW burial site was transferred to the State of New York in 1983. According to a DOE report, page 28 (DOE 2000), the first major emphasis was:

> *Since 1980 the mission of DOE has been to conduct a technology demonstration project to solidify liquid high level waste, develop containers suitable for the*

> *permanent disposal of solidified high level waste at an appropriate federal repository, transport…,*

This vitrification project took place at the WVDP during the period of 1996–2001. Related major projects included shipping all the spent fuel off site, removing contents of underground storage tanks, stabilizing and decreasing waste storage areas, and D&D of facilities and grounds.

In 2007, WVES was awarded a contract (June 2007 through June 2011) by DOE to continue the cleanup of facilities at the WVDP (WVES 2010). During this contract period, WVES is:

- Decontaminating the Main Plant Process Building, Remote-Handled Waste Facility, and the Vitrification Facility
- Processing and shipping LLW off site for disposal
- Processing and packaging transuranic waste
- Deactivating, decontaminating, and removing ancillary site facilities
- Safely storing HLW canisters

While some area exposure levels were not as great as during the reprocessing era, there were/are high external radiation levels from the HLW and other operations, especially during and after the vitrification took place, as these operations resulted in concentrated radioactive materials, such as glass logs in canisters reading 2,600 rad/hr on contact. Additionally, vitrification, removal of radioactive waste, etc., resulted in spreadable contamination and potential intakes of radioactive materials.

Scope and Approach

SC&A reviewed the WVDP site TBD for the following attributes, in accordance with *Site Profile Review Procedures* (SC&A 2004):

- Completeness of Data Sources
- Technical Accuracy
- Adequacy of Data
- Consistency among Site Profiles
- Regulatory Compliance

In preparation for this report, SC&A reviewed the WVDP site TBD in detail, along with many WVDP site-related documents located at the WVDP document site near Ellicottville, New York, and in the Site Research Data Base (SRDB) on the Center for Disease Control (CDC) server. SC&A also conducted onsite and telephone interviews with current and former WVDP site workers. From these reviews, SC&A developed a number of issues regarding the WVDP site profile. These issues were identified, consolidated, and grouped into findings. Findings that have the potential to significantly impact the results of at least some dose reconstructions (DRs) are listed as Primary Findings, and those that are important, but may have less impact on the results of DRs, are listed as Secondary Findings. Additionally, items in the TBD that could

potentially lead to incorrect dose assignments, because of errors, lack of clarity, inconsistencies, omissions, etc., are listed as Observations.

In this section, a brief summary of the issues are presented, followed by a summary of the primary findings. (Primary Findings, along with Secondary Findings, are further detailed in Section 3 of this report). SC&A then provides a discussion of the strengths of the TBD, followed by recommendations for improvement at the end of this section, which are listed as Observations.

Summary of Issues

SC&A found that there is a reasonable amount of documentation available describing the plant's operations and cleanup activities, and dose/bioassay records available for some workers. The TBD for the WVDP site incorporated some of this material and uses it in performing dose DRs. However, SC&A has identified some areas that indicate that the dose assignments during DR may not be sufficiently adequate and/or accurate; these areas are summarized below, with detailed discussions provided in Section 3 of this report.

1.1 SUMMARY OF PRIMARY FINDINGS

Internal

Finding #IN-1: Adequacy and Accuracy of Internal Dose Records Not Addressed
Although the TBD mentions bioassay records on page 63, it does not address the adequacy or accuracy of internal dose records. It appears that it is assumed by NIOSH that the exposure records requested from NSF headquarters and those in the individual's personnel folder are accurate and complete. However, as far as SC&A can determine, there has not been any verification that the bioassay data used in DR for WVDP claimants are sufficiently complete and accurate.

Finding #IN-2: Bioassay Requirements and Sufficient Bioassay Data Not Established
Although Section 5 of the TBD provides some indication of which personnel were required to have bioassays, there is insufficient information to ensure that adequate bioassays were performed. This is especially applicable during the operational era, 1966–1972, when bioassays were viewed as an evaluation aid after the fact, rather than as a means to control exposures.

Finding #IN-3: Non-routinely Bioassayed Workers' Chronic and Episodic Exposures Inside Buildings Not Addressed
Section 5 of the TBD does not address radionuclides that workers inside of buildings were potentially exposed to from operational releases because of changes in backpressures, air leakage, incidents, etc. Workers with principal job functions that may not qualify them for routine bioassays because of their work functions/locations may have been exposed to potential airborne radionuclides inside the buildings. Therefore, non-routinely bioassayed workers inside the buildings (including the aisles, labs, and offices) could have had intakes not accounted for. Occasional or annual bioassays may not have captured intakes from episodic releases or from radionuclides with relatively quick biological clearance times.

External

Finding #EX-1: Adequacy and Accuracy of External Dose Records Not Addressed
Although the TBD covers some aspects of the practices, forms, and reports for the external dose records on pages 78–81, it does not address the adequacy or accuracy of external dose records. As for internal bioassay records, it appears that NIOSH assumes that the exposure records requested from NSF headquarters and those in the individual's personnel folder are accurate and complete. However, as far as SC&A can determine, there has not been any verification that the recorded external dose data used in DR for WVDP claimants are sufficiently complete and accurate.

Finding #EX-2: Floor Exposure Geometry Not Considered
Although the TBD makes many references to contamination and hot spots on the floor and significant radiation fields originating from the floor, there is no mention of geometry factors in the document. Radiation originating from the floor is not correctly registered on the worker's badge worn on the chest area. This could result in significant inaccuracies in the assigned doses during DR for any organs located below the chest area. This was one of the main issues brought forth by the workers and is applicable to the total time period of 1965–2007.

Finding #EX-3: Streaming Exposure Geometry Not Considered
The TBD makes references to extremity dosimetry, but does not consider situations at the WVDP site where narrow radiation fields could have been present from tank risers/vents (such as the large underground storage tank access ports), pipes, and other collimated radiation fields. These situations could result in a significant underestimate of dose assignment to the exposed organs and was a concern expressed by some workers.

Finding #EX-4: Lack of Dosimetry Calibration Knowledge Prior to 1990
According to page 75 of the TBD, the calibration methods used by the outside vendors prior to 1990 are unknown. The lack of knowledge of the calibration for skin doses is also an important issue not addressed in the TBD, considering beta doses could be significant at WVDP. The lack of knowledge of potential dosimetry adjustment factors for WVDP prior to 1990 could lead to inaccuracies in dose assignments.

Finding #EX-5: Lack of Information Concerning Neutron Exposure/Dosimetry
According to the TBD, it appears that neutron dosimetry at the WVDP site was not well documented. The TBD did not go on to develop the process of assigning neutron doses for the dose reconstructor to a level that would ensure sufficiently accurate and adequate dose assignments. SC&A did not find that neutron exposures were sufficiently addressed in the TBD to allow neutron doses to be assigned to exposed workers using technically sound methods.

Finding #EX-6: Problem in Deconvoluting Single Entry in Dose of Record
Much of the external dose information in the individual files for workers at West Valley under NFS consists of a single sentence that provides total whole-body, skin, and extremity dose for their period of employment. No yearly or badge-cycle monitoring data are provided. Having only the whole-body dose recorded, without knowing the year or radiation type (photon or neutron), presents complications. The TBD recommends partitioning the dose by year to create

the greatest probability of causation (POC). However, there is no way of separating the photon and neutron doses from the information provided, or of knowing the number of badge cycles by which to assign missed doses.

Finding #EX-7: No Information Concerning Skin Contamination and Egress Monitoring
The TBD did not address the frequency of skin contamination, how it was monitored, and any egress monitoring that was performed, especially in the early years before portal monitors were common. Skin contamination that was not detected and removed provides the potential of long-term localized irradiation, especially relevant to skin cancers, and also shallow cancers, if the energy of the betas is relatively high. Even with good dosimetry and records, there would be no records of these missed exposures for DR purposes.

Environmental

Finding #E-1: Chronic Ground-level and Episodic Building-released Airborne Contaminates Not Adequately Addressed
Section 4 of the TBD, pages 52–56, addresses the stack and the resulting ground-level concentrations during the operational era, 1965–1972, by illustrating that the maximum potential doses from the stack releases were <1 mrem/y, and assumes that the releases for the following years would be less than that. NIOSH used the same approach when considering some of the potential sources of ground-level airborne releases, such as tank vents, etc. (page 56 of the TBD). While the stacks may have been monitored, there were no details on how the discharge data in Table 4-5 for vents, etc., were obtained; i.e., were there air monitors at these discharge points 24/7, or were these calculated values?

Additionally, Section 4 of the TBD does not address radionuclides that workers outside of buildings were potentially exposed to from building releases (other than stacks, vents, and tanks) because of changes in backpressures, air leakage, incidents, etc. Workers with principal job functions outside the operation buildings may not have been routinely bioassayed because of their work locations, but may have been exposed to potential airborne radionuclides in the vicinity of the buildings.

All sources of environmental airborne contaminates outside the operating areas need to be addressed and quantified to determine if the bioassay program for workers outside the production areas was sufficient. This is applicable to all eras from 1965 to present.

Finding #E-2: Total Period of 1965–2007 Potential Environmental Intakes Not Addressed
The data used to demonstrate very low levels of potential intakes in Section 4 of the TBD was only from a few years of monitoring, centered around the early 1970s. There has been no supporting evidence provided to ensure that other periods at the site did not present different exposure potential, such as increased exposures, different radionuclides, or other pathways.

Finding #E-3: Insufficient Data Used to Determine Control Badge Readings
Page 57 of the TBD describes the process used to determine the control badge reading that will be added to the recorded dose of the individual monitored, because it was originally subtracted prior to entering the dosimeter dose into the dose of record. However, the data used to generate

the summary in Table 4-6 were insufficient to determine these values with reasonable accuracy for the periods 1965–1973 and 1974–1981. The external radiation fields at the WVDP were not negligible, and were subject to change as a function of time; therefore, the use of isolated readings for the control badge is not sufficiently accurate for DR purposes.

Finding #E-4: Recommended Unmonitored Workers' External Dose Not Supported
The TBD states on page 58 that there were no unmonitored workers at the site during the period 1965–1981, which is plausible. However, it goes on to state that during the DOE era, 1982–2007, the data for ambient exposures while outdoors at the WVDP are not available, and goes on to assign the administrative limit of 170 mrem/y for the period 1982–1993 and the 10 CFR Part 835 (DOE 2007) limit of 100 mrem/y for the period 1994–2007. There were no measured values for external ambient doses and nothing to support the assumption that regulatory limits prevented exposures in excess of these regulatory limits.

1.2 SUMMARY OF STRENGTHS

The WVDP site TBD was written in one volume, containing six sections, which assist the reader in accessing and analyzing the information in an orderly fashion. The TBD addressed the different time periods (reprocessing, residual, and DOE vitrification/remediation) relevant to the WVDP site in a consistent manner. Section 2 of the TBD provided a sufficient description of the site's history from its origin in 1963 to its present day status under DOE. References were well documented and editorial errors were kept to a minimum. (See Section 1.3, entitled "Opportunities for Improvement," for observations concerning some of the errors that were located during this review.) The information presented was fairly consistent across the six sections of the TBD. The current TBD is a good starting point for this site profile, but could use more detailed information, as described in Section 3 of this report.

1.3 OPPORTUNITIES FOR IMPROVEMENT

There are numerous opportunities for the TBD to be further developed, so that it would be more useful and accurate in DR by building on the basic information provided in the current version. Most of the major issues are identified in the findings described in Section 3 of this report. Additionally, SC&A has identified some areas where changes in the TBD would be beneficial to the claimant by preventing possible mistakes during DR or clarifying items to make them less ambiguous. These are listed as Observations as follows:

Observation 1 – Incomplete references

It is unclear what reference was used to generate the data in Table 2-26. The last paragraph on page 47 lists two references, but the TBD does not list an SRDB Ref ID# for NFS 1969 (NFS 1969), and the HNS 1971 reference (HNS 1971) is for in-vivo counts, not alpha activity. This needs to be clarified.

Observation 2 – Incorrect Statement

The TBD, page 106, second paragraph, states that Attachment B contains drawings; however, it does not contain drawings; it contains a copy of a Landauer report.

2.0 SCOPE AND INTRODUCTION

The review of the West Valley Demonstration Project (WVDP) site, near West Valley, New York, was conducted during April 2010–February 2011 by a team of SC&A health physicists and technical personnel. Almost all the records for the site have been declassified at this time. However, one member of the SC&A team held a "Q" clearance that permitted unencumbered access for this review, as needed.

SC&A understands that site profiles are living documents, which are revised, refined, and supplemented with NIOSH technical information bulletins (TIBs) as required to help dose reconstructors. Site profiles are not intended to be prescriptive or necessarily complete in terms of addressing every possible issue that may be relevant to a given DR. However, future revisions of the WVDP site TBD would serve to mitigate some of the gaps and issues raised in this report.

2.1 REVIEW SCOPE

Under the EEOICPA, the Advisory Board is mandated to conduct an independent review of the methods and procedures used by NIOSH and its contractors for DR. As a contractor to the Advisory Board, SC&A has been charged to support this effort by independently evaluating a select number of site profiles that correspond to specific facilities at which energy employees worked and were exposed to ionizing radiation.

This report provides a review of the site profile document, ORAUT-TKBS-0057, for the WVDP site in West Valley, New York. To date, this document has not been supplemented by site-specific TIBs, but there are several generic TIBs that provide additional guidance to the dose reconstructor.

Implementation guidance is also provided by so-called "workbooks," which have been developed by NIOSH for selected sites to provide more definitive direction to the dose reconstructors on how to interpret and apply the TBD, as well as other available information. To date, no WVDP site-specific workbooks have been developed.

SC&A has critically evaluated the WVDP site TBD for the following:

- Determine the completeness of the information gathered by NIOSH in behalf of the site profile, with a view to assessing its adequacy and accuracy in supporting individual DRs
- Assess the technical merit of the data/information
- Assess NIOSH's use of the data in DRs

SC&A's review of this site profile document focuses on the quality and completeness of the data that characterized the facility and its operations, and the use of these data in DR. The review was conducted in accordance with *Site Profile Review Procedures* (SC&A 2004), which was approved by the Advisory Board.

The review is directed at "sampling" the site profile analyses and data for validation purposes. The review does not provide a rigorous quality control process, whereby actual analyses and calculations are duplicated or verified. The scope and depth of the review are focused on aspects or parameters of the site profile that would be particularly influential in deriving DRs, bridging uncertainties, or correcting technical inaccuracies.

The WVDP site TBD serves as a site-specific guidance document used in support of DRs. These site profiles provide the health physicist who conducts DRs on behalf of NIOSH with consistent general information and specifications to support their individual DRs. This report was prepared by SC&A to provide the Advisory Board with an evaluation of whether and how the TBD can support DR decisions. The criteria for evaluation include whether the TBD provides a basis for scientifically supportable DR in a manner that is adequate, complete, efficient, and claimant favorable. Specifically, this review was conducted using the criterion of whether DRs based on the TBD would provide for robust compensation decisions.

The basic principle of DR is to characterize the radiation environments to which workers were exposed and determine the level of exposure the worker received in that environment through time. The hierarchy of data used for developing DR methodologies is dosimeter readings and bioassay data, coworker data and workplace monitoring data, and process description information or source term data.

2.2 ASSESSMENT CRITERIA AND METHODS

SC&A is charged with evaluating the approach set forth in the site profiles that is used in the individual DR process. These documents are reviewed for their completeness, technical accuracy, adequacy of data, consistency with other site profiles, and compliance with the stated objectives, as defined in SC&A's *Site Profile Review Procedures* (SC&A 2004). This review is specific to the WVDP site profile and supporting TIBs; however, items identified in this report may be applied to other facilities, especially facilities with similar source terms and exposure conditions. The review identifies a number of issues and discusses the degree to which the site profile fulfills the review objectives delineated in SC&A's *Site Profile Review Procedures*.

2.2.1 Objective 1: Completeness of Data Sources

SC&A reviewed the site profile with respect to Objective 1, which requires SC&A to identify principal sources of data and information that are applicable to the development of the site profile. The two elements examined under this objective are (1) determining if the site profile made use of available data considered relevant and significant to DR, and (2) investigating whether other relevant/significant sources are available, but were not used in the development of the site profile.

2.2.2 Objective 2: Technical Accuracy

Objective 2 requires SC&A to perform a critical assessment of the methods used in the site profile to develop technically defensible guidance or instructions, including evaluating field characterization data, source term data, technical reports, standards and guidance documents, and

literature related to processes that occurred at the WVDP site. The goal of this objective is to analyze the data according to sound scientific principles, and then evaluate this information in the context of DR.

2.2.3 Objective 3: Adequacy of Data

Objective 3 requires SC&A to determine whether the data and guidance presented in the site profile are sufficiently detailed and complete to conduct DR, and whether a defensible approach has been developed in the absence of data. In addition, this objective requires SC&A to assess the credibility of the data used for DR. The adequacy of the data identifies gaps in the facility data that may influence the outcome of the DR process. For example, if a site did not monitor all workers exposed to neutrons who should have been monitored, this would be considered a gap, and therefore an inadequacy in the data. An important consideration in this aspect of our review of the site profile is the scientific validity and claimant favorability of the data, methods, and assumptions employed in the TBD to fill in data gaps.

2.2.4 Objective 4: Consistency among Site Profiles

Objective 4 requires SC&A to identify common elements within site profiles completed or reviewed to date, as appropriate. In order to accomplish this objective, the WVDP site TBD were compared to other TBDs previously reviewed. This assessment was conducted to identify areas of inconsistencies, and determine the potential significance of any inconsistencies with regard to the DR process.

2.2.5 Objective 5: Regulatory Compliance

Objective 5 requires SC&A to evaluate the degree to which the site profile complies with stated policy and directives contained in 42 CFR Part 82. In addition, SC&A evaluated the TBD for adherence to general quality assurance policies and procedures utilized for the performance of DRs.

SC&A's draft report and preliminary findings will undergo a multi-step resolution process. Prior to and during the resolution process, the draft report is reviewed by the DOE Office of Health, Safety, and Security to confirm that no classified documents or information have been incorporated into the report. Resolution includes a transparent review and discussion of draft findings with members of the Advisory Board Working Group, petitioners, claimants, and interested members of the public. A final report will then be issued to the full Advisory Board for deliberation and a final recommendation.

All review comments apply to Rev. 00 PC-1 of the WVDP site TBD, which is the most recently published version.

Site expert interviews were conducted with current and former WVDP site workers to help SC&A obtain a comprehensive understanding of the radiation protection program, site operations, and historic exposure experience.

Attachment 1 provides summaries of the interviews conducted by SC&A during the course of this review. The interviewees included a good cross-section of current and former WVDP site workers, including production, maintenance, safety, office, and radiological safety personnel that worked at the WVDP site at some point during the period of spent fuel processing by Nuclear Fuel Services (1965–1972); 1973–1982, when the facility was being modified and then mostly idle; and from February 26, 1982, through the present when the facility was under the DOE, with WVNSC and then WVES as the site contractors. The interviews were conducted at the WVDP site and by telephone, and documents pertinent to the WVDP site and its operations were reviewed at the WVDP document site near Ellicottville, New York.

Because of the singularity of purpose, limited operating period, and relatively small size of the WVDP site (as opposed to other DOE sites or national laboratories), SC&A did not submit a list of questions to NIOSH as part of its evaluation of the WVDP site TBD. SC&A believed that the resources and time that would have been involved in submitting questions and obtaining responses could be more effectively spent in performing document research and other tasks for this site profile review.

2.3 REPORT ORGANIZATION

In accordance with directions provided by the Advisory Board and with *Site Profile Review Procedures* prepared by SC&A and approved by the Advisory Board, this report is organized into the following sections:

(1) Executive Summary
(2) Scope and Introduction
(3) Vertical Issues
(4) Overall Adequacy of the Site Profile as a Basis for Dose Reconstruction.

Based on the issues raised, SC&A prepared a summary list of findings, which are provided in the Executive Summary. Issues are designated as Primary Findings if SC&A believes that they represent deficiencies in the TBD that need to be corrected, and which have the potential to have a substantial impact on at least some DRs. Issues can also be designated as Secondary Findings or Observations if they simply raise questions, which, if addressed, would further improve the TBD and may possibly reveal deficiencies that will need to be addressed in future revisions of the TBD. Detailed analyses of the primary and secondary findings are provided in Section 3 of this report.

3.0 VERTICAL ISSUES

SC&A developed the issues for the WVDP site profile document using the five objectives defined in SC&A's review procedures (SC&A 2004). The issues were identified, consolidated, and grouped into findings. Findings that could substantially impact the results of DR for some workers are listed as Primary Findings, and those that are important, but may have less impact on the results of DR, are listed as Secondary Findings. SC&A has also identified some areas where changes in the TBD would be beneficial to the claimant by preventing possible mistakes during DR, or where clarification of items would make them less ambiguous; these were listed as Observations in Section 1 of this report.

3.1 FINDINGS

3.1.1 Occupational Medical Dose, Section 3 of ORAUT-TKBS-0057

Background and Introduction

The current version of the WVDP site TBD contains a relatively short section (approximately one page beginning on page 50) concerning occupational medical doses. This section contains some general information concerning the WVDP site x-ray examination frequency, but very little specific information concerning the WVDP site occupational medical procedures, equipment, x-ray examination views, etc. Apparently, all the medical x-rays were performed offsite, making it more difficult to assess the particulars for the WVDP occupational medical program. The TBD recommends that the dose reconstructor use the doses listed in Table 3-6, pages 22–23, of ORAUT-OTIB-0006 (ORAUT 2005a) to assign organ doses from occupational medical x-ray examinations.

SC&A has reviewed the WVDP TBD and has no primary findings in the Occupational Medical Dose section, but has the following secondary findings.

3.1.1.1 Occupational Medical Secondary Findings

Finding #M-1s: Photofluorography Exams Not Addressed
The TBD does not mention photofluorography (PFG) examinations. It is possible that by 1965, PFG examinations were not conducted, but this should be verified, because the PFG doses are substantially different from posterior-anterior (PA) chest x-rays for some organs. A survey of workers' medical files should be conducted to verify this assumption.

Finding #M-2s: Lumbar Spine and Lateral Exams Not Sufficiently Addressed
The TBD makes no mention of lumbar spine x-ray examinations and states that there was no indication that lateral (LAT) views were taken. These issues were not sufficiently addressed to dismiss them as not being possible for some WVDP workers, especially in the operations period of 1965–1972. A survey of workers' medical files should be conducted to verify these assumptions.

3.1.2 Occupational Internal Dose, Section 5 of ORAUT-TKBS-0057

Background and Introduction

The Internal Dose TBD, Section 5, pages 59–75, was written to provide the dose reconstructor with recommendations concerning internal DR at the WVDP site during the period of spent fuel processing by Nuclear Fuel Services (1965–1972); 1973–1982, when the facility was being modified and then mostly idle; and from February 26, 1982, through the present when the facility was under the DOE, with WVNSC and then WVES as the contractors, to vitrify the HLW and perform D&D of the facilities and waste management areas. This section provides some information concerning internal dose controls, bioassay programs, in-vitro analysis, in-vivo analysis, and interpretation of bioassays, as briefly described below. Each topic was addressed for the two major time periods; operation/residual era (1966–1982) under NFS and the DOE era (1982–present).

1. **Internal Dose Control** –
   - 1966–1982: Used screening methods consisting of air samples and nasal swabs and some chest counts to estimate intakes; screening methods' sensitivities based on ≥25% of intake limits. Bioassays [urine, fecal, and whole-body counters (WBC)] were only used to evaluate, not control, intakes.
   - 1982–present: Used a combination of bioassay and air sampling for intake assessment. Air sampling was used when it was more sensitive than bioassays to estimate 12-month intakes; additional air and/or bioassay sampling required if >10 mrem Committed Effective Dose Equivalent (CEDE).

2. **Bioassay Program** –
   - 1966–1982: Combination of semi-routine and event-driven bioassays by urinalysis, chest counts, WBC, and fecal samples. Frequency and who was bioassayed varied with time.
   - 1982–present: Bioassays for initial employment, routine, special, and termination of employment.
   - Summarized in Table 5-2, page 65, of the TBD, and reproduced below:

Table 5-2. Summary of routine *in vitro* bioassay frequencies for West Valley radiation workers.

Period	Routine urinalysis	Routine fecal analysis
1966–1972	• Semiannual for all radiation workers for plutonium • ≥ Annual for selected workers for MFP (may have been more frequent than annually)	Annual for all radiation workers beginning ca. 1968.
1973–February, 1982	• Annual for all radiation workers for plutonium • Annual for MFP and tritium for SDA workers (through 1975)[a, b]	None known
March, 1982–late 1990	• Baseline, annual, and termination for workers with monthly TLD exchange or with respiratory protection qualifications. Analytes were plutonium isotopic, total uranium, Am-241 and Sr-90.	None known
Late 1990–present	• Baseline, annual, and termination for workers with monthly TLD exchange or with respiratory protection qualifications. Analytes were plutonium isotopic, total uranium, and Sr-90.	None known

a. Annual whole body counts replaced routine urinalysis for mixed fission products (MFPs) for workers in the process building.
b. The SDA was closed in May 1975.

3. **In-Vitro Analysis** –
   - 1966–1982: Mostly by outside vendors, some in-house analysis; bioassay results in workers' files. List of vendors and dates in Table 5-3, pages 66–67, of TBD.
   - 1982–present: Vendors used for bioassay analysis; detection/decision levels in Tables 5-4 through 5-7 of the TBD.

4. **In-Vivo Analysis** –
   - 1966–1982: In-house chest counter, commercial vendor, and NYU Phoswich counter.
   - 1982–present: Onsite bed-type lung counter, then HPGe in 1993.

5. **Interpretation of Bioassays** –
   Nuclide mix and activity fractions shown in tables on pages 73–75 for:
   - MFAP: Table 5-10
   - Uranium: Table 5-11
   - Plutonium: Table 5-12
   - Plutonium: Fresh/Aged, Table 5-13

The TBD suggests on page 75 that the dose reconstructor can use ORAUT-OTIB-0002 (ORAUT 2007b) or ORAUT-OTIB-0018 (ORAUT 2005c) for workers who were not bioassayed.

SC&A reviewed Section 5 of the TBD in accordance with the guidance provided in *Site Profile Review Procedures* (SC&A 2004) and has the following findings.

3.1.2.1 Internal Dose Primary Findings

Finding #IN-1: Adequacy and Accuracy of Internal Dose Records Not Addressed
Although the TBD mentions bioassay records on page 63, it does not address the adequacy or accuracy of internal dose records. It appears that it is assumed by NIOSH that the exposure records requested from NSF headquarters and those in the individual's personnel folder are accurate and complete. There are no indications that an electronic database has been used by either the WVDP for an individual worker's internal bioassay records, or by NIOSH for DR purposes. SC&A's preliminary review of some of the WVDP claimant files indicates that there are some tritium, transuranic, uranium, and mixed fission bioassays by urinalyses and WBC recorded prior to 1982, when NFS was in control of the site, and also for 1982 forward, when DOE took over the site. However, as far as SC&A can determine, there has not been any verification that the bioassay data used in DR is sufficiently complete and accurate for WVDP claimants.

Finding #IN-2: Bioassay Requirements and Sufficient Bioassay Data Not Established
Although Section 5 of the TBD provides some indication of which personnel were required to be bioassayed, there is insufficient information to ensure that adequate bioassays were performed. This is especially applicable during the operational era, 1965–1972, when bioassays were viewed as an evaluation aid after the fact, rather than as a means to control exposures. Nasal wipes and air monitoring (with some chest counting) were the major means of internal exposure control during the operating era; this was to keep exposures below certain regulatory limits, not to

decrease them or keep them as low as reasonably achievable (ALARA). There are indications that annual bioassays were scheduled for some plant, radiation, and waste burial workers. These bioassays consisted of chest or WBCs, and urinalysis for plutonium and sometimes Am-241, and also mixed fission/activation products (MFAP) and tritium for some workers during some periods. However, there has not been sufficient information provided to demonstrate that these segmented bioassay programs provided for sufficient internal intake monitoring. For example, annual urinalyses for tritium were not necessarily sufficient to detect tritium intakes, nor some MFAP intakes. Radionuclides that had relatively quick biological clearance times may not have been detected by the detection methods and scheduling used at the WVDP, especially for acute intakes. The use of ORAUT-OTIB-0002 (ORAUT 2007b) and ORAUT-OTIB-0018 (ORAUT 2005c), as suggested by the TBD on page 75, has very limited application to the WVDP site, and are generally applicable only to workers who were not likely to have significant exposures and/or for maximum-estimate DR cases.

Bioassay monitoring requirements and demonstration that these requirements were enforced is needed, such as by analyses of bioassay data. This may include determining the fraction of workers monitored per year by work area and/or job title, and analyzing the frequency of bioassays compared to different exposure potential throughout the facility as a function of time.

Finding #IN-3: Non-routinely Bioassayed Workers' Chronic and Episodic Exposures Inside Buildings Not Addressed

Section 5 of the TBD does not address radionuclides that workers inside of buildings were potentially exposed to from operational releases because of changes in backpressures, air leakage, incidents, etc. Workers with principal job functions that may not qualify them for routine bioassays because of their work functions/locations may have been exposed to potential airborne radionuclides inside the buildings. As described in Section 2 of the TBD, there were many incidences that could have led to the potential release of radioactive materials from the ventilation systems, acid recovery systems, fuel receiving/storage facility, duct-flushing operations, and numerous other potential release pathways at the plant. A few examples from Section 2 of the TBD are:

- Page 22: *Fuel segmentation operations resulted in substantial quantities of high specific activity airborne particulate matter, resulting in significant operational difficulties associated with the plant ventilation systems and airflow issues. This, coupled with other unforeseen circumstances involving radioactivity in systems where it was not anticipated, or at unanticipated levels, meant radiological conditions encumbered operation of the facility from the outset…. High backgrounds compromised the effectiveness of contamination control measurements…*

- Page 23: *The principal personnel exposure mechanism in the processing plant was "finely divided fuel particles" in direct-maintenance work areas adjacent to process cells, in analytical hot cells, in sample enclosures, solution storage areas, filter housings, and ventilation ducts.*

- Page 25: *The FRS facility was a significant source of personnel exposure for workers in the head end of the plant. The primary source of these exposures (internal and external) was contamination of the pool water from ruptured fuel elements, and failure of the cleanup systems to reduce activity concentrations to desirable levels.*

- Page 25: *These duct-flushing operations would cause elevated airborne radioactivity levels in numerous areas of the plant. In July 1970 the following areas showed concentrations that would have resulted in inhalation exposure in excess of 40 maximum permissible concentration (MPC)-hours…*

Another example is the statement in the NFS Health and Safety Manual (NFS 1969) that, "Doors left open upset this balance and cause inadequate air changes in some areas or even reverse air flow from 'hot' to 'cold' areas."

All of the contamination and resulting airborne radionuclides could not have been perfectly contained within the building cells and rooms where only bioassayed personnel worked with none of it escaping to other areas in the building, such as walkways, offices, change-rooms, etc. Therefore, non-routinely bioassayed workers inside the buildings could have had intakes not accounted for. Occasional or annual bioassays may not have captured intakes from episodic releases or from radionuclides with relatively quick biological clearance times.

3.1.2.2 Internal Dose Secondary Findings

There were no internal dose secondary findings.

3.1.3 Occupational External Dose, Section 6 of ORAUT-TKBS-0057

Background and Introduction

Section 5 (External Dosimetry) of the TBD, pages 75–84, covers the period of spent fuel processing by NFS (1965–1972); 1973–1982, when the facility was being modified and then mostly idle; and from February 26, 1982, through the present when the facility was under the DOE, with WVNSC and then WVES as the contractors, to vitrify the HLW and perform D&D of the facilities and waste management areas. This section provides some information concerning dose units, badging policies, dosimetry technology, workplace radiation fields, missed dose, and dosimetry uncertainties as briefly described below.

1. **Dose Units:** The TBD recommends using exposure dose conversion factors (DCFs) for 1965–1989 and deep dose equivalent DCFs for 1990 to present, and to use skin dose as recorded. DOELAP accreditation was obtained in January 1990.

2. **Badging Policies:** All persons entering the plant area through the guard gate(s) or the waste disposal areas were issued a monitoring badge. Workers in the FRS and plutonium loadout area may have been issued neutron film badges, or neutron films were placed in certain locations and exposures calculated; however, neither of these practices has been

well defined. Extremity dosimeters [thermoluminescent dosimeters (TLDs)] were assigned if the skin dose was expected to exceed the whole-body dose. Prior to 1982, outside vendors processed photon/beta and neutron NTA films, but TLD extremity monitors were processed onsite. From 1982 forward, all dosimeters were processed onsite, with the exception that extremity monitors were processed offsite.

3. During the operating period, employees were limited to **quarterly** doses of:
   - 3 rem to the whole body
   - 7.5 rem to the skin of the whole body
   - 18.75 rem to the extremities

   As of May 1971, contract employees were limited to quarterly doses of:
   - 2 rem to the whole body
   - 4 rem to the skin of the whole body
   - 13 rem to the extremities

   In most cases of over exposures, chronic exposures were the cause of over exposures, as opposed to acute events.

4. **Dosimetry Technology:** As of 1971, the reporting level from the dosimetry vendors was 10 mrem x- or gamma-rays, 40 mrem hard beta, 20 mrem fast neutrons, and 10 mrem thermal neutrons. For whole-body monitoring, film badges were used from 1965–August 1982; TLDs were used from August 1982 to the present. TLDs were used for extremity monitoring beginning in March 1967.

5. **Workplace Radiation Fields:** The TBD recommends using the same photon energy spectra as established at Hanford (ORAUT 2006a), which is 25% 30–250 keV and 75% >250 keV for mixed fission and activation products. Betas are to be treated as 100% >15 keV and neutrons as 100% 0.1–2 MeV. This applies to all areas of the WVDP site.

6. **Missed Dose:** The TBD recommends using the following minimum detection levels (MDL) for deep dose (DD) and nonpenetrating (NP) dose:
   - 1965–1982 (film): 40 mrem for DD (from ORAUT 2006b) and 50 mrem for NP (from ORAUT 2005b)
   - 1982–August 1986 (Harshaw TLD): 15 mrem for DD and 30 mrem for NP (from claimant files)
   - Sept 1986–present (Panasonic TLD): 10 mrem for DD and 30 mrem for NP (from claimant files)
   - 1965–present: 80 mrem for neutron dose (ORAUT 2006a)

7. **Dosimetry Uncertainties:** Uncertainties in dosimetry at WVDP have not been identified. The TBD recommends using those obtained from the Y-12 and X-10 sites, as shown in Table 6-7 of the TBD.

SC&A reviewed Section 6 of the TBD in accordance with guidance provided in *Site Profile Review Procedures* (SC&A 2004) and has the following findings.

3.1.3.1 External Dose Primary Findings

Finding #EX-1: Adequacy and Accuracy of External Dose Records Not Addressed
Although the TBD covers some aspects of the practices, forms, and reports for the external dose records on pages 78–81, it does not address the adequacy or accuracy of external dose records. As for internal bioassay records, it appears that NIOSH assumes that the exposure records requested from NSF headquarters and those in the individual's personnel folder are accurate and complete. There are no indications that an electronic database has been used by either the WVDP for individual worker's external dose records, or by NIOSH for DR purposes. SC&A's preliminary review of some of the WVDP claimant files indicates that there are only summary external exposure monitoring results for the NFS period (i.e., prior to 1982), and then badge-cycle data from the DOE era (1982–present). However, as far as SC&A can determine, there has not been any verification that the recorded external dose data used in DR for WVDP claimants is sufficiently complete and accurate.

Finding #EX-2: Floor Exposure Geometry Not Considered
Although the TBD makes many references to contamination and hot spots on the floor and significant radiation fields originating from the floor, there is no mention of geometry factors in the document. Radiation originating from the floor is not correctly registered on the worker's badge worn on the chest area. These radiation fields were not trivial; they read in the hundreds and thousands of mrem/hr (searching for the word "floor" in Attachment A of the TBD provides examples of some of the radiation levels present). Therefore, the dose of record would not correctly reflect the actual doses received by the lower part of the body. This could result in significant inaccuracies in the assigned doses during DR for any organs located below the chest area. This was one of the main issues brought forth by the workers and is applicable to the total time period of 1965–2007.

Finding #EX-3: Streaming Exposure Geometry Not Considered
The TBD makes references to extremity dosimetry, but does not consider situations at the WVDP site where narrow radiation fields could have been present from tank risers/vents, pipes, and other collimated radiation fields. Workers indicate that they were required to not put their extremities in the collimated radiation fields (such as the large underground storage tank access ports), but were allowed to put their head in the stream to see to work, resulting in eye and head exposures not registered on the extremity or regular monitoring badges. These situations could result in a significant underestimate of dose assignment to the exposed organs and was a concern expressed by some workers.

Finding #EX-4: Lack of Dosimetry Calibration Knowledge Prior to 1990
According to page 75 of the TBD, the calibration methods used by the outside vendors prior to 1990 are unknown. The TBD recommends using **exposure** DCFs prior to 1990 and **deep dose equivalent** DCFs for 1990 forward, and also 25% 30–250 keV and 75% >250 keV photons for DR. However, using exposure DCFs is not always claimant favorable [see OCAS-IG-001 (NIOSH 2002)], especially for >250 keV photons. The lack of knowledge of potential dosimetry adjustment factors for WVDP prior to 1990 could lead to potential inaccuracies in dose assignments. Considering the large average doses received by some workers at the WVDP site (i.e., see page 35 of the TBD where the average exposure was 7 rem/person in 1971 for some

category of workers), a small correction factor could result in substantial dose additions, potentially changing the POC to >50% for claims close to the 50% POC mark.

The lack of knowledge of the calibration for skin doses is also an important issue not addressed in the TBD; considering beta doses could be significant at WVDP. Instrument and dosimetry beta calibrations were often performed using uranium in the early years, which may or may not have matched the beta-energy spectra present at the WVDP workplace locations. Therefore, the statement on page 75 of the TBD, "Skin dose measurements, if needed, should be used as reported," could lead to substantial inaccuracies in skin dose assignments.

The TBD, i.e., page 82–84, indicates that the photon/beta exposure conditions and dosimetry were not well characterized at the WVDP site. For example:

- There are no indications that photon, beta, or neutron energy spectra were ever measured
- There were no measurements showing that low-energy photons did or did not contribute significantly to the total dose
- MDLs were not established
- Uncertainty/bias/correction factors were not documented

This lack of information has led to the unsupported use of generalized badge characteristics, such as from Hanford, Y-12, and X-10, as quoted on pages 82 and 84 of the TBD; these factors may or may not be applicable to the dose of record for WVDP workers for sufficiently accurate DR.

Finding #EX-5: Lack of Information Concerning Neutron Exposure/Dosimetry
On page 76 of the TBD it is stated:

> *NFS (1976) states neutron exposures were encountered in the FRS and the plutonium loadout area. "Neutron film badges" were therefore used in those areas. NFS (1974b, p. 4.0) states, "Special film badges sensitive to neutrons will be worn by personnel working in plutonium loadout and shipping areas when directed to do so. A satisfactory alternate procedure will be to place neutron films in typical locations and calculate exposures" using occupancy times. "On lower burnup fuels, Health and Safety will waive these requirements."*

And on page 82:

> *Neutrons could have been encountered in the FRS (cask handling operations), the Product Packaging and Handling (PPH), and the Product Packaging and Shipping (PPS) areas from spontaneous fission sources and (α, n) reactions. Given a lack of information on workplace neutron spectra at West Valley, users should assume 100% of any neutron dose was from the 0.1 to 2.0 MeV energy group [18]. Any positive neutron dose reported for West Valley workers based on personnel dosimetry or survey data should be doubled to reflect ICRP Publication 60 radiation weighting factors (ICRP 1991). This would apply to any missed neutron dose assigned as well.*

On page 86 of the TBD, the Attributions and Annotations section provides comment number 18 as follows:

> *[18] Burns, Jr. Robert E., CHP. Shonka Research Associates. Senior Health Physicist. March 2007. This neutron energy group is representative of fission neutron spectra and is also most favorable to the claimant.*

And on page 83:

> *Practices for assigning personnel neutron dosimetry at West Valley during operations have not been identified. If necessary, users should assume a neutron MDL of 80 mrem, consistent with that asserted for neutron film dosimeters in previous site profiles (e.g., Hanford). Any neutron missed dose assigned using this MDL should be doubled to account for ICRP Publication 60 radiation weighting factors (ICRP 1991).*

As can be seen from these passages, it appears that neutron dosimetry at the WVDP site was not well documented. The following is a list of issues that may result in the omission of, or inaccuracy in, neutron dose assignments in the DR process:

- No documented procedure stating the criteria for wearing neutron badges.
- No survey or other data showing the magnitude of potential neutron exposures.
- No neutron energy spectra measurements to determine calibration requirements.
- No neutron energy spectra measurements to determine the validity of using 100% 0.1–2 MeV energy neutrons for DR.
- No information concerning neutron calibration source(s).
- No adjustment for the neutron doses that were not registered because of NTA film's low-energy threshold at approximately 0.7 MeV.
- No consideration of fading of NTA film tracks, especially important in view of the long wait time to process the badges, as described on page 78 of the TBD.
- No information concerning how these factors changed as a function of time.
- No details on how **area** neutron monitoring film/TLD or survey instrument results were representative of workers' exposure, or how they were applied to the dose of record. No information concerning exposure conditions, such as the use of phantoms, calibration, fading, etc.

SC&A located some examples of area neutron surveys taken during October 1968 (NFS 1968) described as "Pu loadout" and "Birdcages," but there was no information concerning their application to personnel dosimetry or neutron dose assignments.

It is not clear if the following statement found on page 83 of the TBD recommends that if the worker was not monitored for neutrons, then assign a missing dose based on the MDL. If it does

recommend that, then it is incorrect, because a missed dose can only be assigned if the worker was wearing a badge and the recorded dose was <MDL.

> ***Practices for assigning personnel neutron dosimetry*** *at West Valley during operations have not been identified. If necessary, users* ***should assume a neutron MDL of 80 mrem***. [Emphasis added.]

SC&A did not find that neutron exposures were sufficiently addressed in the TBD to allow neutron doses to be assigned to exposed workers using technically sound methods.

Finding #EX-6: Problem in Deconvoluting Single Entry in Dose of Record
The TBD states on page 79 that:

> *Much of the external dose information in the NOCTS claim files for individuals whom worked at West Valley under NFS consists of a single sentence asserting total whole body, skin, and extremity dose for their period of employment. No individual monitoring data are provided. Dose reconstructors will therefore need to fractionate the reported total dose over the employment period a number of different ways so that latency is accounted for in the POC calculation in a manner most favorable to the claimant. This can be done, for example, by loading the reported total dose over the first few years of employment, the last few years, and evenly over the employment period and taking the result that yields the largest POC. However, in doing so the dose assigned for any individual year should not exceed the corresponding legal maximum. Annual legal maximums for the operations era are as follows (e.g., see Wenstrand 1971b).*
>
> - *12 rem whole body*
> - *30 rem skin*
> - *75 rem extremity*

SC&A assumes that the statement, "No individual monitoring data are provided," means that for some individual workers, no badge-cycle data or annual total doses are available, as opposed to all the dose data for all workers being lumped together. Having only the whole-body dose recorded, without knowing the year or radiation type (photon or neutron), presents complications. The TBD recommends partitioning the dose by year to create the greatest POC. However, there is no way of knowing how much of the recorded dose is from photons and how much is from neutrons. A fictitious example of one of these entries is as follows:

EE's name EE's SSN EE's DOB 5.900 15.002 31.090

There were no headings, units, dates, etc., listed at the top of the page. It may be assumed that the first number represents the accumulated (in rems) whole-body dose, the second number the skin dose, and the third number the extremity dose, but there are no labels to confirm that this assumption is true in the cases that SC&A has examined. There is no way of separating the photon and neutron doses from the information provided, or of knowing the number of badge cycles by which to assign missed doses.

Finding #EX-7: No Information Concerning Skin Contamination and Egress Monitoring
The TBD did not address how frequent skin contamination was, how it was monitored, and any egress monitoring that was performed, especially in the early years before portal monitors were common. Skin contamination that was not detected and removed provides the potential of long-term localized irradiation, especially relevant to skin cancers and also shallow cancers, if the energy of the betas is relatively high. An example of concern with this issue is provided in a 1967 NFS memorandum in which the author is concerned with contamination spreading into uncontrolled areas, such as the lunchroom and office area (NFS 1967). Personnel badges worn during working hours would not have picked up beta exposures from contamination on the skin that could have irradiated local skin areas for extended periods, especially in the folds of the skin around the ears, nose, neck, and arms. Additionally, because some workers only periodically submitted urine samples, some of these individual internal intakes through resuspension and ingestion could have been missed. Even with good dosimetry and records, there would be no records of these missed exposures for DR purposes.

3.1.3.2 External Dose Secondary Findings

Finding #EX-8s: Date of External Monitoring Unknown
Page 75 of the TBD states that, "No definite date has been established for when personnel monitoring began." The date that personnel monitoring began could be determined by examining the workers' DOE files. Most likely, dosimetry began by the time fuel arrived at the WVDP; however, this should be verified to ensure early doses were monitored and recorded.

3.1.4 Occupational Environmental Dose, Section 4 of ORAUT-TKBS-0057

Background and Introduction

The TBD, Section 4, Environmental Dose, addresses potential outdoor environmental intakes/submersion doses (pages 52–57) and potential external exposures (pages 57–59).

Internal Dose

The TBD addresses two potential intake sources:

1. **Stacks**, which include particulates and gaseous emissions from major stacks
2. **Ground level releases**, which include facilities, tanks, and numerous vents

Stacks: For environmental intakes and submersion doses, the TBD illustrates that, according to their methodology using a combination of measured stack releases and/or regulatory release limits, beta to alpha ratios, and dispersion coefficients, the particulates containing beta/alpha emitters and gaseous emissions of K-85 and I-131 would result in <1 mrem/yr of dose to the critical organs from these radionuclides. Additionally, tritium releases, according to the methodology used, were shown to result in <1 mrem/yr, including intake and submersion doses.

Ground level releases: Releases from the laundry, LLWT facility, vents from the extraction chemical room and tank, the process chemical room tank, and the FRS were addressed in this TBD. It was concluded that the maximum resulting environmental dose would be <1 mrem/yr.

External Dose

The external environmental doses were sometimes significant at the WVDP. For example, the TBD estimates that the radiation level above background was approximately 6 mrem/wk (312 mrem/yr) during 1966–1973, 18 mrem/(2,600 hr) during 1974–1981, and 0 mrem/hr during 1982–present. Table 4-6 on page 58 of the TBD lists the additional dose that is to be added to the dose of record for monitored workers (312 mrem/yr for 1965–1973, 18 mrem/yr for 1974–1981, and none for 1982–2007), because the control badge readings were subtracted from the badge readings during some periods. For unmonitored workers, no dose is to be assigned for the period 1965–1982 (because all workers potentially exposed to workplace radiation were to be badged), 170 mrem/yr for the period 1982–1993, and 100 mrem/yr for the period 1994–2007 (based on regulatory limits for unmonitored workers at the time). These doses are to be assigned as 30–250 keV photons.

SC&A reviewed Section 4 of the TBD accordance with *Site Profile Reviews Procedures* (SC&A 2004) and has the following findings.

3.1.4.1 Environmental Primary Findings

Environmental Internal Intakes

Finding #E-1: Chronic Ground-level and Episodic Building-released Airborne Contaminates Not Adequately Addressed
Section 4, pages 52–56, of the TBD addresses the stack and the resulting ground-level concentrations during the operational era, 1965–1972, by illustrating that the maximum potential doses from the stack releases were <1 mrem/y, and assumes that the releases for the following years would be less than that. For ground releases, NIOSH used the same approach when considering some of the potential sources of ground-level airborne releases, such as tank vents, etc. (page 56 of the TBD).

While the stacks may have been monitored, there were no details on how the discharge data in Table 4-5 for vents, etc., were obtained; i.e., were there air monitors at these discharge point 24/7, or were these calculated values? The only reference provided is "Miller 1972" and no SRDB reference number was provided in the reference listing; SC&A could not locate this reference (Miller 1972) by searching on the SRBD. Therefore, it is inconclusive if these values are appropriate. Also, ground-level environmental monitoring data are needed for the period after 1972 when cleanup, vitrification, and D&D work could have created potential intakes to workers not directly involved in these activities and, therefore, not routinely bioassayed.

Additionally, Section 4 of the TBD does not address radionuclides that workers outside of buildings were potentially exposed to from building releases (other than stacks, vents, and tanks)

because of changes in backpressures, air leakage, incidents, etc. Workers with principal job functions outside the operation buildings may not have been routinely bioassayed because of their work locations, but may have been exposed to potential airborne radionuclides in the vicinity of the buildings. As described in Section 2 of the TBD, there were many incidents that could lead to a potential release of radioactive materials from the ventilation systems, acid recovery systems, fuel receiving/storage facility, duct flushing operations, and numerous other potential release pathways at the plant. All of the contamination and resulting airborne radionuclides could not have been perfectly contained within the building to prevent any escape into the outside air surrounding the buildings. Therefore, non-routinely bioassayed workers outside the buildings could have had intakes not accounted for. Occasional or annual bioassays may not have captured intakes from episodic releases, or from radionuclides with relatively short biological retention times.

All sources of environmental airborne contaminates outside the operating areas need to be addressed and quantified to determine if the bioassay program for workers outside the production areas was sufficient. This is applicable to all eras from 1965 to the present.

Finding #E-2: Total Period of 1965–2007 Potential Environmental Intakes Not Addressed
The data used to demonstrate very low levels of potential intakes in Section 4 of the TBD were only from a few years of monitoring centered around the early 1970s. There has been no supporting evidence provided to ensure that other periods at the site did not present different exposure potential, such as increased exposures, different radionuclides, or other pathways. This especially could have occurred during the early years while lessons were being learned, and also during different fuel campaigns, and in later years, due to vitrification operations or during D&D activities.

Environmental External Exposures

Finding #E-3: Insufficient Data Used To Determine Control Badge Readings
Page 57 of the TBD describes the process used to determine the control badge reading that will be added to the recorded dose of the individual monitored, because it was originally subtracted prior to entering the dosimeter dose into the dose of record. However, the data used to generate the summary in Table 4-6 were insufficient to determine these values with reasonable accuracy for the periods 1965–1973 and 1974–1981, as summarized below:

- 1965–1973: The annual value of 312 mrem for this 9-year period was determined from a 1-week reading on a control badge in the guard house during the week of December 27, 1971; i.e., 20 mrem/wk × 50 hrs/168 hrs × 52 wk/y = 312 mrem/y.

- 1974–1981: There were no data available to determine the control badge readings for each year during this period; therefore, NIOSH used the highest reading from the control badge in the guard house for the period of 1983–1985, which was 18 mrem/y.

- 1982–2007: Control badges were stored in a shielded location; therefore, there were no significant external exposures to subtract/add to the recorded dose.

The external radiation fields at the WVDP were not negligible, and were subject to change significantly as a function of time; therefore, the use of isolated readings for the control badge is not sufficiently accurate for DR purposes.

Finding #E-4: Recommended Unmonitored Workers' External Dose Not Supported
The TBD states on page 58 that there were no unmonitored workers at the site during the period 1965–1981, which is plausible. However, it goes on to state that during the DOE era, 1982–2007, the data for ambient exposures while outdoors at the WVDP are not available, and goes on to assign the administrative limit of 170 mrem/y for the period 1982–1993 and the 10 CFR Part 835 limit of 100 mrem/y for the period 1994–2007. There were no measured values for external ambient doses presented, and nothing to support the assumption that regulatory limits prevented exposures in excess of these regulatory limits.

3.1.4.2 Environmental Dose Secondary Findings

There were no environmental dose secondary findings.

4.0 OVERALL ADEQUACY OF THE SITE PROFILE AS A BASIS FOR DOSE RECONSTRUCTION

The SC&A procedures call for both a "vertical" assessment of a site profile for purposes of evaluating specific issues of adequacy and completeness, as well as a "horizontal" assessment pertaining to how the site profile satisfies its intended purpose and scope. This section addresses the latter objective in a summary manner by evaluation of (1) how, and to what extent, the site profile satisfies the five objectives defined by the Advisory Board for ascertaining adequacy; (2) the usability of the site profile for its intended purpose (i.e., to provide a generalized technical resource for the dose reconstructor when individual dose records are unavailable); and (3) generic technical or policy issues that transcend any single site profile that need to be addressed by the Advisory Board and NIOSH.

4.1 SATISFYING THE FIVE OBJECTIVES

The completeness, accuracy, and adequacy of data (to include data to be used for monitored workers' individual DRs and data to be used in deriving coworker databases for unmonitored workers) should be validated to demonstrate its usefulness. SC&A has performed extensive document searches and found approximately 900 WVDP documents available in the SRDB plus many other documents located at the WVDP records site near Ellicottville, New York. SC&A also reviewed the approximately 100 WVDP claims to assess the information available in the energy employees' doses record and their applicability to DR and coworker databases. SC&A also conducted 4 days of onsite interviews with current and former WVDP site workers to obtain information concerning working conditions and exposure potentials that may impact the completeness and usefulness of dose records. The following is a summary of SC&A's evaluation of the present resources available (TBD, dose records, site documents, etc.) to the dose reconstructor for reconstruction of dose to WVDP site workers with reasonable completeness and accuracy.

4.1.1 Objective 1: Completeness of Data Sources

During the review of the WVDP site TBD and associated documents, SC&A found that the records used for DR have not been analyzed to determine that they are sufficiently complete and accurate for DR purposes. Additionally, the apparent lack of a centralized electronic database for WVDP external exposure and bioassay records complicates a records verification process. SC&A has not found documented evidence that there are missing exposure and bioassay records, but neither has this issue been sufficiently addressed by NIOSH for the WVDP.

There are a large number of operational documents and other WVDP-related documents available from the beginning of operations in the mid-1960s to the present. These are available at the WVDP records office near Ellicottville, New York, and on the SRDB. These collections of documents appear to provide sufficient data sources to determine operational conditions at the WVDP for DR purposes.

4.1.2 Objective 2: Technical Accuracy

SC&A found that the WBDP TBD generally presents technically accurate information. However, as described in the findings in Section 3 of this report, there are numerous situations where there is a lack of sufficient information or investigation of an issue. As addressed in detail in the findings in Section 3 of this report, there is a lack of technical details concerning the accuracy of the recorded doses, investigation of dosimetry calibration factors, and applicability to radiation fields present at the various WVDP locations as a function of time, dosimetry geometry factors, availability and accuracy of neutron exposure records, and other recorded dose-related issues. The TBD assumes that the dose of record is complete, accurate, and applicable without the need for further verification, or adjustments; this opens up the potential for incorrect and/or incomplete dose assignments.

4.1.3 Objective 3: Adequacy of Data

There appears to be adequate information concerning operating conditions and potential exposure conditions at the WVDP for DR purposes. The individual dose data records are apparently available from NFS and the workers' personnel files. However, as discussed in Section 3 of this report, there has not been any verification of the individual dose records to ensure that they are complete, and therefore, adequate for DR. SC&A's preliminary review of some of the claims indicates that there are external and bioassay monitoring records, although some individual records show sporadic monitoring results; this could be the result of various job assignments or a lack of routine monitoring. This indicates that WVDP coworker models for internal intakes and external exposures are needed for DR purposes.

4.1.4 Objective 4: Consistency among Site Profiles

When compared to other site profiles, SC&A's review of the WVDP site profile TBD did not find major inconsistencies that would significantly impact DR or create claimant-unfavorable situations.

4.1.5 Objective 5: Regulatory Compliance

No regulatory compliance issues were identified by SC&A in the WVDP site TBD.

4.2 USABILITY OF SITE PROFILE FOR INTENDED PURPOSES

Because the purpose of a site profile is to support the DR process, it is critical that the site profile assumptions, analytic approaches, and procedural directions be clear, accurate, complete, and auditable (i.e., sufficiently documented). The WVDP site TBD generally provided some method of assessing workers' external, internal, occupational medical dose, and environmental dose; however, SC&A has some concerns in the use of this TBD for DR:

4.2.1 Lack of Attention to Intakes by Unmonitored/Undermonitored Workers

The TBD essentially provides for two categories of workers; those occupationally exposed and those environmentally exposed. Those occupationally exposed are assumed to have sufficient bioassay records for DR, and those environmentally exposed are assumed to only have received "negligible" intakes (page 58 of TBD). However, as pointed out in the findings in Section 3 of this report, there are numerous situations where workers, who may not have been on the production line, could potentially have been exposed to airborne radioactive materials, either acutely by episodic releases, back drafts, etc., or chronically via contamination, etc. These workers may not have received sufficient monitoring by bioassays, because they were not considered at the time to be part of the sufficiently exposed population.

4.2.2 Lack of Environmental External Dose Information

There is lack of information concerning environmental external doses around the WVDP complex as a function of time. The assumptions made in the TBD concerning assigning unmonitored external dose are not sufficiently refined in time and space to address the many changes in external dose rates at the facility.

4.2.3 Incomplete Information and DR Recommendations for Neutrons

The TBD does not sufficiently investigate the potential neutron exposures at WVDP, nor does it make specific recommendations to the dose reconstructor concerning assigning neutron doses, i.e., how are the area neutron survey data to be used to assign individual doses, who is to be assigned neutron doses, and when, etc.

4.2.4 Insufficient Definition of X-ray Exam Parameters

The WVDP site TBD does not provide any verification that the occupational medical x-ray exposures received by WVDP workers are indicative of those doses listed in ORAUT-OTIB-0006 (ORAUT 2005a).

4.3 UNRESOLVED POLICY OR GENERIC TECHNICAL ISSUES

A number of issues identified in the WVDP site TBD review represent potential generic policy issues that transcend other individual site profiles. These include a lack of recorded data analysis for adequacy/accuracy, lack of sufficient environmental data for onsite unmonitored workers, insufficient knowledge/documentation of some source terms and radiation fields (especially neutrons), lack of dosimetry geometry factors, and lack of adequately developed (or insufficient) data for coworker internal and external dose development. Additionally, the lack of information concerning occupational medical procedures, equipment, types of exams (PA/LAT, PFG, lumbar), frequency of exams for different job titles, etc., are prevalent for the WVDP site and obvious in Section 3 of the TBD, as it is for many of the earlier DOE sites. These issues are discussed in detail as findings in Section 3 of this report.

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ATTACHMENT 1: SITE EXPERT INTERVIEW SUMMARY

INTRODUCTION

As a technical support contractor supporting the Advisory Board on Radiation and Worker Health (Advisory Board), S. Cohen & Associates (SC&A) has been tasked with reviewing the site profile for the West Valley Demonstration Project (WVDP) prepared by the National Institute for Occupational Safety and Health (NIOSH). One component of SC&A's review is a series of interviews with site experts, including current and former site workers. The purpose of these interviews was to hear first-hand accounts of past radiological control and personnel monitoring practices, and to better understand how operations and safety programs were implemented at the site over time.

Kathryn Robertson-DeMers and Ron Buchanan conducted interviews on site from September 13–16, 2010. Participants were selected by the site coordinator based on availability and relevance to subject matter.

Workers were briefed on the background of the Energy Employee Occupational Illness Compensation Program Act (EEOICPA) and the purpose of the interviews. Workers were asked to supply names and contact information for follow-up. Interviewees were directed not to disclose classified information, and all interview notes and tour notes were submitted for classification review.

Interviewees were given the opportunity to review their individual interview summaries for accuracy and completeness. This is an important safeguard against missing key issues or misinterpreting information. Approximately 50% of the participants did not respond to the request for review; the information obtained from non-responders has been withheld from this master summary.

The workers whose interviews are summarized below represent the time period from 1982 through September 2010. The work categories collectively represented by the interviewees include the following:

- Communications
- Dosimetry (Internal and External)
- Environmental Monitoring
- Industrial Hygiene/Industrial Safety
- Maintenance
- Radiological Control (RadCon)
- Security

The information provided by the workers and site experts is invaluable in helping SC&A to better understand the operations at WVDP. This summary report is not a verbatim presentation of the material contained in the interview notes, nor is it a statement of SC&A's findings or opinions—it is a consolidated summary of statements, opinions, observations, and comments that the interviewees communicated to SC&A. The sole intent of this summary is to communicate to

the Work Group, the Advisory Board, and other interested parties information acquired by SC&A during these interviews. ***Comments are included in brackets where SC&A has provided clarification.***

Information provided by the interviewees is based entirely on their personal experience at WVDP. The site experts' recollections and statements may need to be further substantiated; however, they stand as critical operational feedback and reality reference checks. This interview summary is provided in that context. Key issues raised by site experts are similarly reflected in our review discussions, either directly or indirectly. Interviews from all workers who reviewed and approved their individual interview summaries were consolidated into a single summary document. The information has been categorized into topical areas: Facilities and Operations, Maintenance and Construction Trades, Security, Radiological Control, External Monitoring, Internal Monitoring, Incidents and Accidents, Waste Management and Environmental Monitoring, Medical, Radiological and Medical Records, and Miscellaneous comments. Where conflicting observations and statements have been received, all perspectives have been retained in this summary report.

The following are summaries derived from the interviews:

FACILITIES AND OPERATIONS

[The interviewees, collectively, provided their characterization of the facilities and operations at WVDP, as follows:]

The highest number of employees during Nuclear Fuel Services (NFS) operations was about 200–300. NFS hired some locals as temporary workers, often recent high school graduates. The temporary assignments were often very short term, sometimes just a few days, weeks, or months. Temporary workers were often used because permanent employees generally received substantial chronic doses and could not perform all the necessary work without exceeding regulatory dose limits. The site has not brought in temporary workers to take dose since 1982.

There was a carryover of staff from NFS during the transition to DOE [Department of Energy]. Peak employment at WVDP was in 1994–1995, during construction of the vitrification plant, with about 1,200 employees. Currently there are about 300 employees and approximately 100 subcontractors.

There are about 170 acres in the North and South Plateaus within the perimeter of the security fence. The guard shack is still in its original location. The administration building, outside the fenced area, also dates back to the NFS operational era.

North Plateau – Developed Area, Currently Under DOE Control

Tank Farm

There are four underground tanks for liquid waste. Two carbon steel tanks have a capacity of about 750,000 gallons each (the "million gallon" tanks), and two stainless steel tanks have a

capacity of about 30,000 gallons each. The tanks are encased in concrete vaults from the original design and construction. Each large tank has its own vault; the two smaller tanks are contained in a single vault. One of the larger tanks was filled with about 600,000 gallons of high-level waste (HLW) from NFS operations, and one of the smaller tanks was filled with about 15,000 gallons of HLW from NFS operations. The other two tanks (one large, one small) were not used.

The tops of the tanks are 8 feet below the ground, with risers on top of the tank for access. During NFS operations, there was grass over this area. A superstructure was constructed over the tanks in the DOE era to support pumps used for remediation and vitrification projects.

The liquid waste stratified in the tanks. The supernatant layer was siphoned off first; 20,000 drums of low-level waste (LLW) cement were formed from the supernatant. The LLW was stored onsite until it was shipped to the Nevada Test Site a few years ago. After the supernatant was removed, pumps were used to slurry and mobilize the sludge layer for vitrification.

The local climate is very moist, with a lot of rain. As a result, there are blue enclosures over the tanks to shelter workers from the weather. They are now installing desiccants and dehumidifiers to dry out residual liquids inside the tanks and vaults.

Vitrification Plant

When DOE took over the site in 1982, a primary mission was to solidify high-level radioactive liquid waste from operations. A vitrification (Vit) plant and a receiving area for waste to be vitrified were constructed adjacent to the main process plant building. A tunnel connects the Vit plant to the main plant cells, where the vitrified waste is stored. The waste coming into the receiving area was pumped underground.

The vitrification process involved superheating the waste and combining it with glass-forming material. This took place in a ceramic melter heated by electrodes. The material was poured into specially built stainless-steel canisters where it cooled into borosilicate glass logs. Vitrified logs of HLW are stored in the Chemical Process Cell (CPC) of the process building. There are 275 vitrified canisters stored inside the Main Plant Process Building.

The vitrification cell is used for waste processing at the present time. There are support areas for Waste Reduction. Equipment from vitrification has been removed and decontaminated. Some of it is in CPC awaiting size reduction.

Main Plant Process Building (MPPB)

On the driving tour, the MPPB is located directly to the right of the vitrification waste receipt area, tank farms superstructure, and vitrification plant. The facility is still accessed through the original main entrance used when the facility was operated by NFS.

There are offices in the area of the process building adjacent to the Vit plant receiving area that were occupied from the time of NFS operations until they were vacated about a year ago. Workers have been relocated to temporary office structures just inside the barrier fence.

The Fuel Receiving and Storage (FRS) facility was accessible by railcar; the rail spur ran right inside the building. The last remaining fuel was shipped out in 2005, and the pool has been drained and emptied. The facility is used now for some large contact-handled waste items. Outside this area of the building is a posted soil contamination area. The FRS is at ground level in the main plant.

The CPC was the step where the cladding was removed from the fuel. The product of this step was sent to the Extraction Cells.

The General Purpose Cell (GPC) is in the sub-basement of the main plant.

Because of the design of the plant, there was more hands-on work in this facility as compared to other facilities.

Remote Handled Waste Facility (RHWF)

This process building was constructed during the DOE era to conduct remote waste handling activities on materials with extremely high dose rates. Specifically, it was built to handle process equipment from the CPC. They are now processing a waste stream of highly contaminated filters. A modified drum crusher is used to compact the filter; crushing is preferable to cutting, because the radioactive material trapped by the filter is contained rather than dispersed. The filters are brought into RHWF with a shielded forklift.

Quonset Hut

This building was constructed to store the equipment and vessels that were taken out of the process cell where the glass logs are now stored. The building is called Chemical Process Cell Waste Storage Area (CPCWSA).

Barrier Project

There is a plume of contaminated groundwater that originated from the main plant. A current project is to create a barrier wall to contain the migrating radionuclides. Supplies of Zeolite are present onsite for use in this project. The project will use a specialized single-pass trencher that can simultaneously dig a trench and deposit the Zeolite barrier material. The Zeolite is being used to remove the Sr-90 and provide a barrier to prevent further migration.

Near the barrier project are wastewater lagoons. The wastewater lagoons are sampled before discharge offsite is allowed.

Test Towers

Two test towers were constructed to facilitate testing of equipment and procedures used during the vitrification project. The towers were built to the height of the underground storage tanks to practice the installation and removal of pumps from the underground tanks. The test towers enabled workers to evaluate/refine procedures and become familiar with techniques in a mock-up setting, decreasing the time and personnel exposure involved in the hot work.

One tower has been dismantled; the taller tower is still standing and has proven useful for other D&D [Decontamination and Decommissioning] projects. During preparations for D&D of Extraction Cell 1 (XC1), the hottest extraction cell, workers spent 8 weeks at the test tower practicing use of the robotic arm. They were able to refine the equipment and practice using it before deploying it in the cell.

South Plateau

The South Plateau houses two waste disposal areas and a drum storage facility. [One waste disposal area is licensed by the U.S. Nuclear Regulatory Commission (NRC); the other is licensed by New York State (NYS).] A fence separates the NRC-licensed Disposal Area (NDA) and Drum Cell from the State-licensed Disposal Area (SDA). The state is responsible for the SDA and the areas outside the 170-acre perimeter fence.

A metrology tower in this area is used to monitor radiological data. The site's rail spur crosses the South Plateau and has been used for outgoing waste shipments.

Three shrink-wrapped containers are stored above ground on the federally regulated area of the plateau. These items are the melter feed hold tank, melter, and concentrator feed makeup tank.

Erosion damage in the West Valley area from heavy rains in August 2009 is still being corrected. Roads were washed out. There was no damage to the disposal areas; however, NYS performed some preventative erosion controls at the edge of the SDA after the storm to prevent stream creep from impacting the disposal area in the future.

The NDA covers about 7.5 acres of land. NFS used the burial area for plant waste, and DOE also used it for disposing items during D&D. The NDA was used for higher activity wastes (e.g., primarily "hulls" from fuel elements, process vessels, dissolvers), which were disposed of by deep-hole burial. The facility discontinued receiving waste in 1976. A cover was applied to the ground area.

The SDA covers about 14 acres of land. It was operated by NFS as a commercial venture to dispose of LLW in 14 trenches. The disposal area was closed in the 1970s due to water management problems. The state has put in a barrier wall to prevent lateral water movement and a membrane cover (installed about 10–12 years ago). These measures were successful for water control, so DOE put a membrane and barrier wall in place at the NDA about 2 years ago. The cost of the area is shared; however, the responsibility for cleanup of SDA lies with the state.

Bulk Storage Warehouse [BSW] (formerly Plutonium Storage Facility [PSF])

This building is located outside the developed area (security fence), but within the buffer land designated as the Western New York Nuclear Service Center (WNYNSC) (barbed wire fence). NFS originally used it for storing recovered plutonium. DOE later used the building as a storage warehouse. There have been multiple surveys of the area with no detectable contamination. There is a fence around the building. An environmental air sampling station is present near the building fence.

The New York State Energy Research and Development Authority is considering selling off some of the outlying property, including the land where the BSW/PSF is located. Because it is reserved for government use as part of the WNYNSC, the land is exempt from state tax. There is a movement to sell some of the land, so that it can be developed for taxable uses.

MAINTENANCE AND CONSTRUCTION TRADES

[The interviewees involved with construction and maintenance, collectively, provided a description of construction and maintenance activities at WVDP, as follows:]

Electricians are responsible for electrical work ranging from the High Voltage down to the daily facility electrical maintenance. They also did new construction and tore out old material. There is a separate instrument group responsible for instrumentation.

Work is conducted throughout the site. The work is hands-on. Maintenance personnel kept individual maintenance logs. In the past, some maintenance workers worked a lot of overtime.

Electricians got to areas that are not routinely occupied by people. They have been everywhere onsite except the CPC; they have spent time at the Bulk Storage Facility. They have made entries into all the cells except the CPC, including the Extraction Cell 2 (XC2), the Extraction Cell 3 (XC3), the Product Purification Cell (PPC), the Hot Add Cell, the Process Mechanical Cell (PMC), and the GPC. They have also conducted work in the vitrification crane room, the scrap removal area, the Chemical Process Cell Crane Room (CCR), the Uranium Loadout Area (ULO), the Equipment Decontamination Room (2 entries per week), the analytical labs, and the Fuel Receiving and Storage area.

To enter the cells, you must access them through the bottom or top of the cells. A seal plug has to be removed in order to gain access. Cells can also be accessed via doors.

The Preventive Maintenance has gone downhill. The philosophy is to run to failure. This is not the same as it was 10 years ago. Things have gotten so bad they will never be able to recover.

SECURITY

[The interviewees involved with security, collectively, provided a description of security responsibilities at WVDP, as follows:]

A Security Inspector was responsible for all aspects of physical security at the site. Security Inspectors, later referred to as Security Police Officers, were also responsible for escorting visitors. Anytime there was a medical incident onsite, Security was responsible for traffic direction.

Category 4 Special Nuclear Material (SNM) required guarding. They guarded SNM in casks when it was set outside the fuel storage area. This required that they visibly watch the cask around the clock if it was outside the view of facility cameras. Security was not responsible for Material Control and Accountability. There was a single individual who was responsible for this task—to account for the SNM in the fuel storage pool.

Various activities took security into radiological areas. There were security time clock rounds in the main plant. Some of these were in Radiological Buffer Areas (RBAs). There were scenario-based force-on-force exercises. They could pass through radiological areas.

RADIOLOGICAL CONTROL

[The interviewees, collectively, provided their characterization of the radiation protection organization and practices at WVDP, as follows.]

The core Radiological Control team is good here. There is a lot of support throughout the organization. There is a standard of excellence. They make sure people don't get contaminated. The dose reconstruction of worker dose is done by the dosimetry department.

There was an increase/decrease in the number of Radiological Control Technicians (RCTs) depending on the work scope. There have been 13–32 house technicians and 3–5 supervisors, with the number fluctuating over time. The RCT support has been contracted out for the last 3–4 years.

RCTs were in-house [in the late 1980s]. Now they are supplied by a subcontractor. Everybody does things differently. Going from inside to outside has degraded the quality of the RadCon program. In-house practices were more consistent. They knew the conditions of the plant.

There is an ALARA [As Low as Reasonably Achievable] committee that evaluates the hot jobs for exposure potential. Personnel are moved around to prevent any one individual from receiving too much dose. In 2009, the maximally exposed individual received 711 mrem [millirem].

DOELAP [Department of Energy Laboratory Accreditation Program] does assessments of the dosimetry program every 2–3 years. There are also triennial assessments, which are conducted

by an outside contractor. Every 3 years, 16 elements of the radiological program are evaluated. In addition, there are audits conducted by DOE and URS [United Research Services].

Radiological Control Engineers perform document reviews and work planning for [site activities, including] waste reduction and shipping, and plant D&D.

Analytical work, such as waste dilution, was done in hot cells with manipulators. There were liquid-filled windows shielding the workers from the radiation inside the hot cells. Samples had to be diluted down to 10 mR [milliroentgen]/hour so they could be handled in a fume hood. There was no appreciable dose received from work with the hot cell; however, there was dose received from the floor. There was a hot ventilation duct right under the floor in this area. The analytical laboratory was on shift work.

Birdcages were used to maintain geometry.

Radiological Hazards/Source Term

The signature radionuclides at West Valley are Cs-137 and Sr-90 in roughly equal amounts. There are also Am-241 and other fission products (FPs) from the fuel. The ratio of FPs to Am-241 is roughly 10:1. The exact ratio of the radionuclides is dependent on the specific area of the plant. Also found at West Valley in lower concentrations are Eu-154, Co-60, Pu-239/240/241, and U-235. They have not seen any Th-232 or U-233, though there is Th-234.

The predominant radionuclides by area are as follows:

Extraction Cells:	Pu-239 and Am-241 as a decay product of Pu-241
Head End Cells (PMC, GPC, CPC):	Cs-137, Sr-90, uranium and uranium decay products
Tank Farms:	Cs-137 and Sr-90
Vitrification Facility:	Cs-137

There is too high a dose to make entry into the cells (3.4 to 20 R/hour). The GPC has dose rates of 200 R/hour.

There is no tritium at the main plant.

There are no radiation-generating devices onsite. There are sources that are used for instrumentation. There was some radiography done down at the drum cell at one point by an outside contractor.

There was some neutron dose associated with the handling of fuel. The dose rate was about 10 mrem/hour. There are no neutron dose rates associated with the PPC. There was no personnel neutron monitoring for jobs at the PPC, but there were measurements taken with a Snoopy. There have been no neutron spectral studies completed. There were also some neutron measurements made in the Extraction Cells.

Access/Egress

At one time, there were three access areas to the site. There is the existing guard house at the main gate, a construction gate, and an access point through the Administrative Building. The current Administration Building has been there from the NFS days. The construction gate was established as an access point in the fall of 1983 and closed in 1996.

There was a portal monitor that they walked through. They had portal monitors at each access point (three areas). There are also portal monitors at the plant. Prior to portal monitors, there were and still are frisking booths where you stepped into a concrete containment and were frisked with a GM [Geiger-Mueller] detector. Egress monitoring became optional about 10 years ago.

The new alpha/beta personal contamination monitors (PCMs) have been in place for about the last 5 years. Prior to this, there were beta PCMs. Before the PCMs, there was a hand-frisking station using a GM counter. There were times when workers were contaminated and set off the PCMs. When this occurred, RadCon would survey them with a beta/gamma and an alpha probe.

Training

[Security personnel] received General Employee Training and Radiation Worker training as soon as they came to the site.

[Maintenance workers] have received radiation worker training since they first arrived.

Administrative Controls

There is a stop-work/question attitude at West Valley. Safety-related information from the workers is readily accepted. Time-outs are also used to regroup on jobs if things don't go right, or if there are unexpected situations. There are a lot of administrative controls put in place.

There have always been Radiation Work Permits (RWPs) at West Valley. They specify the required personnel protective equipment, training, and external monitoring. Not all RWPs have specified internal monitoring requirements.

When an RWP is generated, Radiological Engineering does some calculations to estimate the airborne levels. The administrative limiting conditions on the RWP are set at 80% of the WVDP limiting condition. The Work Instruction packages have steps to decontaminate, fix, or cover removable contamination at 50% of the RWP limiting condition.

There was no eating, drinking, or smoking in the vicinity of radioactive material. This could result in an individual being fired.

There is a drinking fountain in the hallway on the third floor of the main plant. Initially, they were allowed to eat and drink in the buffer areas.

Maintenance had a shower area with limited capacity. There was no requirement to shower.

Surveillances

There were some survey reports around for reference when DOE took over.

There could be spots with streaming radiation. They do general area radiation surveys. For areas that are not general use areas, characterization surveys are conducted.

There are requirements for special surveys to be conducted when accessing areas above the 7-foot mark. Anything below 7 feet and not posted can be considered clean. There is no housekeeping above the 7-foot mark, and contamination is present in some areas of the plant.

Contamination can be found in the back of the control room, inside the electrical boxes, and inside the conduit pipes.

The trigger levels for release of equipment and individuals are as follows:

< 20 dpm [disintegrations per minute] alpha smearable
< 200 dpm beta/gamma smearable
< 5 cpm [counts per minute] alpha by direct scan
< 100 cpm beta/gamma by direct scan

The portal monitors/PCMs are set to these release limits; however, the levels are an average over the volume of the detector.

There is a count room onsite for identification of radionuclides. All the fission products are listed in the library. They are actually not seeing the uranium on samples.

The air monitoring program includes Plant Tour Air Sampling, Continuous Air Monitors (CAMs), and job-specific breathing zone, general area, and continuous air monitoring samples. The Plant Tour Air sample filters and the CAM filters were exchanged and counted weekly and twice per week, respectively. Occupational air samples are analyzed routinely for gross alpha/beta. Everything is monitored to below one Derived Air Concentration (DAC).

The use of job-specific air sampling has increased over the last several years. When there is a potential for rapidly changing conditions, all workers are now assigned breathing zone samplers. In the past, the breathing zones were assigned to the most exposed.

There are triennial air flow tests. Direction flow is tested on a daily basis. If there are changes to the ventilation, air flow studies are redone.

The air sampling program consists of fixed air samplers, alpha and beta continuous air monitors, breathing zone sampling, and job-specific general area sampling. Breathing zone sampling requirements are job-specific and require that every individual on the job wears a sampler. More

recent air sampling results are available in a database. There is also a DAC-hour tracking program. Nasal smears are collected as needed for a job.

They used to do nasal smears every time you wore a mask. Nasal smears have decreased over the last 5–10 years due to changes in monitoring policy.

Any concern regarding neutron exposure was gone with the shipment of the last fuel. The site maintained neutron instrumentation (Snoopy) until 2005. There has been some intermittent monitoring for neutron exposure. A Snoopy was taken into the PPC cell to see if there was any dose rate. They also used a Snoopy at the FRS. There were no positive readings.

Personal Protective Equipment

Security personnel wore their uniforms into the RBAs.

The radiological jobs Electricians become involved with required personal protective equipment (PPE), including single pair anti-contamination clothing, double pair of anti-contamination clothing, bubblesuits, rain gear, PAPRs [Powered Air-Purifying Respirators], and full-face respirators. There was a single use respirator policy.

They don't do the suit-ups like they did in the past. They were making more entries in the past.

They have done some testing associated with shielding provided by the PPE.

EXTERNAL MONITORING

[The interviewees, collectively, provided their characterization of how external monitoring was performed at WVDP, as follows:]

External monitoring is currently provided to any individual likely to receive 100 mrem in a year. This determination is made by management and supervision, not by Radiological Control. The managers and supervisors are pretty consistent throughout the site in the individuals they badge. There is a requirement to have Radiation Worker I or II training in order to receive a dosimeter. There has never been a requirement at West Valley to badge all personnel onsite.

Everyone coming through the guard shack did not have to have a dosimeter. Dosimeters were assigned to those with Radiation Training. All security personnel wore dosimeters. [Their] dosimeters were left onsite at the guard house. Visitors always had to have dosimetry if they were going in any radiological buffer areas. If they were in a large group, they had a tour dosimeter assigned to the tour leader or escort.

Dosimeters were always stored onsite. There were periodic sweeps to see if people were complying. Control badges were stored in the badge racks at all locations. Background badges were stored in a lead cave. Regardless, the background is not subtracted from the badge.

There is an area dosimetry program. These dosimeters are located in work areas where the individuals are not monitored. This has been around at least since DOE took over.

The exchange frequency for dosimeters has gone back and forth from monthly to quarterly during different time periods.

West Valley is accredited for low energies, but most of the dose seen is from fission products, such as Cs-137. The angular dependence testing is documented in the site external dosimetry technical basis document. There was a short period of time when they did extremity dosimetry processing onsite.

The external monitoring was processed in-house from 1982–1986. West Valley was using the Harshaw dosimeter up to 1986. Then the site went to the Panasonic dosimeter in October of 1986 and has continued to use this dosimeter to the present.

West Valley uses dosimeter relocation and multi-pack dosimeters for non-uniform radiation fields. For non-uniform exposure fields, they use extremity and multiple dosimetry in accordance with the requirements of their procedures. Use is based on pre-job surveys.

Badges have been relocated from the chest for cell work in Very High Radiation Areas. The badge was moved to the highest exposed portion of the body. An example of when they would relocate a badge is during work on risers, such as during sampling. This is the result of shine straight up from the riser. Where there were hot spots on the floor, they have relocated the badge to just above the knee.

Extremity dosimetry is used when there is a potential to receive 100 mrem whole-body exposure in a month and the ratio of extremity to whole-body exposure is 10:1. This is consistent with 10 CFR 835 requirements.

Multipacks are used when there is a 50% difference in the exposure to portions of the body other than the chest. For example, work conducted in XC2 required use of multipack dosimeters to monitor the lower legs. They are also used for specific jobs at the Waste Tank farms. When a multipack of dosimeters is worn, the dose of record is the highest of the whole-body doses.

For the hot jobs, the site uses electronic dosimeters [EDs]. PICs [Personal Ionization Chambers] were used for a while. About 5 years ago, they dropped the use of PICs. They now have an ED program, which was implemented about 6–7 years ago. The EDs are fairly consistent with TLDs [Thermoluminescent Dosimeters].

Time-keeping is used in beta areas for certain jobs. This is particularly true for extremity dose, where the ACL [Administrative Control Limit] is 1 rem.

Neutron badges were worn for fuel shipment and PPC cell measurement. In 2003, they shipped out spent fuel on railroad cars. In this case, they obtained neutron dosimeters from the Idaho National Engineering Laboratory (INEL). There were also Personal Neutron Accident

Dosimeters among the dosimeters. There were no neutron spectral studies during the tenure of these interviewees [mid-1980s to present].

[Electricians] characterize their radiation exposure as chronic. They always wore a TLD and a PIC or an ED. There were time limitations in some of these areas. The particular jobs varied over time. They have been assigned electronic dosimeters for work in the vitrification crane room and CCR. Dosimeters were worn between the waist and the neck. Electricians wore finger rings for some jobs, such as in the crane area. They were not assigned multiple TLDs. They have relocated the primary dosimeter for jobs in the Acid Recovery Cell. The placement of the dosimeter for non-uniform fields is job-specific.

INTERNAL MONITORING

[The interviewees, collectively, provided their characterization of how internal monitoring was performed at WVDP, as follows:]

Less than 10% of the dose is internal at West Valley. Internal dose is assigned to only about one individual per year. This is the result of the use of respiratory protection, rather than the lack of spreadable contamination.

There was a whole-body counter during the NFS days of operation, which was more of a lung counter than whole body. The site currently uses a Canberra Accuscan for in-vivo counting. Everyone that has a dosimeter gets an annual WBC [whole-body count].

These scans are primarily used to identify intakes of Cs-137. In the last 8 years, the unit has been calibrated for Am-241. The Department of Energy Laboratory Accreditation Program (DOELAP) currently includes Cs-137, Co-60, and Am-241. Americium-241 is a byproduct of handling plutonium from the reprocessing. The in-vivo counting program is DOELAP-accredited for Cs-137 and Am-241, but the counter is used for the detection of Cs-137; Am-241 monitoring is performed by urinalysis.

There are classifications of workers that participate in the in-vitro monitoring program. Respirator-qualified personnel are on a urinalysis program. Other individuals on the urinalysis program are those belonging to high risk groups. Individuals wearing respiratory protection, RCTs, and operators would be in the routine program. There is special monitoring for jobs or events in addition to routine monitoring. For example, there were jobs at the PPC south and the ARPR (Acid Recovery Pump Room) where workers were put on monthly Am-241 bioassays. There are also event-driven bioassays.

In the 1980s, the in-vitro bioassay program included annual Sr-90 and biennial Pu-238, Pu-239, and Pu-240 bioassays. The plutonium bioassays were then changed to annual. In the late-1990s, americium and uranium bioassays by mass measurements were added. The bioassay collected is a 24-hour sample. West Valley used various offsite contractors for processing of bioassay samples, including Eberline, TMA [Thermo Analytical], Quanterra, Severn Trent, and Gel.

During the DOE era at West Valley, bioassay has been done offsite since 1982. The current vendor is Gel. Bioassay sampling is done for Cs-137, Sr-90, Pu-238/239/240, uranium by mass, and Am-241 annually.

Tritium bioassay was not done for the covered population, because it is not an issue at the plant or at the NRC burial site. There is job-specific tritium bioassay sampling associated with the SDA.

There is no high-fired plutonium oxide at West Valley. There has been uranium in urine background studies. Interviewees are not aware of any particle size studies done at West Valley. For internal dose calculations, they use the ICRP [International Commission on Radiological Protection] default particle sizes.

In the past 2 years, [the site has] gotten away from bioassay sampling for americium and plutonium and implemented BZ sampling and DAC-hour tracking. They weren't seeing any positive bioassay results. DAC-hour tracking is used to trigger special bioassay at 40 DAC-hours, but is not used to assign dose.

If there is a reason to believe they have exceeded the protection factor, they will pull the nasal smear. If there is a positive nasal smear or if they exceed the respiratory protection factor, a special bioassay is taken. There have been occasions where the respiratory protection factor was exceeded or there were positive nasal smears.

Tritium monitoring [bioassay] is a concern at the State-licensed Disposal Area (SDA) only. Pre- and post-job tritium monitoring of personnel working in this area was done for a period of time. RadCon Support was provided to this area, but this is no longer the case.

Security Inspectors receive an annual whole-body count. The WBC is done in-house. An interviewee submitted bioassay samples on an annual basis when in a respirator program [late 1980s]. These samples were typically overnight collections.

[Maintenance workers said] whole-body counting and bioassay monitoring are done annually. There was an entry into the Acid Recovery Cell. This required the submittal of monthly samples. [The interviewees] have not been asked to submit fecal samples.

INCIDENTS AND ACCIDENTS

[The interviewees, collectively, provided their recollection and understanding of what incidents occurred at WVDP, and how they were handled and documented, as follows:]

When contamination is detected, a decontamination and release procedure is followed (RC-EMRG-1). There is also an incident response when a protection factor is exceeded.

Skin dose from a contamination is determined through the use of Varskin. There are about 12 skin and clothing contaminations per year from about 1985 or 1986 to present. An assessment is completed at a trigger of 10 mrem (600 cpm).

There is a summary of contamination incidents back to 1991. Other incidents are tracked with the Occurrence Reporting and Processing System or Noncompliance Tracking System. There have been no releases to the environment.

There have been several incidents or unusual occurrences at West Valley. Back prior to 1984, the filters blew and went up the stack. There are occasionally spills from the pipes. There have been radiation alarms. There was a chemical reaction, which occurred in the laboratory area.

[Interviewees provided several examples of incidents and unusual occurrences at WVDP as follows:]

- There was an incident in the Crane Maintenance Room (CMR) where personnel were working with a liner from the Vitrification Cell. Workers were supposed to be doing a waste loadout. The technician found a hot spot. There was a Radiation Area Monitor (RAM) in the area, but it was too far from the source. By the time the hot spot was discovered, the technician and the operator had exceeded the ACL. As a result of this incident, there is a requirement to check for non-uniform dose rates for entry into a cell. Checking for non-uniform dose rates for entry into a cell is determined by an RCT taking window open/closed window dose rates at the floor, knee, waist, chest, and head.

- There were issues where the PAPR failed. The crane was screaming. They didn't take nasal smears. No special bioassay was done, because the air concentration was less than 1 DAC according to Safety.

- The [**redacted**] incident occurred in [**redacted**]. A worker was working on a [**redacted**] and became contaminated as a result of contamination on the [**redacted**]. The worker did not know of the contamination at that point, so the worker [**redacted**] for other colleagues for [**redacted**]. When the worker went to exit the plant that night, the personal contamination monitor alarmed. There were probably about 20 individuals who became contaminated to some degree. There was extensive monitoring throughout the site.

- There was an incident involving the blowout of the main stack about 10 years ago [~2000]. There was a failure of the filters. There were outside personnel who were contaminated. The material traveled northwest towards the tank farms. They had to chip up some of the concrete as a result of the release. The roofs became contaminated. The incident occurred as a result of the filter not being changed out when it was needed.

- There was an incident where [[**redacted**] workers] were working on steam lines. A CAM went off due to airborne levels. They evacuated the plant. The nasal smear and urinalysis came up hot.

- There have been several times when individuals were wrapped up because of radiation contamination. For example, someone with hand contamination would have his/her hands wrapped in plastic wrap for the purpose of "sweating" the contamination out.

- There was an incident where an operator put [**redacted**] through the line and ended up with contaminated [**redacted**] on the operator. The worker had to be decontaminated.

- There were [**redacted**] personnel contaminations requiring decontamination during work in the CMR, Extraction Cell, and Fuel Receiving and Storage.

- [[**Redacted**] workers] were involved in an incident in the late 19[**redacted**]s. They [**redacted**] and were contaminated. The root cause was that they were not following the procedure for their job.

WASTE MANAGEMENT & ENVIRONMENTAL MONITORING

[The interviewees, collectively, provided their characterization of waste management and environmental monitoring practices at WVDP, as follows:]

The site is not shipping any waste now [at the time of the interview]; it is being stored onsite. [According to a DOE representative in 2012, there have been periods when waste shipment was suspended temporarily due to budget constraints.]

There are four waste tanks onsite at West Valley: 8D-1, 8D-2, 8D-3, and 8D-4. 8D-2 contains fission product waste from the PUREX (Plutonium-Uranium Extraction) process runs at the plant. The THOREX (Thorium Extraction) waste was put into tank 8D-4. There was a flush of the process systems after the THOREX process. The waste from 8D-2 was the waste that was vitrified.

The supernatant in the waste was run through an ion-exchange column to remove Cs-137 and then mixed with grout. This material was put into drums. There is a significant amount of Sr-90 in the sludge of the waste tanks.

WVDP (DOE) did not bury waste at SDA. It is a completely different facility. It has its own fence separating it from DOE operations. DOE is not allowed in this area. None of the waste from the site went to the SDA.

DOE did bury waste at the NDA. There was a little bit of everything buried at the NDA. Some of the material in the holes was packaged and some unpackaged. This knowledge of the contents comes from digging up the holes. The NDA is still a DOE responsibility. They have added a cover to this area to mitigate water seepage. There is no seepage to the DOE area from the SDA.

The contaminated water from the laundry went through drains in the plant, passed through ion exchange, and was discharged to the lagoons.

Regulatory Affairs is responsible for the environmental monitoring program.

There is continuous air monitoring on the main stack, and anything that vented to the environment has been monitored. The main stack exhaust is passed through a High Efficiency Particulate Filter and then monitored. There is a whole ring of air samplers around the site. The

samplers on the perimeter were higher than the filtered stack samples. The emission from the main stack is roughly five times the background. The gas fiber filters used for sample collection are analyzed for gross alpha/beta. The charcoal used to collect samples was sent offsite for analysis.

Three locations were monitored for [environmental] tritium: (1) the main stack, (2) the permanent ventilation system that monitors offgas from the waste tank farms, and (3) an ambient sampler at one of the SDA trenches. There were also a couple of beta continuous air monitors set up outside. These filters were also analyzed.

Groundwater analysis includes gross alpha/beta, tritium, and gamma spectroscopy.

There are outside soil contamination areas around the site, which are roped off and controlled. Legacy contamination is present in ditches around the plateau, around the lagoons, in nooks around the main plant, and between buildings.

There was an incinerator onsite, but the interviewees are not aware of any burning activities involving radioactive material. The onsite incinerator has not operated since at least 1982.

MEDICAL

[The interviewees, collectively, provided their characterization of how medical monitoring was performed at WVDP, as follows:]

There is no diagnostic medical x-ray unit onsite. The medical x-rays were never done onsite in the DOE era.

Annual physicals are done at offsite medical facilities. There are multiple sites. Those in the Respiratory Protection program receive chest x-rays. The asbestos program requires chest x-rays. Security was never required to have spinal x-rays.

A doctor used to visit the site to do the physicals. Physicals have been extensively cut back.

[An interviewee] recalls receiving a pre-employment chest x-ray [offsite] in 1988. [Another worker] did not recall having any chest x-rays.

RADIOLOGICAL AND MEDICAL RECORDS

[The interviewees, collectively, provided knowledge of their understanding of the completeness and adequacy of radiological and medical records, as follows:]

Workers receive an exposure report annually.

The dosimetry records are available in a database; however, the hardcopy record is considered the official record. The hardcopy records include all monitoring data, contamination incident reports, and previous exposure records. The dosimetry data are available on magnetic tape from

1986–1996. Data from mid-1997 are available on a Personal Computer (PC). Detailed information on personnel exposures in the hardcopy files begin starting in 1982, when DOE took over. The only records provided for EEOICPA requests are those available in the DOE hardcopy file. There are no medical x-rays in the radiation file.

West Valley does not maintain the NFS dosimetry records. The hardcopy records at West Valley include a summary of NFS exposure similar to other previous exposure requests from other sites, but there is no detailed external and internal exposure information. Detailed information for NFS must be requested from NFS. In order to obtained detailed information on exposure from the NFS days, the site has to make an official request for the records to Erwin, Tennessee.

A complaint was made that West Valley was hiding records. As a result, the FBI [Federal Bureau of Investigation], lead by Gary Dolora, came in to investigate. The FBI took a van full of records with them. The final determination was that there was no wrongdoing. The Tiger Team came to West Valley at the same time.

MISCELLANEOUS

[The interviewees, collectively, provided additional comments they wished to include in the summary for consideration, as follows:]

Community attitudes towards WVDP have been mixed. In the early years, the plant brought hope of prosperity, but it did not last long—the site only operated from 1965 through 1972. Some residents blamed the activists and excessive regulation for plant closure and lost hope. It is somewhat ironic that the cleanup efforts have brought more jobs and prosperity for a longer period than the operations did.