

## SEC Petition Evaluation Report Petition SEC-00155

Report Rev #: 0

Report Submittal Date: April 28, 2011

Subject Expert(s):		Chris Miles, Michael Kubiak		
Site Expert(s):				
<b>Petition Administrative Summary</b>				
<b>Petition Under Evaluation</b>				
Petition #	Petition Type	Petition Receipt Date	Qualification Date	DOE/AWE Facility Name
SEC-00155	83.13	November 10, 2009	April 29, 2010	Hanford
<b>Petitioner Class Definition</b>				
All personnel who were internally monitored (urine or fecal), who worked at the Plutonium Finishing Plant in the 200 Area at the Hanford Site, from January 1, 1987 through December 31, 1989.				
<b>Class Evaluated by NIOSH</b>				
All personnel who were internally monitored (urine or fecal), who worked at the Plutonium Finishing Plant in the 200 Area at the Hanford Site, from January 1, 1987 through December 31, 1989.				
<b>NIOSH-Proposed Class(es) to be Added to the SEC</b>				
None				
<b>Related Petition Summary Information</b>				
SEC Petition Tracking #(s)	Petition Type	DOE Facility Name	Petition Status	
<ul style="list-style-type: none"> <li>• SEC-00057 (including SEC-00050 and SEC-00078)</li> <li>• SEC-00152</li> </ul>	83.13  83.14	Hanford  Hanford	Two classes added to the SEC.  One class added to the SEC.	
<b>Related Evaluation Report Information</b>				
Report Title	DOE/AWE Facility Name			
<ul style="list-style-type: none"> <li>• SEC Petition ER for Petition SEC-00057-1 (SEC Class: Specified areas and time periods, Oct. 1, 1943 through Aug. 31, 1946)</li> <li>• SEC Petition ER for Petition SEC-00057-2 (SEC Class: Specified areas and time periods, Sep. 1, 1946 through Dec. 31, 1968)</li> <li>• SEC Petition ER for Petition SEC-00152 (SEC Class: All areas, Oct. 1, 1943 through Jun. 30, 1972)</li> </ul>	Hanford  Hanford  Hanford			
<b>ORAU Lead Technical Evaluator:</b> Chris Miles		<b>ORAU Peer Review Completed By:</b> Michael Kubiak		
<b>Peer Review Completed By:</b>	[Signature on file] _____		4/28/2011	
	<i>Samuel E. Glover</i>		<i>Date</i>	
<b>SEC Petition Evaluation Reviewed By:</b>	[Signature on file] _____		4/28/2011	
	<i>J. W. Neton</i>		<i>Date</i>	
<b>SEC Evaluation Approved By:</b>	[Signature on file] _____		4/29/2011	
	<i>Stuart L. Hinnefeld</i>		<i>Date</i>	

This page intentionally left blank

## Evaluation Report Summary: SEC-00155, Hanford

This evaluation report by the National Institute for Occupational Safety and Health (NIOSH) addresses a class of employees proposed for addition to the Special Exposure Cohort (SEC) per the *Energy Employees Occupational Illness Compensation Program Act of 2000*, as amended, 42 U.S.C. § 7384 *et seq.* (EEOICPA) and 42 C.F.R. pt. 83, *Procedures for Designating Classes of Employees as Members of the Special Exposure Cohort under the Energy Employees Occupational Illness Compensation Program Act of 2000*.

### Petitioner-Requested Class Definition

Petition SEC-00155 was received on November 10, 2009, and qualified on April 29, 2010. The petitioner requested that NIOSH consider the following class: All personnel who were internally monitored (urine or fecal), who worked at the Plutonium Finishing Plant in the 200 Area at the Hanford Site, from January 1, 1987 through December 31, 1989.

### Class Evaluated by NIOSH

Based on its preliminary research, NIOSH accepted the petitioner-requested class. NIOSH evaluated the following class: All personnel who were internally monitored (urine or fecal), who worked at the Plutonium Finishing Plant in the 200 Area at the Hanford Site, from January 1, 1987 through December 31, 1989.

### NIOSH-Proposed Class(es) to be Added to the SEC

Based on its full research of the class under evaluation, NIOSH has obtained numerous documents containing monitoring results, bioassay program audit reports, independent bioassay program data evaluations, as well as Hanford process and source information. In addition, several individuals with first-hand knowledge of the contractor bioassay laboratory issues during the period under evaluation have been interviewed. Employee-specific information provided through the EEOICPA claims process and Technical Basis Documents written by NIOSH have also been available for this evaluation. Based on its analysis of these available resources, NIOSH found no part of the class under evaluation for which it cannot estimate radiation doses with sufficient accuracy.

### Feasibility of Dose Reconstruction

Per EEOICPA and 42 C.F.R. § 83.13(c)(1), NIOSH has established that it has access to sufficient information to: (1) estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred in plausible circumstances by any member of the class; or (2) estimate radiation doses of members of the class more precisely than an estimate of maximum dose. Information available from the site profile and additional resources is sufficient to document or estimate the maximum internal and external potential exposure to members of the evaluated class under plausible circumstances during the specified period.

### Health Endangerment Determination

Per EEOICPA and 42 C.F.R. § 83.13(c)(3), a health endangerment determination is not required because NIOSH has determined that it has sufficient information to estimate dose for the members of the evaluated class.

This page intentionally left blank

## Table of Contents

1.0	Purpose and Scope.....	7
2.0	Introduction .....	7
3.0	SEC-00155 Hanford Class Definitions .....	8
3.1	Petitioner-Requested Class Definition and Basis .....	8
3.2	Class Evaluated by NIOSH .....	11
3.3	NIOSH-Proposed Class(es) to be Added to the SEC .....	11
4.0	Data Sources Reviewed by NIOSH to Evaluate the Class .....	11
4.1	Site Profile Technical Basis Documents (TBDs) .....	12
4.2	ORAU Technical Information Bulletins (OTIBs) and Procedures .....	12
4.3	Facility Employees and Experts .....	13
4.4	Previous Dose Reconstructions .....	14
4.5	NIOSH Site Research Database .....	14
4.6	Other Technical Sources.....	15
4.7	Documentation and/or Affidavits Provided by Petitioners .....	15
5.0	Radiological Operations Relevant to the Class Evaluated by NIOSH .....	16
5.1	Hanford Plutonium Finishing Plant and Process Descriptions.....	16
5.2	Radiological Exposure Sources from PFP Operations, Hanford 200 Area.....	18
5.2.1	Internal Radiological Exposure Sources from PFP Operations .....	18
5.2.2	External Radiological Exposure Sources from PFP Operations .....	18
5.2.3	Incidents .....	19
6.0	Summary of Available Monitoring Data for the Class Evaluated by NIOSH .....	19
6.1	Available Plutonium Finishing Plant Internal Monitoring Data .....	19
6.2	Available Plutonium Finishing Plant External Monitoring Data .....	20
7.0	Feasibility of Dose Reconstruction for the Class Evaluated by NIOSH.....	21
7.1	Pedigree of Hanford Data.....	21
7.1.1	Internal Monitoring Data Pedigree Review.....	22
7.1.1.1	Hanford Bioassay Audit Program .....	23
7.1.1.2	UST-Related Audits and Surveillances Conducted by PNL .....	25
7.1.1.3	Other Evaluations of UST-Richland and Associated Data Integrity .....	27
7.1.1.4	Personnel Interviews .....	31
7.1.1.5	Review of Investigative Documents at the DOE IG's Office .....	31
7.1.1.6	Internal Data Pedigree Review Conclusions .....	32
7.1.2	External Monitoring Data Pedigree Review.....	32
7.2	Evaluation of Bounding Internal Radiation Doses at the Plutonium Finishing Plant .....	33
7.3	Evaluation of Bounding External Radiation Doses at the Plutonium Finishing Plant .....	34
7.4	Evaluation of Petition Basis for SEC-00155 .....	35
7.4.1	Fraudulent Data from UST.....	35
7.4.2	Interviews by U.S. EPA OIG of Former UST Employees .....	35

7.5	Other Potential SEC Issues Relevant to the Petition Identified During the Evaluation.....	36
7.6	Summary of Feasibility Findings for Petition SEC-00155.....	36
8.0	Evaluation of Health Endangerment for Petition SEC-00155.....	38
9.0	Class Conclusion for Petition SEC-00155 .....	38
10.0	References .....	41
	Attachment 1: Data Capture Synopsis.....	45

## Tables

4-1:	No. of Hanford Claims Submitted Under the Dose Reconstruction Rule .....	14
7-1:	Summary of UST-Related Audits and Surveillances Conducted by PNL.....	25
7-2:	Summary of Feasibility Findings for SEC-00155.....	37

## SEC Petition Evaluation Report for SEC-00155

*ATTRIBUTION AND ANNOTATION: This is a single-author document. All conclusions drawn from the data presented in this evaluation were made by the ORAU Team Lead Technical Evaluator: Chris Miles, Quantaflux, LLC. The rationales for all conclusions in this document are explained in the associated text.*

### 1.0 Purpose and Scope

This report evaluates the feasibility of reconstructing doses for all personnel who were internally monitored (urine or fecal), who worked at the Plutonium Finishing Plant (PFP) in the 200 Area at the Hanford Site, from January 1, 1987 through December 31, 1989. It provides information and analyses germane to considering a petition for adding a class of employees to the Congressionally-created SEC.

This report does not make any determinations concerning the feasibility of dose reconstruction that necessarily apply to any individual energy employee who might require a dose reconstruction from NIOSH. This report also does not contain the final determination as to whether the proposed class will be added to the SEC (see Section 2.0).

This evaluation was conducted in accordance with the requirements of EEOICPA, 42 C.F.R. pt. 83, and the guidance contained in the Division of Compensation Analysis and Support's (DCAS) *Internal Procedures for the Evaluation of Special Exposure Cohort Petitions*, OCAS-PR-004.<sup>1</sup>

### 2.0 Introduction

Both EEOICPA and 42 C.F.R. pt. 83 require NIOSH to evaluate qualified petitions requesting that the Department of Health and Human Services (HHS) add a class of employees to the SEC. The evaluation is intended to provide a fair, science-based determination of whether it is feasible to estimate with sufficient accuracy the radiation doses of the class of employees through NIOSH dose reconstructions.<sup>2</sup>

42 C.F.R. § 83.13(c)(1) states: *Radiation doses can be estimated with sufficient accuracy if NIOSH has established that it has access to sufficient information to estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred in plausible circumstances by any member of the class, or if NIOSH has established that it has access to sufficient information to estimate the radiation doses of members of the class more precisely than an estimate of the maximum radiation dose.*

Under 42 C.F.R. § 83.13(c)(3), if it is not feasible to estimate with sufficient accuracy radiation doses for members of the class, then NIOSH must determine that there is a reasonable likelihood that such radiation doses may have endangered the health of members of the class. The regulation requires

---

<sup>1</sup> DCAS was formerly known as the Office of Compensation Analysis and Support (OCAS).

<sup>2</sup> NIOSH dose reconstructions under EEOICPA are performed using the methods promulgated under 42 C.F.R. pt. 82 and the detailed implementation guidelines available at <http://www.cdc.gov/niosh/ocas>.

NIOSH to assume that any duration of unprotected exposure may have endangered the health of members of a class when it has been established that the class may have been exposed to radiation during a discrete incident likely to have involved levels of exposure similarly high to those occurring during nuclear criticality incidents. If the occurrence of such an exceptionally high-level exposure has not been established, then NIOSH is required to specify that health was endangered for those workers who were employed for at least 250 aggregated work days within the parameters established for the class or in combination with work days within the parameters established for one or more other SEC classes (excluding aggregate work day requirements).

NIOSH is required to document its evaluation in a report, and to do so, relies upon both its own dose reconstruction expertise as well as technical support from its contractor, Oak Ridge Associated Universities (ORAU). Once completed, NIOSH provides the report to both the petitioner(s) and to the Advisory Board on Radiation and Worker Health (Board). The Board will consider the NIOSH evaluation report, together with the petition, petitioner(s) comments, and other information the Board considers appropriate, in order to make recommendations to the Secretary of HHS on whether or not to add one or more classes of employees to the SEC. Once NIOSH has received and considered the advice of the Board, the Director of NIOSH will propose a decision on behalf of HHS. The Secretary of HHS will make the final decision, taking into account the NIOSH evaluation, the advice of the Board, and the proposed decision issued by NIOSH. As part of this decision process, petitioners may seek a review of certain types of final decisions issued by the Secretary of HHS.<sup>3</sup>

### **3.0 SEC-00155 Hanford Class Definitions**

The following subsections address the evolution of the class definition for SEC-00155, Hanford. When a petition is submitted, the requested class definition is reviewed as submitted. Based on its review of the available site information and data, NIOSH will make a determination whether to qualify for full evaluation all, some, or no part of the petitioner-requested class. If some portion of the petitioner-requested class is qualified, NIOSH will specify that class along with a justification for any modification of petitioner's class. After a full evaluation of the qualified class, NIOSH will determine whether to propose a class for addition to the SEC and will specify that proposed class definition.

#### **3.1 Petitioner-Requested Class Definition and Basis**

Petition SEC-00155 was received on November 10, 2009 (Petition, 2009), and qualified on April 29, 2010 (published in Federal Register on May 6, 2010). The petitioner requested that NIOSH consider the following class: *All personnel who were internally monitored (urine or fecal), who worked at the Plutonium Finishing Plant in the 200 Area at the Hanford Site, from January 1, 1987 through December 31, 1989.*

---

<sup>3</sup> See 42 C.F.R. pt. 83 for a full description of the procedures summarized here. Additional internal procedures are available at <http://www.cdc.gov/niosh/ocas>.



The petitioner provided information and affidavit statements in support of the petitioner's belief that accurate dose reconstruction over time is impossible for the Hanford workers in question due to radiation monitoring records being lost, falsified, or destroyed. Although NIOSH did not find support for this petition basis, NIOSH deemed the following information and affidavit statements sufficient to qualify SEC-00155 for evaluation on the basis that a report from a health physicist with expertise in radiation dose reconstruction documented limitations of existing DOE records on radiation exposures at the facility:

An audit report, *Oversight of U.S. Testing Company Implementation of Analytical Procedures and Protocol*, prepared by the U.S. Department of Energy, Richland Operations Office, June 21, 1990 (DOE/Richland Audit Report, 1990).

The above report was produced as a result of an audit conducted at the U.S. Testing Company Laboratory in Richland, Washington during the period May 1-31, 1990. This audit was precipitated by the EPA's action to suspend U.S. Testing from the U.S. EPA Contract Laboratory Program which resulted, at least in part, from accusations by the U.S. EPA of purposeful wrongdoing in the analysis of environmental (non-bioassay) samples at the company's laboratory in Hoboken, N.J. The month-long oversight activity included personnel from the Environmental Protection Agency Region 10 Laboratory, Washington Department of Ecology Quality Assurance Section, Washington Department of Health Radiation Protection Division, and the Department of Energy – Richland Operations Office Quality Assurance Division.

Several potential QA/QC questions and issues were noted in this report, including the following:

- *Inspection of UST QC data showed that low (less than 50%) and extremely low (less than 8%) recoveries were used for some analyses (e.g., total U, Pu in urine/feces, Pu-239/240 and Pu-239, U in urine).*
- *For some Pu-239/240 bioassay analyses in the 1Q90 QC data, the analytical bias range showed extreme variation.*
- *There is a requirement in the Bioassay portion of the Pacific Northwest Laboratory (PNL)-UST contract that requires that intercomparisons shall be performed with the EPA; although the Environmental Radiochemistry section of UST participates in the QA programs, the Bioassay section does not.*
- *There has been historic inconsistency with the precision of the "less sensitive" uranium analyses for bioassay.*
- *Some radiochemical analyses showed unacceptable results for concentrations near the detection limits. This may be associated with the fact that QC samples are processed with added radionuclides at or near the low-level detection limits.*

- *PNL submitted only 75 unknown samples out of 3000 radiological bioassay urine samples for QC purposes. No feces QC samples were submitted. This is an inadequate number of QC samples to judge the accuracy of the analyses.*

The concluding paragraphs of the report included the following statements:

*There were no evident items that could easily be attributed to the requirements of a Level 1 finding.*

*The type of oversight performed would not necessarily detect malicious wrongdoing. Actions of purposeful deceit can be hidden from a person performing real-time laboratory oversight. Although the oversight activities resulted in a number of items classified as 'observations' and 'findings' it was the conclusion of each oversight individual that the work that had been observed by the respective participants would result in data that was of acceptable quality.*

There is currently an SEC petition (SEC-00057) that qualified for evaluation on November 21, 2006, requesting that NIOSH consider the following class: All employees in all facilities and areas of the Hanford Reservation from January 1, 1942 through December 31, 1990. NIOSH documented two evaluations associated with SEC-00057 in NIOSH evaluation reports *SEC Petition Evaluation Report, Petition SEC-00057-1* (NIOSH, 2007), and *SEC Petition Evaluation Report, Petition SEC-00057-2* (NIOSH, 2008). The petitioner-proposed SEC class associated with SEC-00155 is enveloped by the previously-petitioned class for SEC-00057 and was, therefore, previously evaluated by NIOSH in 2007 and 2008. However, a portion of the SEC-00057 period, July 1, 1972 through December 31, 1990 (which includes the SEC-00155 petitioned class), is currently identified for continued evaluation via interactions between NIOSH and the Hanford Work Group of the Advisory Board on Radiation and Worker Health (Board).

Although the SEC-00155 class proposed by this petitioner is encompassed by an SEC evaluation scheduled for continued evaluation by NIOSH and the Board Work Group, the petitioner's specific evidence of accusations by the U.S. EPA of purposeful wrongdoing resulted in NIOSH determining that issues regarding quality of bioassay data from U.S. Testing in Richland required further investigation as a separate issue from the continuing Board evaluation of SEC-00057. The intent of NIOSH's separate evaluation of SEC-00155 is to ensure that issues identified with UST's non-bioassay analytical programs did not also adversely affect the company's bioassay analysis operations in Richland, WA.

Based on its Hanford research and data capture efforts, NIOSH determined that it has access to internal dosimetry data for Hanford personnel who worked at the Plutonium Finishing Plant in the 200 Area during the time period under evaluation. However, NIOSH also determined that the quality of those data warranted evaluation due to accusations by the U.S. EPA of deliberate falsification or manipulation of non-radiological data. NIOSH concluded that there is sufficient documentation to support, for at least part of the requested time period, the petition basis that internal radiation doses were not adequately monitored at Hanford through personal bioassay monitoring. The information and statements provided by the petitioner qualified the petition for further consideration by NIOSH, the Board, and HHS. The details of the petition basis are addressed in Section 7.4.

### **3.2 Class Evaluated by NIOSH**

Based on its preliminary research, NIOSH accepted the petitioner-requested class. Therefore, NIOSH defined the following class for further evaluation: *All personnel who were internally monitored (urine or fecal), who worked at the Plutonium Finishing Plant in the 200 Area at the Hanford Site, from January 1, 1987 through December 31, 1989.*

### **3.3 NIOSH-Proposed Class(es) to be Added to the SEC**

Based on its research, NIOSH has obtained internal bioassay audit program reports, independent bioassay program audit reports, bioassay data reliability assessment reports, and data from various other program review and personnel interviews indicating that the bioassay analysis results provided by UST-Richland are of sufficient quality to allow their use in development of sufficiently accurate bounding doses for workers in the proposed class. Based on its analysis of these available resources, NIOSH found no part of the class under evaluation for which it cannot estimate radiation doses with sufficient accuracy.

### **4.0 Data Sources Reviewed by NIOSH to Evaluate the Class**

As a standard practice, NIOSH completed an extensive database and Internet search for information regarding Hanford. The database search included the DOE Legacy Management Considered Sites database, the DOE Office of Scientific and Technical Information (OSTI) database, the Energy Citations database, the Atomic Energy Technical Report database, and the Hanford Declassified Document Retrieval System. In addition to general Internet searches, the NIOSH Internet search included OSTI OpenNet Advanced searches, OSTI Information Bridge Fielded searches, Nuclear Regulatory Commission (NRC) Agency-wide Documents Access and Management (ADAMS) web searches, the DOE Office of Human Radiation Experiments website, and the DOE-National Nuclear Security Administration-Nevada Site Office-search. Attachment One contains a summary of Hanford documents. The summary identifies data capture details and general descriptions of the documents retrieved.

In addition to the database and Internet searches listed above, NIOSH identified and reviewed numerous data sources to determine information relevant to determining the feasibility of dose reconstruction for the class of employees under evaluation. This included determining the availability of information on personal monitoring, area monitoring, industrial processes, and radiation source materials. The following subsections summarize the data sources identified and reviewed by NIOSH.

## 4.1 Site Profile Technical Basis Documents (TBDs)

A Site Profile provides specific information concerning the documentation of historical practices at the specified site. Dose reconstructors can use the Site Profile to evaluate internal and external dosimetry data for monitored and unmonitored workers, and to supplement, or substitute for, individual monitoring data. A Site Profile consists of an Introduction and five Technical Basis Documents (TBDs) that provide process history information, information on personal and area monitoring, radiation source descriptions, and references to primary documents relevant to the radiological operations at the site. The Site Profile for a small site may consist of a single document. As part of NIOSH's evaluation detailed herein, it examined the following TBDs for insights into Hanford operations or related topics/operations at other sites:

- *TBD for the Hanford Site – Introduction*, ORAUT-TKBS-0006-1; Rev. 04; March 2, 2010; SRDB Ref ID: 79568
- *TBD for the Hanford Site – Site Description*, ORAUT-TKBS-0006-2; Rev. 02; February 22, 2010; SRDB Ref ID: 79424
- *TBD for the Hanford Site – Occupational Medical Dose*, ORAUT-TKBS-0006-3; Rev. 02; January 7, 2010; SRDB Ref ID: 77579
- *TBD for the Hanford Site – Occupational Environmental Dose*, ORAUT-TKBS-0006-4; Rev. 03; January 7, 2010; SRDB Ref ID: 77582
- *TBD for the Hanford Site – Occupational Internal Dose*, ORAUT-TKBS-0006-5; Rev. 04; October 20, 2010; SRDB Ref ID: 89283
- *TBD for the Hanford Site – Occupational External Dose*, ORAUT-TKBS-0006-6; Rev. 04; January 7, 2010; SRDB Ref ID: 77581

## 4.2 ORAU Technical Information Bulletins (OTIBs) and Procedures

An ORAU Technical Information Bulletin (OTIB) is a general working document that provides guidance for preparing dose reconstructions at particular sites or categories of sites. An ORAU Procedure provides specific requirements and guidance regarding EEOICPA project-level activities, including preparation of dose reconstructions at particular sites or categories of sites. NIOSH reviewed the following OTIBs as part of its evaluation:

- *OTIB: Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures*, ORAUT-OTIB-0006, Rev. 03 PC-1; December 21, 2005; SRDB Ref ID: 20220
- *OTIB: Guidance on Assigning Occupational X-ray Dose Under EEOICPA for X-rays Administered Off Site*, ORAUT-OTIB-0079, Rev. 00; January 3, 2011; SRDB Ref ID: 29957

### 4.3 Facility Employees and Experts

To obtain additional information, NIOSH interviewed eight people concerning the data issues specific to this evaluation. The interviewees included four former Hanford employees, one current Hanford employee, two current Pacific National Laboratory employees, and one former United States Testing Company employee.

- Personal Communication, 2010a, *Personal Communication with former Hanford Health Physicist*; Telephone Interview by the ORAU Team; June 2, 2010; SRDB Ref ID: 84328
- Personal Communication, 2010b, *Personal Communication with former Hanford Dosimetry staff member*; Telephone Interview by the ORAU Team; June 3, 2010; SRDB Ref ID: 84326
- Personal Communication, 2010c, *Personal Communication with former United States Testing Company Radiochemistry staff member*; Telephone Interview by the ORAU Team; June 2, 2010; SRDB Ref ID: 84324
- Personal Communication, 2010d, *Personal Communication with a current Pacific National Laboratory staff member*; Telephone Interview by the ORAU Team; September 23, 2010; SRDB Ref ID: 93710
- Personal Communication, 2010e, *Personal Communication with a current Pacific National Laboratory staff member*; Telephone Interview by the ORAU Team; September 23, 2010; SRDB Ref ID: 93710
- Personal Communication, 2010f, *Personal Communication with current Hanford union staff member*; interview by NIOSH; July 21, 2010; SRDB Ref ID: 88216
- Personal Communication, 2010g, *Personal Communication with former Hanford Health Physicist*; interview by NIOSH; July 21, 2010; SRDB Ref ID: 88215
- Personal Communication, 2010h, *Personal Communication with former Hanford Health Physicist*; interview by NIOSH; July 21, 2010; SRDB Ref ID: 88215

#### 4.4 Previous Dose Reconstructions

NIOSH reviewed its NIOSH DCAS Claims Tracking System (referred to as NOCTS) to locate EEOICPA-related dose reconstructions that might provide information relevant to the petition evaluation. Table 4-1 summarizes the results of this review. (NOCTS data available as of April 13, 2011).

<b>Table 4-1: No. of Hanford Claims Submitted Under the Dose Reconstruction Rule</b>	
<b>Description</b>	<b>Totals</b>
Total number of claims submitted for dose reconstruction	4034
Total number of claims submitted for energy employees who worked during the period under evaluation (January 1, 1987 through December 31, 1989).	1347
Number of dose reconstructions completed for energy employees who worked during the period under evaluation (i.e., the number of such claims completed by NIOSH and submitted to the Department of Labor for final approval).	1036
Number of claims for which internal dosimetry records were obtained for the identified years in the evaluated class definition	914
Number of claims for which external dosimetry records were obtained for the identified years in the evaluated class definition	1310

NIOSH reviewed each claim to determine whether internal and/or external personal monitoring records could be obtained for the employee. The Computer Assisted Telephone Interviews (CATI) provided some information that is useful for dose reconstruction, including work locations, hours worked, incidents (e.g., fires, radioactive releases, and spills), and hazards encountered. Of the 1,347 claims submitted for the period under evaluation, 68% have internal monitoring data available and 97% have external monitoring data available. As of April 13, 2011, 20 recent claims have not yet received a response from DOE to the NIOSH request for exposure records.

#### 4.5 NIOSH Site Research Database

NIOSH also examined its Site Research Database (SRDB) to locate documents supporting the assessment of the evaluated class. There are 7784 documents in this database that have been identified as pertaining to Hanford. These documents were evaluated for their relevance to this petition. The documents include detailed information on U.S. Testing Company, such as audit reports and evaluations. The database also includes Hanford documents containing historical background on process descriptions, the radiological controls program, site history, monthly reports, incident documentation, and epidemiological studies.

## 4.6 Other Technical Sources

The following additional technical sources were used during the course of this evaluation:

- NIOSH staff travelled to Washington, D.C. in March 2011 to review restricted documentation gathered by the DOE Office of the Inspector General (OIG) during their investigation of U.S. Testing Co (OIG Responses, 2010-11). The NIOSH review included interviews, assessments, contracts, and other documents.
- *Radiation Protection Criteria and Standards: Their Basis and Use*; H. M. Parker; SRDB Ref ID: 27678
- *Hanford Declassified Document Retrieval System (DDRS)*; A DOE project that provides access to declassified information, including that declassified in response to Freedom of Information Act (FOIA) requests; Available at <http://www2.hanford.gov/declass/>
- *Comprehensive Epidemiologic Data Resource (CEDR) Database*
- *Hanford Radiological Exposure (REX) Database*

## 4.7 Documentation and/or Affidavits Provided by Petitioners

In qualifying and evaluating the petition, NIOSH reviewed the following documents submitted by the petitioners. The items are presented in sequential order as provided in the petition (Petition, 2009):

- *Action Referral Memorandum*, excerpts with commentary by petitioner, U.S. Environmental Protection Agency; April 4, 1990; SRDB Ref ID: 94145
- *Radiological Exposure System Internal Dosimetry Report*; REX database search results for petitioner; February 8, 2007; SRDB Ref ID: 94145
- *Interview of [Name redacted]*, report of formal interview with former U.S. Testing employee by agents of the Office of the Inspector General, Office of Investigations, U.S. Environmental Protection Agency; August 15, 1989; SRDB Ref ID: 94145
- *Interview of [Name redacted]*, report of formal interview with former U.S. Testing employee by agents of the Office of the Inspector General, Office of Investigations, U.S. Environmental Protection Agency; June 5, 1989; SRDB Ref ID: 94145
- *Chromatograph Printouts*, two chromatograph printouts, one dated August 7, 1988; no agency name discernable; SRDB Ref ID: 94145
- *Pesticide Evaluation Standards Summary, Evaluation of Retention Time Shift for Dibutylchloroendate*, summary of analyses (with chromatograph printout) performed by U.S. Testing for the U.S. Environmental Protection Agency on October 12-13, 1988; SRDB Ref ID: 94145

- *Action Referral Memorandum, Request for Suspension of United States Testing Co.*; U.S. Environmental Protection Agency; complete document; April 4, 1990; SRDB Ref ID: 94145

## **5.0 Radiological Operations Relevant to the Class Evaluated by NIOSH**

The following subsections summarize both radiological operations at the Plutonium Finishing Plant (PFP) in the 200 Area at the Hanford Site from January 1, 1987 to December 31, 1989 and the information available to NIOSH to characterize particular processes and radioactive source materials. From available sources, NIOSH has gathered process and source descriptions, information regarding radionuclides of concern, and information describing processes through which radiation exposures may have occurred and the physical environment in which they may have occurred.

Section 5.0 in this evaluation does not address all operations or exposure scenarios at the PFP. The petitioned SEC class associated with SEC-00155 is enveloped by the previously-petitioned class for SEC-00057; therefore, the scope of PFP radiological operations during the period 1987 through 1989 was previously evaluated by NIOSH (NIOSH, 2007; NIOSH, 2008). The SEC-00057 period from July 1, 1972 through December 31, 1990, which includes this SEC-00155 petitioned class, is currently identified for continued evaluation during Work Group interactions between NIOSH and the Advisory Board on Radiation and Worker Health. Because the feasibility of sufficiently accurate dose reconstruction for 1987-1989 is being further evaluated under SEC-00057, the scope of this SEC-00155 evaluation is limited to determining the usability of bioassay data supplied by UST-Richland during the period 1987-1989. The information included within this evaluation report is intended only to be a brief summary of the available information.

### **5.1 Hanford Plutonium Finishing Plant and Process Descriptions**

The Hanford Evaluation Reports for Petitions SEC-00057 and SEC-00152 provide detailed historical descriptions of radiological operations at the Hanford site. Additional information can also be found in the Site Description TBD of the Site Profile, ORAUT-TKBS-0006-2. The following discussion focuses on the Plutonium Finishing Plant in the 200 Area and the time period currently under evaluation (1987 through 1989).

Construction of the PFP (234-5Z) building and ancillary structures started in June 1948. The 234-5Z Building itself is 60 feet above grade. It contains three stories: a first floor, a duct level (actually the second floor), and the designated "second floor" (actually the third floor). The frame is constructed of structural steel with an outer sheathing of aluminum panels over rock wool insulation and 16-gauge sheet steel. The first floor is a concrete slab; the duct level is sheet metal roof decking, and the second floor is a concrete slab. The roof is insulated metal decking. Some interior walls are reinforced concrete (PFP History, 1999).

The 234-5Z basement consisted of pipe tunnels carrying drain piping to sumps. The first floor contained the Rubber Glove (RG) processing line, an analytical laboratory, a chemical preparation room, a calcium room, plutonium storage rooms, and many other components. Rooms 106, 166, 173, 174, 175, 190, 194, 200, 201, 225, and later 192 B and C were designated as vault rooms for



plutonium storage. The duct level contained most of the service piping, ventilation ducts, and some filter boxes. The lunchroom, conference room, materials storage room, chemical feed preparation and aqueous makeup rooms, locker rooms with change facilities and restrooms, and office spaces were on the second floor. The second floor also housed exhaust air ductwork, including filter boxes, filter rooms, and the fan room. The fan room, located on the northwestern corner of the second floor, housed the ventilation supply fans, the steam inlet and distribution system, air dryers, the distilled water still, air-chilling units, and the Vent and Balance Control Room (PFP History, 1999).

The PFP (234-5Z) began operations in 1949 and continued until 1989. The Plutonium Finishing Plant consisted of a number of buildings housing many processes, including: the Rubber Glove Line; the Remote Mechanical A (RMA) Line; the Remote Mechanical C (RMC) Line; and the Recovery of Uranium and Plutonium by Extraction (RECUPLEX). There were several other buildings within the Plutonium Finishing Plant, including: an incinerator (232-Z); the Plutonium Reclamation Facility (236-Z); and the Waste Storage Facility (242-Z). The purpose of the Plutonium Finishing Plant was to accept plutonium that had been extracted in liquid form from spent fuel assemblies and process that plutonium into a solid form. Operations involved taking plutonium nitrate solution and making solid plutonium "buttons" as well as performing casting and machining into parts that could then be shipped to weapons production facilities. After plutonium operations ceased in 1989, the Plutonium Finishing Plant was involved in plutonium stabilization efforts as part of the Hanford clean-up program. The plant is currently undergoing decontamination and decommissioning.

Several plutonium storage facilities were constructed at the PFP starting in 1949. These include 2736-Z, 2736-ZA, and 2736-ZB built in 1971, 1977, and 1982, respectively. There were 12 vault or vault-type rooms in the PFP. These vaults contained 93% of the Hanford Site's un-irradiated plutonium items and 92% of the total Hanford un-irradiated plutonium inventory in July 1994 at the time the Plutonium Vulnerability Study was performed (ORAUT-TKBS-0006-2).

The 241-Z Settling Tank, inside the fence of the PFP complex, was used from 1949 to 1973 to store large quantities of plutonium-bearing wastes. In 1974, 80,000 L of supernate were removed from the tank, leaving an estimated 94-inch-deep layer of wet sludge that contains a few tens of kilograms of plutonium. Internal and external exposures from this operation were minimal. The facility is currently awaiting D&D (ORAUT-TKBS-0006-2).

The primary focus of the PFP during the early years of operation was the production of weapons grade plutonium metal and components. In the 1960s, there was an increasing interest in peaceful uses of plutonium through potential use of commercial nuclear reactors for the generation of electricity. Consequently, throughout the 1960s, the mission of the PFP was dual purpose, providing plutonium for continued weapons grade plutonium production and providing non-defense plutonium for research and commercial reactor fuel development programs. Following 1970, the need for weapons grade plutonium diminished and the primary focus of the PFP shifted to non-weapons programs, with only limited activities directed toward support of the defense plutonium production. (PFP Overview, 2004)

During the period from 1987 through 1989, the major process operations and activities at PFP included (PFP Overview, 2004):

- Weapons Grade Metal production, RMC Line
- Plutonium Reclamation Facility
- Miscellaneous Treatment system glove box operations
- Analytical Laboratory operations
- Development Laboratory operations
- Polycube processing in Hood 4 of Room 41 (a polycube is a solid mixture of polystyrene and plutonium oxide, typically smaller than a two-inch cube [Polycube, 2000])

## **5.2 Radiological Exposure Sources from PFP Operations, Hanford 200 Area**

The Hanford Evaluation Reports for Petitions SEC-00057 and SEC-00152 provide details regarding radiological exposure sources at the Hanford site. Additional information can also be found in the Site Description TBD of the Site Profile, ORAUT-TKBS-0006-5 and ORAUT-TKBS-0006-6.

The following subsections provide an overview of the internal and external exposure sources for the Hanford Plutonium Finishing Plant class under evaluation.

### **5.2.1 Internal Radiological Exposure Sources from PFP Operations**

Internal radiological exposure sources at the Plutonium Finishing Plant included plutonium, uranium, neptunium, and americium. Plutonium radionuclides of concern included Pu-238, Pu-239, and Pu-240. Uranium radionuclides of concern included U-233, U-234, U-235, and U-238. Np-237 and Am-241 were also internal exposure sources.

Internal exposures in the operating areas related primarily to contamination incidents that involved americium and plutonium because airflow patterns were designed to control the flow from areas of lower air contamination potential to higher. Maintenance and clean-up operations were conducted in protective clothing that included respiratory protection. Exposures occurred by inhalation, absorption, and injection (i.e., wound sites). Internal exposure in the vault areas was minimal because there were no routine activities that involved opening the storage containers. Internal exposure would have been a concern in the event of an incident that breached the containment. (ORAUT-TKBS-0006-2)

### **5.2.2 External Radiological Exposure Sources from PFP Operations**

Although relatively few Hanford personnel were involved in plutonium finishing, these facilities provided the majority of personnel external exposures to neutron radiation. As production increased, 10-inch-thick water-filled walls were installed to reduce worker exposure to neutrons. Special lead-filled gloves were installed to reduce extremity exposure. Worker external exposure in the vault rooms was due to low-energy photons and neutrons that occurred during periodic inventory and inspection activities. (ORAUT-TKBS-0006-2)

### 5.2.3 Incidents

A comprehensive compilation of contamination incidents occurring in the PFP is presented in *Radiological History of the Plutonium Finishing Plant* (1954-1997), April 1999 (PFP History, 1999). During the period from 1987 through 1989, the following occurrences are noted:

- In mid-1987, polycube cans were being counted in the Nondestructive Analysis Laboratory, Room 637. The cans were in a vented configuration to prevent pressurization. Because of the age of the polycubes and an incorrect filter placed on the cans, a spread of contamination occurred throughout most of the nondestructive analysis room when the polycubes were turned on their sides. A survey revealed contamination on the floor, computer, and counting equipment (some internally) at levels to 50,000 dpm.
- The glovebox 9B instrument rack area in Room 263 south of Door 584 was contaminated at levels >40,000 dpm a number of times from 1984 through 1988 during the last RMC line operation.

## 6.0 Summary of Available Monitoring Data for the Class Evaluated by NIOSH

The following subsections provide an overview of the state of the available internal and external monitoring data for the Hanford class under evaluation.

### 6.1 Available Plutonium Finishing Plant Internal Monitoring Data

The primary sources of monitoring data for this evaluation include the NIOSH Site Research Database (SRDB), the NIOSH OCAS Claims Tracking System (NOCTS), the Comprehensive Epidemiologic Data Resource (CEDR) Database, the DOE Hanford Radiological Exposure (REX) System Database, and the DOE Hanford Declassified Document Retrieval System.

*In vitro* analyses were performed in-house at Hanford until 1965. At that time, the DOE Richland Office established a contract for *in vitro* analyses with UST, which built a commercial low-level radiochemistry laboratory in north Richland and operated it until 1990 (ORAUT-TKBS-0006-5, pdf p. 14). During the three-year period under evaluation (1987-89), UST processed several thousand bioassay samples.

Plutonium represented a primary intake source at Hanford, especially for workers in the Area 200 Plutonium Finishing Plant. Prior to 1983, reported plutonium *in vitro* bioassay results included all of the alpha emitting isotopes of plutonium, primarily Pu-238, Pu-239, and Pu-240. In October 1983, several changes were made to the plutonium *in vitro* analysis procedure. The lanthanum fluoride / thenoyl trifluoroacetone method was replaced by the use of anion exchange columns, alpha spectrometry analysis replaced autoradiography, and chemical yield was established for each sample separately by use of a Pu-242 tracer. Since these changes in 1983, Pu-238 results have been reported separately, independent of Pu-239 and Pu-240 results. Because of the inability of alpha spectroscopy systems to discriminate between the alpha particles from Pu-239 and Pu-240 (which have very similar

energies), these plutonium isotopes have continued to be reported together (ORAUT-TKBS-0006-5, pdf p. 16).

Fecal sampling was normally done in response to suspected intakes; however, routine fecal sampling was used for some high-risk plutonium workers, including operators at the Plutonium Finishing Plant from 1986 through June 1989 (ORAUT-TKBS-0006-5, pdf p. 17). Fecal samples were usually not analyzed in total (i.e., were aliquoted after muffling, dry ashing, and wet ashing); hence, more than one analysis result for a given sample was possible and will often be found in the database (ORAUT-TKBS-0006-5, pdf p. 16).

*In vivo* counting equipment and techniques were developed in the late 1950s and have been in routine use since 1960 (ORAUT-TKBS-0006-5, pdf p. 35). Intake determinations for Am-241 and for other gamma-emitting radionuclides for PFP workers often relied on *in vivo* measurements.

Additional information regarding available *in vitro* and *in vivo* bioassay data for plutonium isotopes and other radionuclide sources of internal exposure at the PFP can be found in previous Hanford SEC Evaluation Reports (NIOSH, 2007; NIOSH, 2008). Unresolved issues associated with dose reconstructions for Hanford workers from July 1, 1972 through December 31, 1990 are being addressed under SEC-00057 by the Advisory Board Work Group on Hanford. The focus of this evaluation is the usability of *in vitro* bioassay data generated by U.S. Testing Company during the years 1987 through 1989, as presented in Section 7.0 below.

Details regarding the various analyses used and the associated minimum detectable activities are presented in the Technical Basis Document for the Hanford Occupational Internal Dose (ORAUT-TKBS-0006-5).

## 6.2 Available Plutonium Finishing Plant External Monitoring Data

Records of radiation doses from personnel dosimeters worn by workers and co-workers are available for Hanford operations beginning in 1944. As is the case with Hanford's internal monitoring data, external monitoring data are available via the CEDR database and the REX database. The NIOSH *External Dosimetry Implementation Guide* (OCAS-IG-001) has identified these records as representing the highest-quality records for retrospective dose assessments.

Additional information regarding available personnel external monitoring data for work at the PFP can be found in previous Hanford SEC Evaluation Reports (NIOSH, 2007; NIOSH, 2008). Unresolved issues associated with dose reconstructions for Hanford workers from July 1, 1972 through December 31, 1990 are being addressed under SEC-00057 by the Advisory Board Work Group on Hanford. The focus of this evaluation is the usability of *in vitro* bioassay data generated by U.S. Testing Company during the years 1987 through 1989, as presented in Section 7.0 below.

Details regarding the various dosimetry systems used and the associated minimum detectable doses are presented in the Technical Basis Document for the *Hanford Site—Occupational External Dose* (ORAUT-0006-6).

## **7.0 Feasibility of Dose Reconstruction for the Class Evaluated by NIOSH**

The feasibility determination for the class of employees under evaluation in this report is governed by both EEOICPA and 42 C.F.R. § 83.13(c)(1). Under that Act and rule, NIOSH must establish whether or not it has access to sufficient information either to estimate the maximum radiation dose for every type of cancer for which radiation doses are reconstructed that could have been incurred under plausible circumstances by any member of the class, or to estimate the radiation doses to members of the class more precisely than a maximum dose estimate. If NIOSH has access to sufficient information for either case, NIOSH would then determine that it would be feasible to conduct dose reconstructions.

In determining feasibility, NIOSH begins by evaluating whether current or completed NIOSH dose reconstructions demonstrate the feasibility of estimating with sufficient accuracy the potential radiation exposures of the class. If the conclusion is one of infeasibility, NIOSH systematically evaluates the sufficiency of different types of monitoring data, process and source or source term data, which together or individually might assure that NIOSH can estimate either the maximum doses that members of the class might have incurred, or more precise quantities that reflect the variability of exposures experienced by groups or individual members of the class as summarized in Section 7.6. This approach is discussed in DCAS's SEC Petition Evaluation Internal Procedures which are available at <http://www.cdc.gov/niosh/ocas>. The next four major subsections of this Evaluation Report examine:

- The sufficiency and reliability of the available data. (Section 7.1)
- The feasibility of reconstructing internal radiation doses. (Section 7.2)
- The feasibility of reconstructing external radiation doses. (Section 7.3)
- The bases for petition SEC-00155 as submitted by the petitioner. (Section 7.4)

### **7.1 Pedigree of Hanford Data**

This subsection answers questions that need to be asked before performing a feasibility evaluation. Data Pedigree addresses the background, history, and origin of the data. It requires looking at site methodologies that may have changed over time; primary versus secondary data sources and whether they match; and whether data are internally consistent. All these issues form the bedrock of the researcher's confidence and later conclusions about the data's quality, credibility, reliability, representativeness, and sufficiency for determining the feasibility of dose reconstruction. The feasibility evaluation presupposes that data pedigree issues have been settled.

U.S. Testing Company was composed of two analytical departments: the Hazardous Substance Analysis Department and the Radiochemistry Department. The Radiochemistry Department was divided into the Bioassay (BA) and Environmental Radiochemistry Analysis (ERA) Sections. Similarly, the Hazardous Substance Analysis (HAS) Department was composed of the Organic and Inorganic Sections. PNL managed the Internal Dosimetry Program for DOE-RL for Hanford

employees, visitors, and subcontractors. As a part of this effort, UST performed bioassay analyses that were used to estimate the uptake of radioactive material by Hanford workers. The BA Section of UST-Richland was almost exclusively devoted to performing these analyses for the PNL-managed program (EPA Debarment, 1990).

A substantial portion of the following subsections describe audits, reviews, and surveillances. Commonly-used audit terms used in these descriptions are “findings,” “observations,” and “concerns.” Often, these terms will be carefully defined for a specific audit or surveillance. In general, for the purposes of reviewing the numerous audit summaries listed in these subsections, a finding should be considered to be the most serious offense. A finding is often something requiring immediate corrective action before operations may continue. An observation is less serious than a finding, but will generally require corrective action in time. A concern will often not require any action, but is sometimes included in an audit report. Concerns can lead to observations or findings if they are ignored.

### **7.1.1 Internal Monitoring Data Pedigree Review**

The Environmental Protection Agency (EPA) suspended U.S. Testing from its Contract Laboratory Program (CLP) on April 24, 1990, because of alleged fraud by the management of the company. The notice of suspension alleges that the management of U.S. Testing "conspired, directed, carried out, and otherwise condoned a scheme to defraud the United States Government" in its performance at facilities in Richland, Washington and Hoboken, New Jersey. The notice also alleges that this scheme "resulted in the submission of false, inaccurate, and unreliable test results and data." (Notice of Suspension, 1990) Furthermore, information contained in EPA Inspector General interviews released in support of the EPA's suspension action suggests that the alleged fraud might very well extend to work performed under the DOE contract with Battelle Memorial Institute's Pacific Northwest Laboratory (Letter from Congress, 1990).

In May 1990, PNL conducted two rather intensive, separate, but related activities: (1) a formal audit of past UST activities that included data traceability; and (2) a three-week on-site performance-based technical oversight of current UST practices. The formal audit revealed that UST had sent certain samples to its Hoboken facility for analysis without imposing appropriate QA per its Battelle contract. Furthermore, UST billed the government through Battelle for these analyses. The analyses in question were non-bioassay samples for dioxin and total petroleum hydrocarbons. No other analyses were involved. None of the PNL-contracted bioassay analyses or analyses for environmental radioactivity was conducted at Hoboken (Summary of Audits, 1992).

On June 1, 1990, Battelle Memorial Institute and PNL announced that, as a result of recent investigations of U.S. Testing Company, the subcontract for analytical services provided by that company was being terminated for default (Contract Default, 1990).

In light of the actions described above, the following subsections describe the reviews undertaken by NIOSH to evaluate the usability of Hanford bioassay data generated by U.S. Testing's Richland laboratory from 1987 through 1989.

### 7.1.1.1 Hanford Bioassay Audit Program

The Hanford Bioassay Audit Program was developed and implemented by PNL to verify that the UST processing laboratory was meeting the performance criteria specified in the PNL Statement of Work (SOW). The audit program involved preparing and submitting blind urine samples with known amounts (known to PNL) of various radionuclides (blanks and spikes) to UST to check for accuracy, precision, and detection limits of their analyses. The program required many of the samples to be submitted blindly (i.e., UST would not be able to distinguish the test samples from the actual worker samples). Details regarding this program can be found in the Bioassay Audit Program Manual, developed and used by the PNL Occupational and Environmental Protection Department (Bioassay Manual, 1984). Annual reports from this program are available beginning in the early 1980s. For *fiscal years* 1987 through 1989, about 250 quality control samples were submitted. Highlights from reports covering the *calendar years* 1987 through 1989 (the period under evaluation in this SEC report) are presented below.

FY1987 (October 1, 1986 through September 30, 1987): About 90 urine samples from the audit program were submitted to UST. Analyses for Sr-90, Pu-238, Pu-239, Pu-241, Am-241, and elemental uranium via two different methods were tested (Bioassay Audit FY1987, 1988). All analyses for the FY1987 audit met or exceeded specifications in the SOW except the following:

- Both the PNL audit program and the UST quality control program revealed a slightly low bias (about 20%) in the Am-241 analysis. This bias was within the guidelines recommended in the Draft ANSI standard on performance criteria for bioassay (ANSI N13.30). It was noted in the report that internal dosimetry of Am-241 was principally performed through *in vivo* measurements, so the slight bias was only of minor importance.
- Pu-241 was audit-tested for the first time in FY1987. The mean blank value was high and the precision at measuring blanks and low-level spiked samples was poor. The calculated detection level did not meet the 2 dpm/sample requirement in the SOW. Performance was acceptable for samples spiked at about 10 times the contractual detection level.

FY1988 (October 1, 1987 through September 30, 1988): About 90 urine samples from the audit program were submitted to UST. Analyses for tritium, Sr-90, Pu-238, Pu-239, Am-241, and elemental uranium via two different methods were tested (Bioassay Audit FY1988, 1989). All analyses for the FY1988 audit met or exceeded specifications in the SOW except the following:

- Both the PNL audit program and the UST quality control program indicated that the Sr-90 analysis could not meet the contractual detection level of 2.0 dpm/sample. The report noted:

*The sensitivity of the strontium-90 analysis has been slowly decreasing over the past two years despite attempts to resolve this problem. In FY88, the sensitivity finally decreased to the point of noncompliance. Trends toward high bias and poorer precision were also noted, although they were still in compliance. UST continued to investigate the problem throughout FY88 and implemented improved procedures for sample preparation and for chemical separation of strontium in January 1989.*

- The report also noted:

*Although strictly in compliance with the Statement of Work, the sensitivity and precision of the americium-241 analysis, especially for low-level samples, had been borderline for several years.*

FY1989 (October 1, 1988 through September 30, 1989): About 75 urine samples from the audit program were submitted to UST. Analyses for Sr-90, Pu-238, Pu-239, Am-241, and elemental uranium via two different methods were tested (Bioassay Audit FY1989, 1990). Funding reduction resulted in the following actions: (1) most of the audit samples were submitted openly to UST in one batch; (2) tritium was not tested; (3) there were only five spiked Pu-238 samples; and (4) fewer uranium samples were submitted. UST implemented improved procedures for sample preparation and for chemical separation of strontium in January 1989. In addition, reagent background subtraction was implemented on all samples received after October 1, 1988 (discussed below). UST quality control results through January 30, 1989 indicated that these two changes had improved the performance of the Sr-90 analysis. All analyses for the FY1989 audit met or exceeded specifications in the SOW except the following:

- At the start of FY89, UST made a universal change to the method of calculating bioassay sample analysis results; the average reagent blank value was determined for each procedure and this value was subtracted from all sample results. This made a substantial improvement on the Sr-90 procedure and the more-sensitive uranium procedures, but produced a negative bias on the less-sensitive uranium procedure. A change was made to the reagent blank value for the latter procedure which they believed would reduce or eliminate the negative bias in FY90. In addition, there was a conflicting result between the audit sample results and UST's own quality control (QC) results concerning the precision of the less-sensitive uranium procedure. The audit results showed poor precision whereas UST's QC samples indicated acceptable precision.
- There was some trouble with the Am-241 analysis in FY89, also. Performance on audit samples submitted in January indicated marginal performance. Contamination was subsequently discovered in the americium lab and processing was suspended. The lab and glassware were cleaned or discarded and processing was restarted after a series of QC samples indicated good performance. However, a small batch of audit samples processed after restart of the procedure still indicated marginal performance on blanks and unacceptable precision on spiked samples near the detection level. Precision on higher level spikes, which provided more relevant data because the analysis was used mostly for incident cases, was acceptable.

FY1990 (October 1, 1989 through September 30, 1990): About 57 urine samples from the audit program were submitted to UST. Analyses for tritium, Sr-90, Pu-238, Pu-239, Am-241, and natural uranium via two different methods were tested (MacLellan, 1991). Fewer audit samples were submitted than in previous years due to the termination of Battelle's contract with UST on June 1, 1990.



All analyses for the FY1990 audit met or exceeded specifications in the SOW except the following:

- The less-sensitive uranium procedure gave conflicting indications of the bias.
- The more-sensitive uranium procedure indicated a problem with relative precision.
- The Am-241 analytical procedure had an unacceptably high detection level. The summary report indicated that this may have been an artifact related to the small number of audit samples submitted.

It is clear from the preceding FY1987 through FY1990 audit reports that the UST-Richland laboratory and the PNL audit program itself were not perfect. The majority of the significant issues identified by this program during these years were related to Am-241 analyses, Sr-90 analyses, and uranium analyses. It was mentioned multiple times in the FY reports that the Am-241 issues were of minor importance because internal dosimetry of Am-241 was principally performed through *in vivo* measurements. Issues associated with Sr-90 and uranium analyses were related to detection sensitivity, bias, and precision. It is evident from these summary reports that many issues were identified as a result of this audit program and that attempts were made to resolve them.

NIOSH did not identify any data from the Bioassay Audit Program suggesting that the UST radiological analysis lab was engaged in any deliberate wrongdoing, actions of purposeful deceit, or other activities that would lead one to question the integrity of the bioassay data generated during this time period. It should also be pointed out that there were no major issues identified for plutonium analyses, which would have been of primary importance to workers in the Area 200, Plutonium Finishing Plant.

#### 7.1.1.2 UST-Related Audits and Surveillances Conducted by PNL

In addition to the Hanford Bioassay Audit Program, PNL had direct involvement in UST's QA Program throughout the 1980s, beginning in July 1980 (Gray, 1992). Table 7-1 provides a summary of UST-related audits and surveillances conducted by PNL.

<b>Table 7-1: Summary of UST-Related Audits and Surveillances Conducted by PNL</b> (This table spans two pages)	
<b>Date</b>	<b>Action</b>
Jul 8, 1980	There was a joint informal technical/quality audit conducted of UST. The audit was limited to reviewing the implementation of written procedures for gross alpha and beta-air filters, strontium, gamma spectroscopy, and tritium analyses. There were several observations noted concerning procedure-related inadequacies (Audits and Reviews, 1992).
Feb 4-6, 1981	A formal quality assurance program audit was performed of UST. Twenty-three requirements of UST's QA Manual were reviewed; there were nine findings and five observations noted during the audit (Audits and Reviews, 1992).
1981	Following the 1981 audit close-out, PNL QA representatives were involved in the review and update of the UST QA Manual (Audits and Reviews, 1992).

<b>Table 7-1: Summary of UST-Related Audits and Surveillances Conducted by PNL</b> (This table spans two pages)	
<b>Date</b>	<b>Action</b>
Mar 30-31, 1982	A formal quality assurance program audit was performed of UST. Twenty-two requirements of UST's QA Manual were reviewed; there were three findings and one observation noted during the audit (Audits and Reviews, 1992).
Jan 16-20, 1984	A formal quality assurance program audit was performed of UST. Fifteen requirements of UST's QA Manual were reviewed; there were three findings and three observations noted during the audit (Audits and Reviews, 1992).
Sep 30, 1986	A surveillance was conducted of Washington State University (WSU), Department of Civil and Environmental Engineering. The surveillance was performed to assess WSU readiness to perform parallel sampling and analysis of Hanford Site groundwater samples as an overcheck of UST (Audits and Reviews, 1992).
Nov 13, 1986	A formal quality assurance audit was performed of WSU. Fourteen contractual requirements were reviewed; there were four findings noted during the audit (Audits and Reviews, 1992).
Dec 15-17, 1986	A formal quality assurance program audit was performed of UST. Twenty-seven requirements of UST's QA Manual were reviewed; there were five findings and three observations noted during the audit (Audits and Reviews, 1992).
Jun 7-8, 1988	A QA pre-award survey was conducted of UST assessing their capability to meet the requirements in Request for Proposal Q5145. This was a competitive bid contract with the intent of imposing ANSI/ASME NQA-1 QA Program requirements. The scope of the pre-award survey included all fourteen RFP Q5145 QA Requirements. There were four deficiencies and two observations noted during the survey. Following this survey, PNL signed a contract with UST in September 1988 (Audits and Reviews, 1992).
Aug 16, 1988	A formal quality assurance audit was conducted of WSU. The audit was based on a contract involving Quality Assurance Review of Sampling and Analysis Tasks for the Hanford Site Ground-Water Monitoring Project. There were two findings and four observations noted during the audit (Audits and Reviews, 1992).
Mar 20, 1989	A verification audit was conducted to confirm UST's corrective action on specific commitments in response to the pre-award survey conducted on June 7-8, 1988 (Stephens, 1989).
Apr 19-21, 1989	A formal quality assurance audit was conducted of UST. In addition to PNL personnel, there were two observers from DOE-Richland Laboratory (DOE-RL) and one observer from Westinghouse Hanford Company (WHC). This audit was based on PNL concerns regarding the recent EPA suspension of future Contract Laboratory Program (CLP) work. No areas of concern were identified during this audit. (Stephens, 1989, pdf p. 32)
Apr 26, 1989 to May 2, 1989	A formal quality assurance audit was conducted of UST. There were three findings, two observations, and four concerns noted during the audit (Stephens, 1989).

In addition to the verification activities described above, PNL also used internal analytical capabilities to provide some overchecks of UST. Examples of the verification activities conducted in 1988 and 1989 include:

- QA audit performed on the Chemistry and Analysis Section (Audit A-89-15) on April 20, 1989 (Audits and Reviews, 1992).
- Surveillance of compliance with technical procedure requirements (Surveillance LJE-89-001) (Audits and Reviews, 1992).
- Surveillance of compliance to QA Program requirements for calibration of measuring and test equipment (Surveillance LJE-89-002) (Audits and Reviews, 1992).
- Surveillance to verify adequacy of corrective action to a finding from a previous audit conducted in 1988 (Surveillance LJE-89-003) (Audits and Reviews, 1992).
- Surveillance to verify that appropriate QA requirements were passed on to PNL laboratories performing duplicate analyses (Surveillance DRD-89-005) (Audits and Reviews, 1992).
- Surveillance of the preparation of QC samples being sent to UST (Surveillances DRD-88-066 and DRD-88-069) (Audits and Reviews, 1992).
- Surveillance of transferral of chain-of-custody responsibilities to UST (Surveillance DRD-89-004) (Audits and Reviews, 1992).

Although numerous findings and observations resulted from these oversight activities, which led to corrective actions, NIOSH did not identify any data from these audits and surveillances suggesting that the UST radiological analysis lab was engaged in any deliberate wrongdoing, actions of purposeful deceit, or other activities that would lead one to question the integrity of the bioassay data generated during this time period.

#### 7.1.1.3 Other Evaluations of UST-Richland and Associated Data Integrity

As a result of the EPA allegations, numerous evaluations of UST data were conducted. These efforts included observers from PNL and several other independent entities. The three most comprehensive of these evaluations are summarized below:

EVALUATION 1: Audit report, *Oversight of U.S. Testing Company Implementation of Analytical Procedures and Protocol*, prepared by the U.S. Department of Energy, Richland Operations Office, June 21, 1990 (DOE/Richland Audit Report, 1990).

The above report was produced as a result of an oversight exercise conducted at the U.S. Testing Company Laboratory in Richland, Washington during the period May 1-31, 1990. This month-long oversight activity included personnel from the Environmental Protection Agency Region 10 Laboratory, Washington Department of Ecology Quality Assurance

Section, Washington Department of Health Radiation Protection Division, and the Department of Energy – Richland Operations Office Quality Assurance Division.

Several potential QA/QC questions and issues were noted in this report, including the following:

- *Inspection of UST QC data showed that low (less than 50%) and extremely low (less than 8%) recoveries were used for some analyses (e.g., total U, Pu in urine/feces, Pu-239/240 and Pu-239, U in urine).*
- *For some Pu-239/240 bioassay analyses in the 1Q90 QC data, the analytical bias range showed extreme variation.*
- *There is a requirement in the Bioassay portion of the PNL-UST contract that requires that intercomparisons shall be performed with the EPA; although the Environmental Radiochemistry section of UST participates in the QA programs, the Bioassay section does not.*
- *There has been historic inconsistency with the precision of the “less sensitive” uranium analyses for bioassay.*
- *Some radiochemical analyses showed unacceptable results for concentrations near the detection limits. This may be associated with the fact that QC samples are processed with added radionuclides at or near the low-level detection limits.*
- *PNL submitted only 75 unknown samples out of 3000 radiological bioassay urine samples for QC purposes. No feces QC samples were submitted. This is an inadequate number of QC samples to judge the accuracy of the analyses.*

The concluding paragraphs of the report included the following statements:

*There were no evident items that could easily be attributed to the requirements of a Level 1 finding.*

*The type of oversight performed would not necessarily detect malicious wrongdoing. Actions of purposeful deceit can be hidden from a person performing real-time laboratory oversight. Although the oversight activities resulted in a number of items classified as ‘observations’ and ‘findings’ it was the conclusion of each oversight individual that the work that had been observed by the respective participants would result in data that was of acceptable quality.*

This report, which was provided by the petitioner and is discussed in Section 3.1, led to the qualification of this petition for evaluation. Although the report does not identify any evidence of wrongdoing or purposeful deceit, it concludes with the above statement indicating that such malicious activities would not necessarily have been detected by an auditor.

EVALUATION 2: October 1991 - University of Washington, *Retrospective Evaluation of Data Submitted by U.S. Testing in Support of the Internal Bioassay Program Operated by Battelle Pacific Northwest Laboratories 1983-1990* (Omenn, 1991)

Dr. Gilbert Omenn, Dean of the School of Public Health & Community Medicine at the University of Washington (UW), was asked to organize an expert committee of UW scientists to review the data generated by UST. The request was precipitated by the EPA's action to suspend work by UST due to alleged misconduct in UST's analytical practices. Dr. Omenn assembled UW committee members representing expertise in analytical chemistry, biostatistics, and health physics.

The focus of the committee was the *in vitro* radionuclide bioassay data for the PNL Internal Dosimetry Program. The committee reviewed various computerized data and hardcopy records. It also reviewed QA/QC procedures and manuals.

One aspect of the evaluation included the review of a random sample of bioassay results. A dataset was released by the Department of Energy that contained 357,400 bioassay records representing data through May 1990. From this dataset, another file was created that included only those records having sample dates in or after 1983. This file contained 51,747 records representing 5,646 workers. The file was then filtered further by eliminating Pu-238 results records and records with a "no results" code. The resulting file consisted of 30,836 records. A random sample of 300 records was selected from this file using a multiplicative congruential random number generator.

The conclusion drawn from this exercise was that "for all 300 cases, information was found indicating that the sample existed and was analyzed, although the sample card or final result was not found for a few cases."

The Committee also sought raw data for 51 bioassay cases in the UST data archive in order to test whether all the pertinent laboratory records were available, including blanks and spikes. These negative and positive control samples are critical to QA/QC and provide extensive data for quantitative assessment. The report states: "All 51 files were found; most were complete."

From the 51 bioassay cases discussed above, the Committee selected six routine urine specimens from 1989 to review for data completeness and requested that another set of six routine urine assays of the same radionuclides be identified and searched for from 1984, including raw counting records, pedigree and preparation records of spikes and tracers, laboratory sample entry records, and records of the calculations from raw data to the results reported to PNL. Records were complete in 11 of the 12 cases, for which calculations were confirmed as accurate, QC procedures were seen to have been followed, and results calculations were checked and found to be valid and scientifically supportable. The one incomplete record of these 12 appears to be a sample taken following an incident. Counting results were negative for this sample; other lab records apparently were not generated.

Results from analyses of urine and fecal specimens on workers who had repeat samples in the 1983-1990 period were compared and characterized for the extent of variability. All fecal and urine samples for Pu-238, Pu-239, Sr-90, and U were included. Pairs of samples with detection limit flags not equal were examined graphically and an explanation sought for the inequality.

For selected samples, all the worker's longitudinal samples were examined. The conclusion from this exercise was that "these data do not provide evidence of a systematic under-reporting of results, i.e., no evidence of an unusual frequency of false negatives."

Two subtests were performed:

- Using the entire specimen file, percentages among 43,000 samples analyzed for Pu-238, Pu-239, Sr-90, or U radionuclides that had positive results were calculated for each year from 1983 through 1990. Higher percentages of positive Pu-238 and Pu-239 samples in 1984-85-86 were attributed to much higher use of these isotopes during those years. Strikingly higher percentages of positive Sr-90 samples were noted for 1987-88. This was attributed to UST QC problems associated with trace contamination of reagents. (Note: A related issue involving Sr-90 was identified by the Hanford Bioassay Audit Program, discussed above in Section 7.1.1.1.)
- Another problem evaluated was the loss of samples. The rate was 0.8 to 1.9 percent in all years except 1989-90, when the rates were 2.8 and 2.6 percent, respectively. The Committee indicated that records document that this problem had been discovered by PNL and discussed with UST personnel and corrected.

Regarding the above subtests, the Committee report states: "Both of these subtests reveal that our approach was sensitive enough to uncover problems in the assays, but that PNL and UST had been aware of the problems and had instituted corrective actions."

The Committee also evaluated the feasibility of using time-series samples for individuals with many sequential samples as a check on the validity of radiobioassay results. Several confounding factors were identified with this effort, which are described in the report. However, the Committee concluded that "no inappropriately discrepant values were obtained."

EVALUATION 3: U.S. Testing (UST) Audits and Reviews, January 1992 (Audits and Reviews, 1992)

On December 20, 1991, following the release of the Omenn Committee report, a PNL committee was designated and assigned the task of listing and summarizing all oversight audits and surveys conducted on U.S. Testing by any organization (internal or external) through the past two years of their analytical work for PNL. The committee was also tasked with providing a brief executive summary of the findings of these audits as they relate to the technical quality and usability of U.S. Testing's analytical work performed for PNL (Gray, 1992).

The above-referenced report was the product of that committee's efforts. The report concluded that: "the data produced under the Battelle Contract with UST are technically supportable for the purposes for which they were collected" and that "all activities performed to date support the technical credibility of the data provided by the UST Richland Laboratory."

#### 7.1.1.4 Personnel Interviews

As a part of its own evaluation, NIOSH interviewed Hanford employees and other individuals with knowledge of the UST issues during the period under evaluation. These communications, summarized in Section 4.3 of this report, included: a former Research Scientist from the Hanford Internal Dosimetry Program, the former Director of the UST Radiochemistry Department, a former Dosimetry Manager from WHC, a retired health physicist, two current workers, and two members of the University of Washington, Omenn Committee.

These individuals were all asked specific questions regarding the allegations against UST and the usability of bioassay data from UST during the period under evaluation. Based on their interview responses, it did not appear that any of the interviewees was of the belief or opinion that bioassay data had been compromised.

#### 7.1.1.5 Review of Investigative Documents at the DOE IG's Office

NIOSH staff travelled to Washington, D.C. in March 2011 to review restricted documentation gathered by the DOE Office of the Inspector General during its investigation of U.S. Testing Co. The NIOSH review included interviews, assessments, contracts, and other documents.

When asked to describe the review by DOE's IG Office of Investigation of U.S. Testing, the OIG response was:

*In February 1989, the OIG received information that U.S. Testing Inc. had allegedly submitted laboratory analysis reports to the Environmental Protection Agency (EPA) and U.S. Department of Energy (through DOE's contractor) which were inaccurate and that the inaccurate results were due to deliberate inappropriate manipulations of the test equipment by U.S. Testing personnel. The inappropriate manipulation of the test equipment was allegedly done with the knowledge and concurrence of U.S. Testing management. The investigation was closed in April 1994.*

When NIOSH asked if the government's investigation found evidence that U.S. Testing (either as a company or through individual employees) provided fraudulent results related to Hanford bioassay samples analyzed for radioactivity, the OIG response was:

*Although U.S. Testing was contracted to analyze bioassay samples, it appears the testing in question related more to altering baselines to meet EPA guidelines on the groundwater, surface water, and soil testing.*

When asked whether the investigation found that the U.S. Testing laboratory in Richland, Washington was involved in any behavior that could be considered fraudulent, OIG had this response:

*The investigation in Richland found that U.S. Testing employees had manipulated test equipment and performed questionable testing. This information was found through witness interviews. The evidence developed by the EPA OIG at U.S. Testing, Hoboken, NJ office was more significant and supported with physical evidence. Continued investigation*

*by the EPA OIG in the District of New Jersey did result in U.S. Testing entering a guilty plea agreement on April 17, 1991.*

#### 7.1.1.6 Internal Data Pedigree Review Conclusions

The Bioassay Section of UST-Richland was almost exclusively devoted to performing bioassay analyses that were used to estimate the uptake of radioactive material by Hanford workers (EPA Debarment, 1990). In its evaluation and review of available information sources, NIOSH did not find any evidence to link the UST-Richland Radiochemistry Department, or specifically, the Bioassay Division, to any of the alleged acts of wrongdoing that led to the termination of the UST contracts with the EPA or Battelle, PNL. Furthermore, as supported by the contemporaneous audits and reviews noted earlier in this Section 7.0, NIOSH does not find the integrity of the bioassay data produced by UST during the 1987 through 1989 period to have been affected by these allegations.

#### **7.1.2 External Monitoring Data Pedigree Review**

The quality of external monitoring data for the period January 1, 1987 through December 31, 1989 was addressed in NIOSH's evaluation of SEC-00057-2 (NIOSH, 2008), which stated:

*... Hanford policies also appear to have been in place for all significant external dosimetry record collection and maintenance activities, resulting in records of sufficient pedigree for external dose reconstruction use. In addition to NIOSH's review, a 1990 evaluation of the Hanford program identified no significant administrative practice that would jeopardize the integrity of the recorded external dose (Wilson, 1990). Two additional reviews of external dose records have been conducted. A study of detailed dosimetry records for a selected group of workers included in the Hanford Mortality study (Gilbert, 1990) found very good agreement between original paper records and Hanford's REX database. A study by the University of Pittsburgh, Feasibility Study of the Correlation of Lifetime Health and Mortality Experience of AEC and AEC Contractor Employees with Occupational Radiation Exposure (AEC, 1966), concluded that good quality control was exercised over the film badge calibration and processing procedures at Hanford ...*

Further details regarding previous NIOSH evaluations of this issue can be found in Hanford SEC Evaluation Reports (NIOSH, 2007; NIOSH, 2008). Unresolved issues associated with dose reconstructions for Hanford workers from July 1, 1972 through December 31, 1990 are being addressed under SEC-00057 by the Advisory Board Work Group on Hanford. Additional information can also be found in the Hanford Site Profile. The focus of this evaluation is the usability of bioassay data generated by U.S. Testing Company in Richland, WA, from 1987 through 1989. This current evaluation into the quality of UST-Richland bioassay data has found no evidence contrary to the conclusions presented for SEC-00057.



## **7.2 Evaluation of Bounding Internal Radiation Doses at the Plutonium Finishing Plant**

The principal sources of internal radiation doses for members of the class under evaluation were plutonium, uranium, neptunium, and americium. Plutonium radionuclides of concern included Pu-238, Pu-239, and Pu-240. Uranium radionuclides of concern included U-233, U-234, U-235, and U-238. Np-237 and Am-241 were also internal exposure sources. (ORAUT-TKBS-0006-5).

In its previous evaluations of petition SEC-00057 (NIOSH, 2007; NIOSH, 2008), NIOSH concluded that for the period from January 1, 1987 through December 31, 1989, it has access to sufficient information to either: (1) estimate the maximum internal radiation dose for every type of cancer for which radiation doses are reconstructed that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the internal radiation doses to members of the class more precisely than a maximum dose estimate. These evaluations included bounding process-related internal doses and bounding ambient environmental internal doses.

This current evaluation into the quality of UST-Richland bioassay data has found no evidence contrary to the above SEC-00057 conclusions. The Bioassay Section of UST-Richland was almost exclusively devoted to performing bioassay analyses that were used to estimate the uptake of radioactive material by Hanford workers (EPA Debarment, 1990). In its evaluation and review of available information sources, NIOSH did not find any evidence to link the UST-Richland Radiochemistry Department, or specifically, the Bioassay Division, to any of the alleged acts of wrongdoing that led to the termination of the UST contracts with the EPA or Battelle, PNL. Furthermore, as supported by the contemporaneous audits and reviews noted earlier in this Section 7.0, NIOSH does not find the integrity of the bioassay data produced by UST during the 1987 through 1989 period to have been affected by these allegations.

Further details regarding previous NIOSH evaluations of dose reconstruction feasibility during the period 1987-1990 can be found in Hanford SEC Evaluation Reports (NIOSH, 2007; NIOSH, 2008). Unresolved issues associated with dose reconstructions for Hanford workers from July 1, 1972 through December 31, 1990 are being addressed under SEC-00057 by the Advisory Board Work Group on Hanford. Additional information can also be found in the Hanford Site Profile. The focus of this evaluation is the usability of bioassay data generated by U.S. Testing Company in Richland, WA, from 1987 through 1989. This current evaluation into the quality of UST-Richland bioassay data has found no evidence contrary to the conclusions presented for SEC-00057.

### **7.3 Evaluation of Bounding External Radiation Doses at the Plutonium Finishing Plant**

The principal sources of external radiation doses for members of the evaluated class were low-energy photons and neutrons (ORAU-TKBS-0006-6).

In its previous evaluations of petition SEC-00057 (NIOSH, 2007; NIOSH, 2008), NIOSH concluded that for the period from January 1, 1987 through December 31, 1989, it has access to sufficient information to either: (1) estimate the maximum external radiation dose for every type of cancer for which radiation doses are reconstructed that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the external radiation doses to members of the class more precisely than a maximum dose estimate. This current evaluation into the quality of UST-Richland bioassay data has found no evidence to the contrary. These evaluations included bounding process-related external doses, bounding ambient environmental doses, and occupational X-ray external doses.

Further details regarding previous NIOSH evaluations of external dose reconstruction methods can be found in Hanford SEC Evaluation Reports (NIOSH, 2007; NIOSH, 2008). Unresolved issues associated with dose reconstructions for Hanford workers from July 1, 1972 through December 31, 1990 are being addressed under SEC-00057 by the Advisory Board Work Group on Hanford. Additional information can also be found in the Hanford Site Profile. The focus of this evaluation is the usability of bioassay data generated by U.S. Testing Company in Richland, WA, from 1987 through 1989. This current evaluation into the quality of UST-Richland bioassay data has found no evidence contrary to the external dose reconstruction conclusions presented for SEC-00057.

## 7.4 Evaluation of Petition Basis for SEC-00155

The following subsections evaluate the assertions made on behalf of petition SEC-00155 for the Hanford site.

### 7.4.1 Fraudulent Data from UST

SEC-00155: The petitioner identified numerous allegations of fraud on behalf of UST, concluding that due to these fraudulent practices, Hanford bioassay results for the years 1987, 1988, and 1989 cannot be deemed reliable. Examples identified by the petitioner included:

- Fraud discovered in an investigation by the U.S. EPA as set forth in their Action Referral Memorandum, dated April 4, 1990, recommending that UST be suspended from further work on dosimetry testing at both their Richland, Washington, and Hoboken, New Jersey, laboratories.
- Fraudulent activity of said EPA report encompasses time periods relevant to Internal Dosimetry Report for petitioner.
- Signatures of persons qualified to do work were forged by unqualified UST personnel during time period relevant to the analysis of Petitioner's fecal samples.
- Fraudulent reports by UST during 1987 and 1988 would have impacted Petitioner's urinalysis tests.
- Backdating of sample preparation and analysis done under both Organics and Inorganics contracts would have impacted Petitioner's urinalysis tests.
- Improper calibration of analytical equipment and failure to utilize required standards would have impacted Petitioner's urinalysis tests.
- "Peak shaving" was a practice used by UST which entailed manipulating a computer program to bring peaks within the desired range would have impacted Petitioner's dosimetry results.

In its review of the issues cited above, NIOSH did not find any evidence to link any of these alleged fraudulent activities to the UST-Richland Bioassay Division, the UST division devoted to performing radiological bioassay sample analyses for Hanford employees. In fact, none of the cited issues pertain to radiological analysis operations. See Section 7.1 for NIOSH's evaluation of Hanford data pedigree relating the above-described allegations of fraud against UST.

### 7.4.2 Interviews by U.S. EPA OIG of Former UST Employees

The petitioner provided two documented interviews of former UST employees by the U.S. EPA's Office of the Inspector General Office of Investigations. Both of these interviews documented negative practices by UST, many of which were summarized by the petitioner.

See the NIOSH response to the UST fraudulent data issue in Section 7.4.1.

## 7.5 Other Potential SEC Issues Relevant to the Petition Identified During the Evaluation

During the feasibility evaluation for SEC-00155, the following issue was identified as needing further analysis and resolution:

ISSUE: The Advisory Board Work Group on Hanford has been assigned the responsibility for reviewing: (1) the Hanford site profile (as revised); (2) SEC petitions from Hanford petitioners; (3) Hanford Evaluation Reports; and (4) the SC&A Review of the Hanford Site Profile. The Hanford Work Group is also responsible for considering issues raised by the Board's contractor (SC&A) concerning the Site Profile and the petition Evaluation Report, and for assisting NIOSH and SC&A in the resolution of such issues. The Work Group may recommend to the Board changes in the site profile, as appropriate, and whether a class should be added to the SEC.

A portion of the SEC-00057 period (July 1, 1972 through December 31, 1990) is currently identified for continued evaluation by the Hanford Work Group. The petitioned SEC class for this SEC-00155 petition (January 1, 1987 through December 31, 1989) is enveloped by the SEC-00057 target period.

RESPONSE: The focus of this current SEC-00155 evaluation is the usability of bioassay data generated by U.S. Testing Company in Richland, WA, from 1987 through 1989. This current evaluation into the quality of UST-Richland bioassay data has found no evidence contrary to the existing feasibility conclusions presented for SEC-00057. However, because the petitioner-proposed SEC class associated with SEC-00155 is enveloped by the time period targeted by the Work Group for SEC-00057, the Work Group's recommendations would likely impact the SEC feasibility determination for SEC-00155.

## 7.6 Summary of Feasibility Findings for Petition SEC-00155

This report evaluates the feasibility for completing dose reconstructions for employees at the Hanford site from January 1, 1987 through December 31, 1989.

NIOSH documented two evaluations associated with SEC-00057 in NIOSH evaluation reports *SEC Petition Evaluation Report, Petition SEC-00057-1* (NIOSH, 2007), and *SEC Petition Evaluation Report, Petition SEC-00057-2* (NIOSH, 2008). These evaluations include: All employees in all facilities and areas of the Hanford Reservation from January 1, 1942 through December 31, 1990. The petitioner-proposed SEC class associated with SEC-00155 is enveloped by the previously-petitioned class for SEC-00057 and was, therefore, previously evaluated by NIOSH in 2007 and 2008.

In its previous evaluations of petition SEC-00057 (NIOSH, 2007; NIOSH, 2008), NIOSH concluded that for the period from January 1, 1987 through December 31, 1989, it has access to sufficient information to either: (1) estimate the maximum radiation dose for every type of cancer for which radiation doses are reconstructed that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the radiation doses to members of the class more precisely than a maximum dose estimate.

NOTE: A portion of the SEC-00057 period, July 1, 1972 through December 31, 1990 (which includes the SEC-00155 petitioned class), is currently identified for continued evaluation via interactions between NIOSH and the Hanford Work Group of the Advisory Board on Radiation and Worker Health. The focus of this current SEC-00155 evaluation is the usability of bioassay data generated by U.S. Testing Company in Richland, WA, from 1987 through 1989. This current evaluation into the quality of UST-Richland bioassay data has found no evidence contrary to the feasibility conclusions presented for SEC-00057.

Table 7-2 summarizes the results of the feasibility findings associated with the NIOSH evaluation of SEC-00057 at Hanford for each exposure source during the time period from January 1, 1987 through December 31, 1989.

<b>Table 7-2: Summary of Feasibility Findings for SEC-00155</b> January 1, 1987 through December 31, 1989		
<b>Source of Exposure</b>	<b>Reconstruction Feasible</b>	<b>Reconstruction Not Feasible</b>
<b>Internal</b>		
- Uranium	X	
- Plutonium	X	
- Fission Products	X	
- Thorium	X	
- Tritium	X	
- Polonium	X	
- Americium	X	
- Iodine	X	
- Ambient Environmental	X	
<b>External</b>		
- Gamma	X	
- Beta	X	
- Neutron	X	
- Occupational Medical X-ray	X	
- Ambient Environmental	X	

As of April 13, 2011, a total of 1347 claims have been submitted to NIOSH for individuals who worked at Hanford and who worked during the period under evaluation in this report. Dose reconstructions have been completed for 1036 individuals (~77%).

## **8.0 Evaluation of Health Endangerment for Petition SEC-00155**

The health endangerment determination for the class of employees covered by this evaluation report is governed by both EEOICPA and 42 C.F.R. § 83.13(c)(3). Under these requirements, if it is not feasible to estimate with sufficient accuracy radiation doses for members of the class, NIOSH must also determine that there is a reasonable likelihood that such radiation doses may have endangered the health of members of the class. Section 83.13 requires NIOSH to assume that any duration of unprotected exposure may have endangered the health of members of a class when it has been established that the class may have been exposed to radiation during a discrete incident likely to have involved levels of exposure similarly high to those occurring during nuclear criticality incidents. If the occurrence of such an exceptionally high-level exposure has not been established, then NIOSH is required to specify that health was endangered for those workers who were employed for a number of work days aggregating at least 250 work days within the parameters established for the class or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

In its review of relevant information relating to bioassay data quality from U.S. Testing Company's Richland laboratory, NIOSH found no evidence of sufficient importance to change its previous feasibility determinations documented in Evaluation Reports for SEC-00057. The class of employees evaluated for SEC-00057 included the class proposed in SEC-00155. NIOSH's evaluation determined that it is feasible to estimate radiation dose for members of the NIOSH-evaluated class with sufficient accuracy based on the sum of information available from available resources. Modification of the class definition regarding health endangerment and minimum required employment periods, therefore, is not required.

## **9.0 Class Conclusion for Petition SEC-00155**

Based on its full research associated with SEC-00155 and SEC-00057 for the class under evaluation, NIOSH found no part of said class for which it cannot estimate radiation doses with sufficient accuracy. This class includes all personnel who were internally monitored (urine or fecal), who worked at the Plutonium Finishing Plant in the 200 Area at the Hanford Site, from January 1, 1987 through December 31, 1989.

In its previous evaluations of petition SEC-00057 (NIOSH, 2007; NIOSH, 2008), NIOSH concluded that for the period from January 1, 1987 through December 31, 1989, it has access to sufficient information to estimate radiation doses with sufficient accuracy. Unresolved issues associated with dose reconstructions for Hanford workers from July 1, 1972 through December 31, 1990 are being addressed under SEC-00057 by the Advisory Board Work Group on Hanford. This current evaluation into the quality of UST-Richland bioassay data has found no evidence contrary to the NIOSH conclusions presented for SEC-00057.

NIOSH has carefully reviewed all material sent in by the petitioner, including the specific assertions stated in the petition, and has responded herein (see Section 7.4). NIOSH has also reviewed available technical resources and many other references, including the Site Research Database (SRDB), for information relevant to SEC-00155. In addition, NIOSH reviewed its NOCTS dose reconstruction database to identify EEOICPA-related dose reconstructions that might provide information relevant to the petition evaluation.

These actions are based on existing, approved NIOSH processes used in dose reconstruction for claims under EEOICPA. NIOSH's guiding principle in conducting these dose reconstructions is to ensure that the assumptions used are fair, consistent, and well-grounded in the best available science. Simultaneously, uncertainties in the science and data must be handled to the advantage, rather than to the detriment, of the petitioners. When adequate personal dose monitoring information is not available, or is very limited, NIOSH may use the highest reasonably possible radiation dose, based on reliable science, documented experience, and relevant data to determine the feasibility of reconstructing the dose of an SEC petition class. NIOSH contends that it has complied with these standards of performance in determining the feasibility or infeasibility of reconstructing dose for the class under evaluation.

This page intentionally left blank



## 10.0 References

42 C.F.R. pt. 81, *Guidelines for Determining the Probability of Causation Under the Energy Employees Occupational Illness Compensation Program Act of 2000*; Final Rule, Federal Register/Vol. 67, No. 85/Thursday, p 22,296; May 2, 2002; SRDB Ref ID: 19391

42 C.F.R. pt. 82, *Methods for Radiation Dose Reconstruction Under the Energy Employees Occupational Illness Compensation Program Act of 2000*; Final Rule; May 2, 2002; SRDB Ref ID: 19392

42 C.F.R. pt. 83, *Procedures for Designating Classes of Employees as Members of the Special Exposure Cohort Under the Energy Employees Occupational Illness Compensation Program Act of 2000*; Final Rule; May 28, 2004; SRDB Ref ID: 22001

42 U.S.C. §§ 7384-7385 [EEOICPA], *Energy Employees Occupational Illness Compensation Program Act of 2000*, as amended; OCAS website

Action Referral, 1990, *Action Referral Memorandum*, excerpts with commentary by petitioner, U.S. Environmental Protection Agency; April 4, 1990; SRDB Ref ID: 94145

AEC, 1966, *Feasibility Study of the Correlation of Lifetime Health and Mortality Experience of AEC and AEC Contractor Employees with Occupational Radiation Exposure*, Progress Report, AEC Contract No. AT(30-1)-3394; Atomic Energy Commission (AEC); University of Pittsburgh; no date; SRDB Ref ID: 25758

Audits and Reviews, 1992, U.S. Testing Audits and Reviews, R. H. Gray, et al; Battelle; January 30, 1992; SRDB Ref ID: 92851

Bioassay Audit FY1987, 1988, *Results of the PNL Bioassay Audit Program for FY 1987*, Battelle Pacific Northwest Laboratory; February 18, 1988; SRDB Ref ID: 82223

Bioassay Audit FY1988, 1989, *Results of the PNL Bioassay Audit Program for FY 1988*, Battelle Pacific Northwest Laboratory; January 30, 1989; SRDB Ref ID: 82243

Bioassay Audit FY1989, 1990, *Results of the PNL Bioassay Audit Program for FY 1989*, Battelle Pacific Northwest Laboratory; February 15, 1990; SRDB Ref ID: 82244

Bioassay Manual, 1984, *Bioassay Audit Program Manual*, Pacific Northwest Laboratory, Occupational and Environmental Protection Department, Personnel Dosimetry Section; 1984; SRDB Ref ID: 82471

Chromatograph, 1988, *Chromatograph Printouts*, two chromatograph printouts, one dated August 7, 1988; no agency name discernable; SRDB Ref ID: 94145

Contract Default, 1990, *Default of United States Testing Company Contract*, Battelle Memorial Institute and Pacific Northwest Laboratory; June 1, 1990; SRDB Ref ID: 92745

DOE/Richland Audit Report, 1990, *Oversight of U.S. Testing Company Implementation of Analytical Procedures and Protocol*, audit conducted May 1-31, 1990; U.S. Department of Energy, Richland Operations Office; report issued June 21, 1990; SRDB Ref ID: 91101 and 94144

EPA Debarment, 1990, *U.S. Testing/EPA Debarment*, appears to be a partial document with technical background on the U.S. Testing program; author likely Pacific Northwest Laboratory; 1990; SRDB Ref ID: 91100

Gilbert, 1990, *A Study of Detailed Dosimetry Records for a Selected Group of Workers Included in the Hanford Mortality Study*, E. S. Gilbert; Pacific Northwest Laboratory; September 1990; SRDB Ref ID: 285

Gray, 1992, *U.S. Testing Audits/Reviews*; R. H. Gray; Battelle; January 20, 1992; SRDB Ref ID: 92859, pdf p. 7

Letter from Congress, 1990, *Letter from U.S. House of Representatives to Secretary of Energy regarding United States Testing Co., Inc.*, letter from Rep. John D. Dingell, et al to James D. Watkins, Secretary of Energy; May 31, 1990; SRDB Ref ID: 91126

MacLellan, 1991, *Results of the Bioassay Audit Program for Fiscal Year 1990*; J. A. MacLellan; February 27, 1991; SRDB 82457, pdf p. 5

NIOSH, 2007, *SEC Petition Evaluation Report for Petition SEC-00057-1, Hanford*; National Institute for Occupational Safety and Health (NIOSH); May 15, 2007; SRDB Ref ID: 72279

NIOSH, 2008, *SEC Petition Evaluation Report for Petition SEC-00057-2, Hanford*; National Institute for Occupational Safety and Health (NIOSH); March 26, 2008; SRDB Ref ID: 72305

Notice of Suspension, 1990, *United States Testing Co., Inc.; EPA Case No. 8900021-00*, letter with accompanying Action Referral Memorandum; U.S. Environmental Protection Agency; April 24, 1990; SRDB Ref ID: 91102

OCAS-IG-001, *External Dose Reconstruction Implementation Guideline*, Rev. 2, Office of Compensation Analysis and Support (OCAS); Cincinnati, Ohio; August 25, 2006; SRDB Ref ID: 29929

OCAS-PR-004, *Internal Procedures for the Evaluation of Special Exposure Cohort Petitions*, Rev. 0, National Institute for Occupational Safety and Health (NIOSH); Cincinnati, Ohio; September 23, 2004; SRDB Ref ID: 32022

OIG Responses, 2010-11, *Interactions Related to NIOSH Staff Visit to the DOE Office of the Inspector General Regarding the UST Investigation*; October 14-27, 2010 and March 15, 2011; SRDB Ref ID: 94111

Omenn, 1991, *Retrospective Evaluation of Data Submitted by U.S. Testing in Support of the Internal Bioassay Program Operated by Battelle Pacific Northwest Laboratories 1983-1990*; G. S. Omenn; October 10, 1991; SRDB Ref ID: 82224

ORAUT-OTIB-0006, *Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures*, Rev. 03 PC-1; December 21, 2005; SRDB Ref ID: 20220

ORAUT-OTIB-0079, *Guidance on Assigning Occupational X-ray Dose Under EEOICPA for X-rays Administered Off Site*, Rev. 00; January 3, 2011; SRDB Ref ID: 29957

ORAUT-TKBS-0006-1, *Hanford Site – Introduction*, Rev. 04; March 2, 2010; SRDB Ref ID: 79568

ORAUT-TKBS-0006-2, *Hanford Site – Site Description*, Rev. 02; February 22, 2010; SRDB Ref ID: 79424

ORAUT-TKBS-0006-3, *Hanford Site – Occupational Medical Dose*, Rev. 02; January 7, 2010; SRDB Ref ID: 77579

ORAUT-TKBS-0006-4, *Hanford Site – Occupational Environmental Dose*, Rev. 03; January 7, 2010; SRDB Ref ID: 77582

ORAUT-TKBS-0006-5, *Hanford Site – Occupational Internal Dose*, Rev. 04; October 20, 2010; SRDB Ref ID: 89283

ORAUT-TKBS-0006-6, *Hanford Site – Occupational External Dose*, Rev. 04; January 7, 2010; SRDB Ref ID: 77581

Personal Communication, 2010a, *Personal Communication with former Hanford Health Physicist*; Telephone Interview by the ORAU Team; June 2, 2010; SRDB Ref ID: 84328

Personal Communication, 2010b, *Personal Communication with former Hanford Dosimetry staff member*; Telephone Interview by the ORAU Team; June 3, 2010; SRDB Ref ID: 84326

Personal Communication, 2010c, *Personal Communication with former United States Testing Company Radiochemistry staff member*; Telephone Interview by the ORAU Team; June 2, 2010; SRDB Ref ID: 84324

Personal Communication, 2010d, *Personal Communication with a current Pacific National Laboratory staff member*; Telephone Interview by the ORAU Team; September 23, 2010; SRDB Ref ID: 93710

Personal Communication, 2010e, *Personal Communication with a current Pacific National Laboratory staff member*; Telephone Interview by the ORAU Team; September 23, 2010; SRDB Ref ID: 93710

Personal Communication, 2010f, *Personal Communication with current Hanford union staff member*; interview by NIOSH; July 21, 2010; SRDB Ref ID: 88216

Personal Communication, 2010g, *Personal Communication with former Hanford Health Physicist*; interview by NIOSH; July 21, 2010; SRDB Ref ID: 88215

Personal Communication, 2010h, *Personal Communication with former Hanford Health Physicist*; interview by NIOSH; July 21, 2010; SRDB Ref ID: 88215

Pesticide, 1988, *Pesticide Evaluation Standards Summary, Evaluation of Retention Time Shift for Dibutylchlorendate*, summary of analyses (with chromatograph printout) performed by U.S. Testing for the U.S. Environmental Protection Agency on October 12-13, 1988; SRDB Ref ID: 94145

Petition, 2009, SEC Petition Proposing an SEC Class for the Hanford Site (qualified as SEC-00155), [Name redacted]; [month/day redacted], 2009; SRDB Ref ID: 94145

PFP History, 1999, *Radiological History of the Plutonium Finishing Plant (1954 – 1997)*, A. L. Ehler; B&W Hanford Company; April 1999; SRDB Ref ID: 64806

PFP Overview, 2004, *Plutonium Finishing Plant Operations Overview (1949 – 2004), Contamination Events and Plutonium Isotope Distributions of Legacy Holdup Material in Process Systems*, Fluor Hanford; 2004; SRDB Ref ID: 65485

Polycube, 2000, *Polycube Oxidation and Factors Affecting the Concentrations of Gaseous Products*, J. Abrefah, et al; Pacific Northwest National Laboratory; April 2000; SRDB Ref ID: 94154

Request for Suspension, 1990, *Action Referral Memorandum, Request for Suspension of United States Testing Co.*; U.S. Environmental Protection Agency; complete document; April 4, 1990; SRDB Ref ID: 94145

REX Report, 2007, *Radiological Exposure System Internal Dosimetry Report*; REX database search results for petitioner; February 8, 2007; SRDB Ref ID: 94145

Stephens, 1989, *Audit Report of the Audit Performed at United States Testing During April 26 to May 2, 1989*; V. L. Stephens; May 25, 1989; SRDB Ref ID: 92819

Summary of Audits, 1992, *Summary of U.S. Testing (UST) Audits and Reviews*, Battelle Pacific Northwest Laboratory; January 3, 1992; SRDB Ref ID: 92856

UST Interview, 1989a, *Interview of [Name redacted]*, report of formal interview with former U.S. Testing employee by agents of the Office of the Inspector General, Office of Investigations, U.S. Environmental Protection Agency; August 15, 1989; SRDB Ref ID: 94145

UST Interview, 1989b, *Interview of [Name redacted]*, report of formal interview with former U.S. Testing employee by agents of the Office of the Inspector General, Office of Investigations, U.S. Environmental Protection Agency; June 5, 1989; SRDB Ref ID: 94145

Wilson, 1990, *Description and Evaluation of the Hanford Personnel Dosimeter Program from 1944 through 1989*; PNNL-7447; R. H. Wilson, J. J. Fix, W. V. Baumgartner, and L. L. Nichols; Pacific Northwest Laboratory; September 1990; SRDB Ref ID: 4793

## Attachment 1: Data Capture Synopsis

<b>Table A1-1: Data Capture Synopsis for Hanford</b>			
<b>Data Capture Information</b>	<b>Data Captured Description</b>	<b>Date Completed</b>	<b>Uploaded to SRDB</b>
<p><u>Primary Site/Company Name:</u> Hanford DOE, 1942-present</p> <p><u>Other Site Names:</u> Hanford Engineer Works (HEW)</p> <p><u>Physical size of the site</u> The full Hanford site is approximately 586 square miles. SEC00155 involves all workers at the Plutonium Finishing Plant complex, which is in Area 200 (approximately 60 square miles and encompasses more than 60 buildings).</p> <p><u>Size of the workforce during the SEC related periods</u> The entire Hanford workforce in September 1990 was nearly 9,000.</p>	<p>Air sample data, ALARA program, americium and neptunium recovery processes, internal dosimetry program reports and procedures, chest X-ray requirements, concentration of NP-237 relative to PU-239, departmental reports, particle size determination, dose data from Hanford DuPont personnel applicable to the Mancuso Study, diethylenetriamine pentaacetate (DTPA) treatment data, environmental data, highly enriched fuel program, history of Hanford exposure limits, hot particle data, internal exposure sources at Hanford, neutron and gamma field surveys, neutron badge data, process descriptions, radiation incidents, radiation protection standards, radioactive shipment records, reactor power levels, retrospective evaluation of data submitted by US Testing, review of US Testing annual quality report, safety analysis reports, special work permits, stack gas particulates report, US Testing records, US Testing audits, feed stock records, N Reactor training videos, fuel processing videos, and trip reports. NOTE: Nine additional personnel interviews remain to be conducted. Additionally, two RHTG documents, that have been reviewed, have not been cleared by classification review. Also, still awaiting search results for "catalogue cards", and a listing of titles of monthly reports to AEC/ERDA/DOE Richland Operations Office from 1972 to 1985.</p>	OPEN	4,057
State Contacted:	NOTE: Contacting the state was not considered necessary since Hanford is an active DOE site and cooperates with relevant data collection.	09/03/2009	0
Amazon.com	A history of Kellex and Vitro, referencing work done at Hanford.	11/23/2010	1
Cincinnati Public Library (Interlibrary Loan)	Radiation safety in the Manhattan Project and environmental levels of radioactivity at AEC installations.	03/23/2010	8
Claimant Provided	Environmental monitoring data, study of uranium losses, in vivo cross comparison studies, how plutonium specimen disintegrates under pressure, behavior and characteristics of radioactive debris from Chinese nuclear weapons tests, and information on reducing the concentration of radioisotopes in effluent water.	06/01/2009	10

<b>Table A1-1: Data Capture Synopsis for Hanford</b>			
<b>Data Capture Information</b>	<b>Data Captured Description</b>	<b>Date Completed</b>	<b>Uploaded to SRDB</b>
Curtiss-Wright	Plutonium Fuel Development Laboratory special procedure, packaging archive waste containers for shipment, shipping records and orders, and methods of separating U-233 from thorium.	04/26/2009	11
Dade Moeller & Associates	Investigation of personal monitoring film, accidental irradiated fuel discharge from N Reactor, radiation exposures of Hanford workers dying from cancer and other causes, Hanford historical production history of all reactors, separations at the Purex Plant, and organizational charts.	08/11/2008	40
Denver Federal Records Center (FRC)	Radiation exposure reports. NOTE: 2 documents were added by site association process.	06/15/2010	5
DOE Albuquerque	Hazard level classification.	04/15/2010	1
DOE Ames National Laboratory	Industrial Medicine on the Plutonium Project 1977.	07/25/2006	1
DOE Argonne National Laboratory - East	Evaluations of intake and deposition based on bioassay data, meetings on proposed high temperature oxide pile, and plutonium scrap processing.	04/04/2008	7
DOE Brookhaven National Laboratory	Compilation of ambient air monitoring parameters at DOE facilities.	03/01/2006	1
DOE Carlsbad, NM	Threshold helium generation reaction rate measurements in FFTF and SP-100/SP-2 irradiation test. NOTE: 1 document was added by site association process.	08/12/2010	6
DOE General Atomics	Nuclear material shipping and receiving reports, health physics reports, and Medical Department reports.	01/09/2006	2
DOE General Electric Vallecitos	TLD and film badge technical information.	05/18/2007	2
DOE Germantown	Calculations and poisonous effects of various materials, communications between AEC and Westinghouse, procedures and policies, oxide fuel materials, feasibility of Hanford to provide U-233, fission distribution in uranium oxide pellets, forecast for discharge of thorium, Hanford codes, irradiation of thorium, Manhattan District history books, monthly material accountability, NYOO uranium operations flow chart, organizational charts, radiation exposures, thorium as pile flattening material, trip reports, U-233 production, waste recovery centrifuge test, and radiation surveys.	05/01/2009	65

<b>Table A1-1: Data Capture Synopsis for Hanford</b>			
<b>Data Capture Information</b>	<b>Data Captured Description</b>	<b>Date Completed</b>	<b>Uploaded to SRDB</b>
DOE Hanford (SC&A)	Monthly reports, control of ground contamination, personnel interview, KW Reactor incident report, radiation incident investigation, removal of ruptured slugs, examination of selected ruptures, divisions reports, interview with petitioners/former and current Hanford workers, reactor effluent water disposal, ruptured slugs, stack gas decontamination - separations plant and stack gas decontamination.	06/24/2010	31
DOE Idaho National Laboratory (SC&A)	Slug shipments to Idaho Chemical Processing Plant (ICPP), summary of stack gas discharge, iodine calculations for Radioactive Barium-Lanthanum (RALA) production, RALA program and problems, RALA project specification letter, shipments to the ICPP, status of project Bluenose, kilogram quantities of UO <sub>2</sub> -233 for the light water breeder reactor demonstration program, and xenon calculations.	06/24/2010	50
DOE Legacy Management - Grand Junction	Mixed waste oil by Hanford, C and D materials produced at Hanford, contract documents, plutonium in soil, production reports, elimination of feed production at Linde and Electro Metallurgical, enriched uranium account report, extrusion of uranium for Hanford, history of refinery operations and site material accountability, Manhattan District history, metal requirements for X-10, monthly progress reports, waste characterization data and management of radioactive tank waste, rolled uranium and fabrication yields, scrap material from Chapman Valve, shipment of rods, spent nuclear fuel project 324 and 327 Buildings material classifications, Tonawanda progress reports, slug production report for AEC, billet requirement schedule, plutonium concentrations in soil, and thorium shipment information.	03/04/2011	122
DOE Legacy Management - Grand Junction (SC&A)	Uranium producing process description.	01/18/2010	1
DOE Legacy Management - Morgantown	Accomplishments of the National Lead Company of Ohio in operating the AEC facilities at Fernald, bibliography of epidemiological papers, control technology for radioactive emissions, environmental survey, preliminary summary report of the defense production facilities, health and mortality study, monthly reports, plutonium content information, quality assurance report, activities of the Center for Epidemiologic Research, recycled uranium reports, Fernald shipment reports, and an update of quantity in storage for radioactive mixed wastes. NOTE: 46 documents were added by site association process.	02/03/2011	91

<b>Table A1-1: Data Capture Synopsis for Hanford</b>			
<b>Data Capture Information</b>	<b>Data Captured Description</b>	<b>Date Completed</b>	<b>Uploaded to SRDB</b>
DOE Legacy Management - MoundView (Fernald Holdings, includes Fernald Legal Database)	Personnel at risk in plutonium-238 operations, re-irradiation of radium, effluent information system/onsite discharge information system, evaluation of high assay Pu-238 oxide for use in fabrication of plasma-fired microspheres, external radiation levels, development and use of actinium, Hanford wastes, production machining of uranium, incineration of radioactive solid wastes, Battelle occupational exposure history, production reports, radiological incidents, shipping documents, standard operating procedures, thorium accountability documents, U-233 as a contaminant in thorium nitrate solution, monthly progress reports, summary of production orders, assessment of the health and mortality studies of federal nuclear workers, U-233 concentration in thorium residues at Fernald, and quality assurance activities.	01/17/2011	97
DOE Los Alamos National Laboratory (LANL)	Isotopic content and specific activity of pile-produced plutonium, radioactive waste disposal and related issues, monitoring of certain personnel for internal plutonium contamination, human studies, radiological incidents, radiological releases, and quantities and characteristics of the contact handled low-level mixed waste streams for the DOE complex.	12/13/2007	20
DOE Nevada Test Site	Photographs of workers in protective clothing.	04/26/2005	2
DOE Oak Ridge Institute for Science and Education (ORISE)	Chelation DTPA data for DOE Employees - REAC.	08/06/2009	94
DOE Oak Ridge National Laboratory	Safe handling of unprocessed metal, DuPont employee roster, and Mancuso Study data.	04/16/2007	27
DOE Oak Ridge Operations, Records Holding Task Group	Film badge and exposure correspondence and NIOSH researcher notes.	12/10/2010	3
DOE Office of Scientific and Technical Information (OSTI)	Ionium, uranium-232, and thorium-228 properties, applications, and availability, survey of irradiation facilities, meeting on collection and measurement of radioactive air contaminants, preliminary hazards report for a reactor experiment at CANEL, a proposed Purex Separations Plant study, trip report, Mallinckrodt reports on Hanford feed material and cross-checking of samples, and zirconium cladding information.	02/11/2011	11



<b>Table A1-1: Data Capture Synopsis for Hanford</b>			
<b>Data Capture Information</b>	<b>Data Captured Description</b>	<b>Date Completed</b>	<b>Uploaded to SRDB</b>
DOE Pacific Northwest National Laboratories (PNNL)	Hanford environmental surveillance, ORAU Team project spreadsheets, radiation protection procedures, whole body counter activities, measurement and evaluation of internal exposure, in vivo bioassay methods and sensitivities, preparation of project proposal for new rolling mill, and fixed time estimation of counting rates with background corrections.	09/06/2006	14
DOE Paducah Gaseous Diffusion Plant	Radioactivity analysis reports, air samples, trace element analysis, ash results, power results, and sample data unspecified.	09/18/2006	5
DOE Rocky Flats Environmental Technology Site (RFETS)	External dosimetry technology technical basis document.	10/03/2003	1
DOE Savannah River Site	Irradiation of thorium slugs, use of pocket dosimeters, progress reports, thorium irradiation program, exposure to gamma radiation, thorium slug failures, production summary 100 and 200 areas, dosimetry visitors cards, polonium production, health physics procedures, exposure data for Hanford test badges, Hanford film badges exposed in the plutonium facility at the Savannah River Site, Savannah River Site lab notebook, and a health physics methods logbook.	01/29/2009	27
DOE West Valley Demonstration Project	Shipping of Pu product to Hanford, waste processing description, and references to Hanford's internal dose assignment protocol.	01/17/2010	4
DOE Waste Isolation Pilot Plant	Battelle West Jefferson transuranic waste shipments to Hanford.	11/05/2010	5
DOL/Paragon	Vitrification of Niagara Falls Storage Site residues, progress reports, shipment of thorium oxide slugs, tabulation of Sylvania's outstanding orders, and disposition of 763 reject Hanford slugs.	12/30/2008	24
Dr. Denise DeGarmo Personal Files	Procurement history, high level waste, and a monthly operations report.	11/24/2009	4
Environmental Measurements Laboratory (EML) Library	Hanford Uranium Bioassay Program and reference to the 1962 criticality incident.	01/21/2011	2

<b>Table A1-1: Data Capture Synopsis for Hanford</b>			
<b>Data Capture Information</b>	<b>Data Captured Description</b>	<b>Date Completed</b>	<b>Uploaded to SRDB</b>
Hagley Museum and Library	Activity of DPW-100 slugs, bioassay manual, canning enriched slugs and Li-Al alloy slugs, continuous incineration of plutonium-bearing scrap, fission product activity, fuel element failures, gamma activity of tritium slugs, monthly reports, slug failures, plutonium button fabrication, plutonium coupling - neutron monitoring, plutonium waste recovery, postum production, radiation readings, reactor shielding, continuous monitor for I-131 in stack gases, thorium program, trip reports, U-237 in UNH processing, uranium isotope analyses, comparison of Chalk River and Hanford slugs, Hanford history, monthly reports, radiographic inspection, reactor operation following slug failures, report of meeting Battelle Memorial Institute, aid of new fuel elements, status of P-10 program, and waste management tank design.	10/01/2010	107
Internet - DOE Comprehensive Epidemiologic Data Resource (CEDR)	No relevant data identified.	05/12/2010	0
Internet - DOE Environmental Management	Linking Legacies, Chapter 3 - Wastes.	10/28/2007	1
Internet - DOE Hanford Declassified Document Retrieval System (DDRS)	Alpha hand monitoring, americium recovery, radiological surveys, attenuation of a neutron and gamma ray beam, calibrated neutron sources and area monitoring chambers, power levels versus Po-210 production, dosimetry and spectrometry of fast neutrons by radio-activation, dosimetry in the Hanford gamma irradiation facilities, double moderator neutron dosimeter, iodine release, sensitivities of reactor neutron flux monitors at B Reactor, measurements produced neptunium, integrated thermal neutron exposure, determination of the radon content of water, neptunium recovery, neutron dosimetry and irradiation of solids, neutron flux monitor detector, power and exposure levels of Hanford reactors, notes on dosimetry problems, production statistics of N Reactor operations, radiation exposure data, radiological incidents, safety analysis report, slow and fast neutrons, scintillation count-rate and dose-rate meter, monthly and weekly reports, thorium U-233 separation, and tritium exposures. NOTE: 1,460 documents identified by previous research and site association process, 2 by dedicated research related to US Testing material.	05/12/2010	1,462
Internet - DOE Hanford Declassified Document Retrieval System (DDRS) / (SC&A)	Monthly reports and a radiological incident investigation.	11/05/2008	6

<b>Table A1-1: Data Capture Synopsis for Hanford</b>			
<b>Data Capture Information</b>	<b>Data Captured Description</b>	<b>Date Completed</b>	<b>Uploaded to SRDB</b>
Internet - DOE Legacy Management Considered Sites	Decontamination and decommissioning of the Westinghouse Nuclear Fuel Facility at Cheswick, PA and progress reports. NOTE: 4 documents were added by site association process.	05/12/2010	4
Internet - DOE OpenNet	Absorption and translocation by plants of radioactive elements from "jangle" soil, human radiation experiments information, air pathway report, Columbia River pathway dosimetry report, fission product iodine during early Hanford operations, hematological effects on heavily irradiated Japanese fishermen, history of the Inhalation Toxicology Research Institute, Manhattan District history book, monthly activities, products, operations and progress reports, Newell Stannard interview, Bikini fall of 1978, plutonium release estimates, radiation dose estimates from Hanford radioactive material releases to the air and the Columbia River, radiological incidents, and a thyroid disease study. NOTE: 76 documents identified by previous research and site association process, 1 by dedicated research related to US Testing.	05/14/2010	77
Internet - DOE OSTI Energy Citations	Pinellas Plant feasibility study, radioactive waste shipments to Hanford, characterization of Uo-2 and Pu-O2 powders, process description for the retrieval of earth-covered transuranic waste containers, decontamination and decommissioning information, wrap module 1 sampling and analysis plan, and monthly activity reports. NOTE: 4 documents identified by previous research and 17 by site association process.	05/12/2010	21

<b>Table A1-1: Data Capture Synopsis for Hanford</b>			
<b>Data Capture Information</b>	<b>Data Captured Description</b>	<b>Date Completed</b>	<b>Uploaded to SRDB</b>
Internet - DOE OSTI Information Bridge	Risk of transporting plutonium oxide and liquid plutonium nitrate, early reactor waste, contaminated sites within the DOE complex, environmental management report, external dosimetry technical basis information, americium recovery and purification, monthly reports, hazard analyses, human radiation experiments, plutonium safety evaluation report, hazards evaluation for enriched uranium-thoria, processing E-metal in the 200 areas, production tests, protective measures for personnel manual, radiation control standards and procedures, radiation survey report, reprocessing uranium - molybdenum alloy fuels, 300 area history, low-level waste vitrification melter, iodine-131 releases, and ionium for radioisotope preparation status report, buried waste integrated demonstration program DOE complex buried waste characterization assessment, hazardous waste shipment data collection from DOE sites, incineration of DOE offsite mixed waste at the INEEL, intercalibration of counting laboratories, N-Reactor monthly reports, shipment of TRU waste from West Jefferson, Ohio, spent fuel background report, summary of the environmental dose models, surface radiological investigations, and tritiated wastewater treatment and disposal evaluation. NOTE: 211 documents identified by previous research and site association process, 2 by dedicated research related to US Testing.	05/11/2010	213
Internet - Global Security	Weapons of Mass Destruction Website: Polonium.	09/14/2009	1

<b>Table A1-1: Data Capture Synopsis for Hanford</b>			
<b>Data Capture Information</b>	<b>Data Captured Description</b>	<b>Date Completed</b>	<b>Uploaded to SRDB</b>
Internet - Google	Radiological surveys, B Reactor museum association history of 100-B/C reactor operations, separation of the uranium isotopes by gaseous diffusion, General Atomics hot cell facility decontamination, monthly reports, health-physics, instrumentation, and radiation protection, history of the department of nuclear science and engineering, nuclear weapons data-book, Project Trinity information, FUSRAP reports, site operating report, annual site environmental report, US nuclear weapons research, development, testing, and production, long-term management of nuclear materials, annual report on waste generation and minimization, environmental restoration and management, Manhattan Engineer District history, low-level radioactive wastes, practices and problems in disposal of radioactive wastes into the ground, subsurface behavior of plutonium and americium, summary of contaminated sites and initial cleanup work, mission transition reports, and a timeline of the Manhattan Project. NOTE: 40 by dedicated research related to US Testing, and 91 by previous research and site association process.	05/11/2010	131
Internet - HP Journal	No relevant data identified.	07/20/2010	0
Internet - Journal of Occupational and Environmental Health	No relevant data identified.	07/20/2010	0
Internet - National Academies Press (NAP)	Tank waste retrieval, processing, and on-site disposal at three DOE sites and complex-wide improving waste characterization and treatment.	07/11/2010	2
Internet - National Nuclear Security Administration (NNSA) - Nevada Site Office	No relevant data identified.	05/12/2010	0
Internet - NRC Agencywide Documents Access and Management System (ADAMS)	NRC's decommissioning procedures and criteria, environmental statement on the use of recycled plutonium in mixed oxide fuel in light water cooled reactors, and a survey of waste solidification process technologies, and an evaluation of potential recycling scrap metals from nuclear facilities. NOTE: 8 documents identified by site association process.	05/12/2010	8
Internet - USACE/FUSRAP	No relevant data identified.	05/12/2010	0
Internet - Washington State University (U.S. Transuranium and Uranium Registries)	No relevant data identified.	05/12/2010	0

<b>Table A1-1: Data Capture Synopsis for Hanford</b>			
<b>Data Capture Information</b>	<b>Data Captured Description</b>	<b>Date Completed</b>	<b>Uploaded to SRDB</b>
Missouri Department of Natural Resources	Individual interviews, history of the St. Louis Uranium Processing Plant, and a feasibility study for the St. Louis site.	10/03/2008	3
NARA - Atlanta	Annual reports, review of the existing reactor confinement program at Hanford, assay of uranium by-product materials, contamination of express cars (Hanford shipment), Dragon Project irradiations, human chromosome aberrations, investigative report on X-ray overexposure, list of commission and contractor personnel by professional category, Madison Square area monthly accountability reports, employee monitoring, monthly progress reports, report on health and safety aspects of recycle material, DOE indoor radon study, summary of work done at Berkeley, fission of uranium-235 or plutonium-239, and product specifications.	05/14/2010	34
NARA - Atlanta (SC&A)	Health and safety report and UO <sub>3</sub> specifications.	03/17/2004	2
NARA - College Park	Handling of radioactive waste materials, shipment of Sr-90 and Cs-137, criticality accident analysis, actions related to tank leak, US Transuranium Registry summary report, personal notes, thorium requirements, fission product distribution, test rolling, and trip reports.	08/19/2010	38
National Technical Information Service (NTIS)	Feasibility studies of the correlation of lifetime health and mortality.	08/21/2006	2
New York State Department of Environmental Conservation	Nickel plating of uranium slugs at Sylvania for Hanford.	09/25/2008	1
NIOSH	Analysis of ignition testing on K-west basin fuel, storage of highly enriched uranium, DOE Ohio sites recycled uranium project report, effects of rolling on the crystallography and metallography of uranium, excretion of Pu-239 in a patient with a plutonium contaminated injury, generation and flow of recycled uranium, highly enriched uranium working group report, list of classified documents, production and recovery of U-233 from thorium, reactor production tests, standardization of gold and indium foils and the absolute neutron flux determination, technical activities, research and development reports, testing prediction capabilities of an I-131 terrestrial transport model, worker outreach meeting documents, and USTUR active registrants living and deceased.	10/19/2010	77
NIOSH (SC&A)	DOE Ohio Field Office recycled uranium report, personnel interview, highly enriched uranium working group reports, and generation and uranium information.	02/16/2006	5

<b>Table A1-1: Data Capture Synopsis for Hanford</b>			
<b>Data Capture Information</b>	<b>Data Captured Description</b>	<b>Date Completed</b>	<b>Uploaded to SRDB</b>
Oak Ridge Associated Universities (ORAU)	Mallinckrodt badge program with description of Hanford film badge.	07/08/2003	1
Oak Ridge Public Library	Construction for Atomic Bomb production facilities.	11/18/2010	1
ORAU Team	Basis for thoron concentration and doses for thoria processing, bounding estimate of neutron dose based on measured photon dose around single pass reactors at Hanford, correspondence on the Mallinckrodt badge program, documented communication, dosimetry data, human radiation exposures related to nuclear weapons industries, annual reports, ORAU Team generated spreadsheets, radiation dose estimates and hazard evaluation for inhaled airborne radionuclides, Savannah River Site thorium processing timeline, study of atmospheric contamination in the Melt Plant, technical basis documents, workplace measurements of neutron and photon doses, and documented correspondence related to US Testing.	11/23/2010	90
Placeholder	Placeholder for upcoming personnel interviews.	03/31/2011	1
San Bruno Federal Records Center (FRC)	Hanford's request for data on the UCRL radiation exposure incident of April 1954.	01/10/2006	1
Sandy Cohen & Associates (SC&A)	Mortality study, review of low-level waste management ES&H vulnerabilities, highly enriched uranium report, recycled uranium mass balance project, bioassay at Hanford, description of Hanford personnel dosimeter program from 1944-1989, laboratory measurement error in dose estimates, progress reports, radioactive contamination environs report, combination neutron dosimeter in plutonium environments, retrospective assessment of personnel neutron dosimetry, summary of recorded external radiation doses for Hanford Workers 1944-1989, and a personnel interview.	06/24/2010	54
Santa Susana Field Laboratory	History of Nuclear Materials Development Facility.	12/18/2007	1
Science Application International Corporation (SAIC)	Radiation exposures by AEC Operating Office and summaries of whole body radiation exposures.	09/02/2004	8
Southern Illinois University, Edwardsville, IL	Mallinckrodt uranium information, disposal of radioactive wastes in the metropolitan St. Louis area, metal billets for Hanford, inspection of uranium casting facilities, shipments of uranium hexafluoride to Hanford, and remelting of Hanford uranium scrap at Mallinckrodt.	11/01/2008	12
University of Colorado Norlin Library	Background measurements of alpha particle emitters at Rocky Flats where the radiochemistry was performed by Hanford.	08/20/2003	1

<b>Table A1-1: Data Capture Synopsis for Hanford</b>			
<b>Data Capture Information</b>	<b>Data Captured Description</b>	<b>Date Completed</b>	<b>Uploaded to SRDB</b>
University of Rochester Miner Library	Quarterly review report.	10/14/2008	1
University of Tennessee Library	Inhalation program, case studies of uranium, and thorium uptakes.	03/18/2010	7
Unknown	Nuclear track emulsions and analysis of urine for very low level plutonium, bioassay procedures, calculation of neutron flux and exposure, film badge comparison, decontamination and decommissioning, detection limits, bioassay data, environmental reports, estimation of plutonium lung burden by urine analysis, external dosimetry manual, fast neutron dose, gamma dose measurement with film badges, external dosimetry program, monthly reports, site history, medical X-ray exposure study, neutron exposures, waste tank inventories, radiation protection aspects of work with promethium-147, radioactive contamination reports and investigations, radionuclide releases, nuclear track dosimeters exposed to plutonium sources, shipping documents, site maps, stack release data, Tiger Team assessment, Mancuso study progress report number 9, and whole body counter activities.	02/10/2011	560
Washington University Libraries - St. Louis	Fast neutron monitoring of personnel.	04/27/2007	1
<b>TOTAL</b>			<b>7,786</b>



<b>Table A1-2: Databases Searched for Hanford</b>			
<b>Database/Source</b>	<b>Keywords / Phrases</b>	<b>Hits</b>	<b>Uploaded to SRDB</b>
NOTE: Database search terms employed for each of the databases listed below are available in the Excel file called "Hanford Rev 04, (83.13) 04-15-11"			
DOE CEDR <a href="http://cedr.lbl.gov/">http://cedr.lbl.gov/</a> COMPLETED 05/12/2010	See Note above	0	0
DOE Hanford DDRS <a href="http://www2.hanford.gov/declass/">http://www2.hanford.gov/declass/</a> COMPLETED 05/12/2010	See Note above	168	2
DOE Legacy Management Considered Sites <a href="http://csd.lm.doe.gov/">http://csd.lm.doe.gov/</a> COMPLETED 05/12/2010	See Note above	0	0
DOE OpenNet <a href="http://www.osti.gov/opennet/advancedsearch.jsp">http://www.osti.gov/opennet/advancedsearch.jsp</a> COMPLETED 05/14/2010	See Note above	23	1
DOE OSTI Energy Citations <a href="http://www.osti.gov/energycitations/">http://www.osti.gov/energycitations/</a> COMPLETED 05/12/2010	See Note above	288	0
DOE OSTI Information Bridge <a href="http://www.osti.gov/bridge/advancedsearch.jsp">http://www.osti.gov/bridge/advancedsearch.jsp</a> COMPLETED 05/11/2010	See Note above	528	2
Google <a href="http://www.google.com">http://www.google.com</a> COMPLETED 05/11/2010	See Note above	2,261,772	40
HP Journal <a href="http://journals.lww.com/health-physics/pages/default.aspx">http://journals.lww.com/health-physics/pages/default.aspx</a> COMPLETED 07/20/2010	See Note above	0	0
Journal of Occupational and Environmental Health <a href="http://www.ijoeh.com/index.php/ijoeh">http://www.ijoeh.com/index.php/ijoeh</a> COMPLETED 07/20/2010	See Note above	1	0
National Academies Press <a href="http://www.nap.edu/">http://www.nap.edu/</a> COMPLETED 07/11/2010	See Note above	36	2

<b>Table A1-2: Databases Searched for Hanford</b>			
<b>Database/Source</b>	<b>Keywords / Phrases</b>	<b>Hits</b>	<b>Uploaded to SRDB</b>
NNSA - Nevada Site Office www.nv.doe.gov/main/search.htm COMPLETED 05/12/2010	See Note above	0	0
NRC ADAMS Reading Room http://www.nrc.gov/reading-rm/adams/web-based.html COMPLETED 05/12/2010	See Note above	15	0
USACE/FUSRAP http://www.lrb.usace.army.mil/fusrap/ COMPLETED 05/12/2010	See Note above	0	0
U.S. Transuranium & Uranium Registries http://www.ustur.wsu.edu/ COMPLETED 05/12/2010	See Note above	0	0

<b>Table A1-3: OSTI Documents Requested for Hanford</b>			
<b>Document Number</b>	<b>Document Title</b>	<b>Requested Date</b>	<b>Received Date</b>
Document Number: HW-81964 OSTI ID: 4020618 Ref ID: 59951	Beta-Gamma Dose Rates From U232 in U233 dated 1964	01/05/2009	02/24/2009