

## SEC Petition Evaluation Report Petition SEC-00115

Report Rev #: 0

Report Submittal Date: January 20, 2009

Subject Expert(s):		Alex Boerner, Joe Guido, Karin Jessen	
Site Expert(s):		NA	
<b>Petition Administrative Summary</b>			
<b>Petition Under Evaluation</b>			
Petition #	Petition Type	Petition Qualification Date	DOE/AWE Facility Name
SEC-00115	83.13	August 4, 2008	Tyson Valley Powder Farm (TVPF)

<b>Petitioner Class Definition</b>
All employees who worked in covered areas at the Tyson Valley Powder Farm in St. Louis, Missouri, during the applicable covered period from January 1, 1942 through December 31, 1949.

<b>Class Evaluated by NIOSH</b>
All employees who worked in covered areas at the Tyson Valley Powder Farm in St. Louis, Missouri, during the applicable covered period from January 1, 1942 through December 31, 1949.

<b>NIOSH-Proposed Class to be Added to the SEC</b>
All Atomic Weapons Employer (AWE) employees who worked at Tyson Valley Powder Farm near Eureka, Missouri, from February 13, 1946 through June 30, 1948, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

<b>Related Petition Summary Information</b>			
SEC Petition Tracking #(s)	Petition Type	DOE/AWE Facility Name	Petition Status
None	NA	NA	NA

<b>Related Evaluation Report Information</b>	
Report Title	DOE/AWE Facility Name
NA	NA

<b>ORAU Lead Technical Evaluator:</b> Karin Jessen	<b>ORAU Review Completed By:</b> Daniel H. Stempfley
--	--

<b>Peer Review Completed By:</b>	[Signature on file] <i>LaVon Rutherford</i>	1/20/2009 <i>Date</i>
<b>SEC Petition Evaluation Reviewed By:</b>	[Signature on file] <i>J. W. Neton</i>	1/20/2009 <i>Date</i>
<b>SEC Evaluation Approved By:</b>	[Signature on file] <i>Larry Elliott</i>	1/20/2009 <i>Date</i>

This page intentionally left blank

## Evaluation Report Summary: SEC-00115, Tyson Valley Powder Farm

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-00115, qualified on August 4, 2008, requested that NIOSH consider the following class: *All employees who worked in covered areas at the Tyson Valley Powder Farm in St. Louis, Missouri, during the applicable covered period from January 1, 1942 through December 31, 1949.*

### Class Evaluated by NIOSH

Based on its preliminary research, NIOSH accepted the petitioner-requested class. NIOSH evaluated the following class: All employees who worked in covered areas at the Tyson Valley Powder Farm in St. Louis, Missouri, during the applicable covered period from January 1, 1942 through December 31, 1949.

### NIOSH-Proposed Class to be Added to the SEC

Based on its full research of the class under evaluation, NIOSH has defined a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. The NIOSH-proposed class includes all Atomic Weapons Employer (AWE) employees who worked at Tyson Valley Powder Farm near Eureka, Missouri, from February 13, 1946 through June 30, 1948, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees in the SEC. There is no evidence of radioactive materials onsite prior to February 13, 1946, and documentation indicates that all radioactive materials were offsite by June 30, 1948 (HydroGeoLogic, 2004, pdf p. 7). Based on the review and assessment as documented in Sections 5 and 7 of this report, NIOSH has not found any reason to include the time period before February 13, 1946 or beyond June 30, 1948 in the NIOSH-proposed class recommended for SEC status.

### Feasibility of Dose Reconstruction

NIOSH was unable to locate any internal or external monitoring records for the period under evaluation. NIOSH determined that it is not feasible to estimate radiation dose for all members of the NIOSH-evaluated class with sufficient accuracy, based on the sum of information available from available resources for all workers at the site from February 13, 1946 through June 30, 1948. However, there is no evidence of radioactive materials at Tyson Valley Powder Farm from January 1, 1942 through February 12, 1946 or from July 1, 1948 through December 31, 1949; therefore, a feasibility evaluation is not required for that time period.

### Health Endangerment Determination

Per EEOICPA and 42 C.F.R. § 83.13(c)(3), a health endangerment determination is required because NIOSH has determined that it does not have sufficient information to estimate dose for the members of the proposed class from February 13, 1946 through June 30, 1948.

NIOSH did not identify any evidence supplied by the petitioner or from other resources that would establish that the proposed class was exposed to radiation during a discrete incident likely to have involved exceptionally high-level exposures. However, evidence indicates that some workers in the proposed class may have accumulated substantial chronic exposures through episodic intakes of radionuclides, combined with external exposures to gamma and beta radiation. Consequently, NIOSH has determined that health was endangered for those workers covered by this evaluation who were employed for at least 250 aggregated work days either solely under that employment or in combination with work days within the parameters established for other SEC classes (excluding aggregate work day requirements).

For the periods from January 1, 1942 through June 27, 1946 and from July 1, 1948 through December 31, 1949, NIOSH determined that there was no health endangerment because there is no evidence of radioactive material exposures at Tyson Valley Powder Farm outside of the February 13, 1946 through June 30, 1948 timeframe.

## Table of Contents

Evaluation Report Summary: SEC-00115, Tyson Valley Powder Farm .....	3
1.0 Purpose and Scope.....	7
2.0 Introduction .....	7
3.0 SEC-00115, Tyson Valley Powder Farm Class Definitions .....	8
3.1 Petitioner-Requested Class Definition and Basis .....	8
3.2 Class Evaluated by NIOSH .....	9
3.3 NIOSH-Proposed Class to be Added to the SEC .....	9
4.0 Data Sources Reviewed by NIOSH to Evaluate the Class .....	9
4.1 Site Profile Technical Basis Documents (TBDs) .....	10
4.2 Technical Information Bulletins (TIBs) .....	10
4.3 Facility Employees and Experts .....	11
4.4 Previous Dose Reconstructions .....	11
4.5 NIOSH Site Research Database .....	12
4.6 Other Technical Sources.....	12
4.7 Documentation and/or Affidavits Provided by Petitioners .....	12
5.0 Radiological Operations Relevant to the Class Evaluated by NIOSH .....	12
5.1 Tyson Valley Powder Farm Plant and Storage Descriptions .....	13
5.1.1 Types of Materials Stored at Tyson Valley Powder Farm .....	14
5.1.1.1 Uranium Scrap Materials.....	15
5.1.1.2 Byproducts of Uranium Ore Processing.....	16
5.2 Radiological Exposure Sources from Tyson Valley Powder Farm Operations .....	17
5.2.1 Internal Radiological Exposure Sources from Tyson Valley Powder Farm .....	17
5.2.1.1 Uranium Scrap.....	18
5.2.1.2 Uranium Residues .....	18
5.2.1.3 Radon.....	18
5.2.2 External Radiological Exposure Sources from Tyson Valley Powder Farm .....	18
5.2.2.1 Photon.....	19
5.2.2.2 Beta.....	19
5.2.2.3 Neutron .....	19
5.2.3 Incidents .....	19
6.0 Summary of Available Monitoring Data for the Class Evaluated by NIOSH .....	19
6.1 Available Tyson Valley Powder Farm Internal Monitoring Data .....	20
6.2 Available Tyson Valley Powder Farm External Monitoring Data.....	20
7.0 Feasibility of Dose Reconstruction for the Class Evaluated by NIOSH .....	20
7.1 Pedigree of Tyson Valley Powder Farm Data.....	21
7.1.1 Internal Monitoring Data Pedigree Review.....	21
7.1.2 External Monitoring Data Pedigree Review.....	21
7.2 Evaluation of Bounding Internal Radiation Doses at Tyson Valley Powder Farm.....	21

7.2.1	Evaluation of Bounding Storage-Related Internal Doses.....	21
7.2.1.1	Uranium Scrap.....	21
7.2.1.2	Uranium Residues and Radon .....	22
7.2.1.3	Residual Contamination .....	22
7.2.2	Internal Dose Reconstruction Feasibility Conclusion .....	22
7.3	Evaluation of Bounding External Radiation Doses at Tyson Valley Powder Farm.....	22
7.3.1	Evaluation of Bounding Storage-Related External Doses.....	22
7.3.2	Tyson Valley Powder Farm Occupational X-Ray Examinations.....	23
7.3.3	External Dose Reconstruction Feasibility Conclusion .....	23
7.4	Evaluation of Petition Basis for SEC-00115 .....	23
7.4.1	Unmonitored Workers .....	23
7.5	Summary of Feasibility Findings for Petition SEC-00115.....	24
8.0	Evaluation of Health Endangerment for Petition SEC-00115.....	24
9.0	Class Conclusion for Petition SEC-00115 .....	25
10.0	References .....	27
	Attachment 1: Data Capture Synopsis.....	30

## Tables

4-1:	No. of TVPF Claims Submitted Under the Dose Reconstruction Rule .....	11
5-1:	Materials Stored at Tyson Valley Powder Farm.....	15
7-1:	Summary of Feasibility Findings for SEC-00115.....	24

## Figures

5-1:	Historical Tyson Valley Powder Farm Layout .....	14
------	--	----

## SEC Petition Evaluation Report for SEC-00115

***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: Karin Jessen, Oak Ridge Associated Universities (ORAU). These conclusions were peer-reviewed by the individuals listed on the cover page. 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 employees who worked in covered areas at the Tyson Valley Powder Farm in St. Louis, Missouri, during the applicable covered period from January 1, 1942 through December 31, 1949. 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 Office of Compensation Analysis and Support's (OCAS) *Internal Procedures for the Evaluation of Special Exposure Cohort Petitions*, OCAS-PR-004.

### 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>1</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 NIOSH to assume that any duration of unprotected exposure may have endangered the health of

---

<sup>1</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>.

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 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>2</sup>

### **3.0 SEC-00115, Tyson Valley Powder Farm Class Definitions**

The following subsections address the evolution of the class definition for SEC-00115, Tyson Valley Powder Farm. 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 all, some portion, or no part of the petitioner proposed class for evaluation. In the case that at least some portion of the proposed class is qualified for evaluation, NIOSH will specify the class (with justification if the petitioner's class has been modified) to be fully evaluated. After a complete analysis, NIOSH will determine whether to propose a worker class for addition to the SEC and will specify that proposed worker class definition.

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

Petition SEC-00115, qualified on August 4, 2008, requested that NIOSH consider the following class for addition to the SEC: *All employees who worked in covered areas at the Tyson Valley Powder Farm in St. Louis, Missouri, during the applicable covered period from January 1, 1942 through December 31, 1949.*

The petitioner provided information and affidavit statements in support of the petitioner's belief that accurate dose reconstruction over time is impossible for the Tyson Valley Powder Farm workers in question. NIOSH deemed the following information and affidavit statements sufficient to qualify SEC-00115 for evaluation:

---

<sup>2</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>.



In support of her petition, the SEC-00115 petitioner provided two affidavits stating that to the best of her knowledge, radiation exposures and radiation doses potentially incurred by members of the proposed class that relate to this petition were not monitored, either through personal monitoring or through area monitoring.

The petitioner stated that the affidavits provided with the petition were based on the petitioner's knowledge of visiting the former Energy Employee at the site and from reviewing photographs of the employees at the facility, which, in the petitioner's opinion, confirm that Tyson Valley Powder Farm employees did not wear dosimeter badges and therefore were not monitored.

Based on the research and data capture efforts for Tyson Valley Powder Farm, NIOSH determined that data are not available for the entire NIOSH-evaluated time period or for all radionuclides. NIOSH concluded that for at least part of the proposed time period, internal and external radiation exposures and radiation doses were not adequately monitored at Tyson Valley Powder Farm, either through personal monitoring or area 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-proposed class. NIOSH defined the following class for further evaluation: All employees who worked in covered areas at the Tyson Valley Powder Farm in St. Louis, Missouri, during the applicable covered period from January 1, 1942 through December 31, 1949.

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

Based on its research of the class under evaluation, NIOSH has defined a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. The NIOSH-proposed class to be added to the SEC includes all Atomic Weapons Employer (AWE) employees who worked at Tyson Valley Powder Farm near Eureka, Missouri, from February 13, 1946 through June 30, 1948, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees in the SEC. The remaining NIOSH-evaluated timeframe is not included in the NIOSH-proposed class because there is no evidence of radioactive materials at Tyson Valley Powder Farm from January 1, 1942 through February 12, 1946 or from July 1, 1948 through December 31, 1949. The review and assessment documented in Sections 5 and 7 of this report describe the basis for this NIOSH conclusion.

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

NIOSH data capture efforts for the Tyson Valley Powder Farm site focused on all types of monitoring data, including film badge data, air monitoring data, and internal monitoring data for the operational period (1942 to 1949) of Tyson Valley Powder Farm. No monitoring data was found. Attachment 1

contains a summary of Tyson Valley Powder Farm documents and specifically identifies data capture details and general descriptions of the documents retrieved.

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. Although there are no Site Profile TBDs written specifically for Tyson Valley Powder Farm, as part of NIOSH's evaluation detailed herein, it examined the following TBDs for insights into Tyson Valley Powder Farm operations or related topics/operations at other sites:

- *Site Profiles for Atomic Weapons Employers that Worked Uranium and Thorium*, Battelle-TBD-6000: PSWS-3738 Rev. F0; December 13, 2006; SRDB Ref ID: 30671
- *Basis for Development of an Exposure Matrix for the Mallinckrodt Chemical Company St. Louis Downtown Site and the St. Louis Airport Site, St. Louis, Missouri*, ORAUT-TKBS-0005; Rev. 02; June 14, 2007; SRDB Ref ID: 32277

#### **4.2 Technical Information Bulletins (TIBs)**

A Technical Information Bulletin (TIB) is a general working document that provides guidance for preparing dose reconstructions at particular sites or categories of sites. NIOSH reviewed the following TIBs as part of its evaluation:

- *TIB: Estimating the Maximum Plausible Dose to Workers at Atomic Weapons Employer Facilities*, ORAUT-OTIB-0004, Rev. 03 PC-2; December 6, 2006; SRDB Ref ID: 36191
- *TIB: Dose Reconstruction from Occupationally Related X-Ray Procedures*, ORAUT-OTIB-0006, Rev. 03 PC-1; December 21, 2005; SRDB Ref ID: 20220
- *TIB: Estimation of Neutron Dose Rates from Alpha-Neutron Reactions in Uranium and Thorium Compounds*, ORAUT-OTIB-0024, Rev. 00; April 7, 2005; SRDB Ref ID: 19445

### 4.3 Facility Employees and Experts

Documentation in the SRDB contains eleven interview summaries and one meeting summary conducted prior to this petition being filed. The purpose of the interviews and the meeting was to gain historical information from people who may have worked at Tyson Valley Powder Farm or who may have had information about Tyson Valley Powder Farm. The meeting included 10 participants; two of the participants appear to have worked at Tyson Valley Powder Farm. None of the interviewees had any knowledge of radioactive material on the Tyson Valley Powder Farm site.

In support of the petition review, NIOSH conducted three additional interviews with individuals considered to be knowledgeable about Tyson Valley Powder Farm, as they had been involved with writing Tyson Valley Powder Farm documents. Two of the interviews were conducted by phone and one was conducted through email correspondence.

- Personal Communication, 2008a, *Personal Communication with [Name One Redacted]*; Email contact; October 27, 2008; SRDB Ref ID: 53358
- Personal Communication, 2008b, *Personal Communication with [Name Two Redacted]*; Telephone Interview by ORAU Team; October 1, 2008; SRDB Ref ID: 54623
- Personal Communication, 2008c, *Personal Communication with [Name Three Redacted]*; Telephone Interview by ORAU Team; November 5, 2008; SRDB Ref ID: 54621

### 4.4 Previous Dose Reconstructions

NIOSH reviewed its NIOSH OCAS Claims Tracking System (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 January 14, 2009)

<b>Table 4-1: No. of TVPF Claims Submitted Under the Dose Reconstruction Rule</b>	
<b>Description</b>	<b>Totals</b>
Total number of claims submitted for dose reconstruction	1
Total number of claims submitted for energy employees who meet the definition criteria for the class under evaluation (January 1, 1942 through December 31, 1949)	1
Number of dose reconstructions completed for energy employees who meet the definition criteria for the class under evaluation (i.e., the number of such claims completed by NIOSH and submitted to the Department of Labor for final approval).	1
Number of claims for which internal dosimetry records were obtained for the identified years in the evaluated class definition	0
Number of claims for which external dosimetry records were obtained for the identified years in the evaluated class definition	0

NIOSH reviewed the claim to determine whether internal and/or external personal monitoring records could be obtained for the employee. Based on the claim and information reviews performed to date, NIOSH has not located any internal or external monitoring data for this claim or for any other individuals who worked at the Tyson Valley Powder Farm site.

#### **4.5 NIOSH Site Research Database**

NIOSH also examined its Site Research Database (SRDB) to locate documents supporting the evaluation of the proposed class. One hundred and seventy documents in this database were identified as pertaining to Tyson Valley Powder Farm. These documents were evaluated for their relevance to this petition. The documents include historical background information regarding Tyson Valley Powder Farm storage areas (a munitions storage area, as well as a storage area for materials from Mallinckrodt Chemical Works and the St. Louis Ordnance Plant). While no monitoring data, program descriptions, or process descriptions were found, some information was found regarding the materials stored at Tyson Valley Powder Farm.

#### **4.6 Other Technical Sources**

NIOSH completed an exhaustive database and internet search for information regarding Tyson Valley Powder Farm. 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. Also, a noted historian for the former weapons work in the St. Louis area allowed NIOSH to conduct data capture on her research materials; however, no data was retrieved for Tyson Valley Powder Farm.

#### **4.7 Documentation and/or Affidavits Provided by Petitioners**

In qualifying and evaluating the petition, NIOSH reviewed the following affidavits and authorization form submitted by the petitioner:

- *Affidavits and Authorization Form from Survivor*; June 13, 2008; OSA Ref ID: 106263

No supporting documents, other than affidavits, were provided by the petitioner.

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

The following subsections summarize both radiological operations at the Tyson Valley Powder Farm from January 1, 1942 to December 31, 1949 and the information available to NIOSH to characterize particular processes and radioactive source materials. From available sources, NIOSH has attempted

to gather process and source descriptions, information regarding the identity and quantities of each radionuclide of concern, and information describing both processes through which radiation exposures may have occurred and the physical environment in which they may have occurred. The information included within this evaluation report is intended only to be a summary of the available information.

## 5.1 Tyson Valley Powder Farm Plant and Storage Descriptions

In 1941, the United States Army purchased 2,621 acres of undeveloped land approximately 25 miles southwest of St. Louis, Missouri, and 3 miles northeast of Eureka, Missouri, and established the Tyson Valley Army Powder Storage Farm, also known as Tyson Valley Powder Farm (TechLaw, 2002). The purpose of Tyson Valley Powder Farm was to meet the need for a large ammunition depot and testing facility during World War II. The primary function of the site was to receive, store, issue, and test explosives, small arms ammunition, 105-mm projectiles, and chemicals commonly used in tracers and incendiaries. Material storage at Tyson Valley Powder Farm was conducted primarily to support the production of small arms ammunition at the nearby St. Louis Ordnance Plant, located on Goodfellow Boulevard in St. Louis, Missouri (TechLaw, 2002).

Buildings, structures, and areas on the Tyson Valley Powder Farm included the following:

- Guard house,
- Administration building,
- Fifty-two igloos or bunkers,
- Ten pentaerythritol tetranitrate (PETN) vaults,
- Four trinitrotoluene (TNT) magazines,
- A firing and testing range,
- Three 4,800 square-foot warehouses,
- A 60,000 square-foot warehouse,
- Popping kettle area and building,
- Two burning pans, and
- Other ancillary buildings

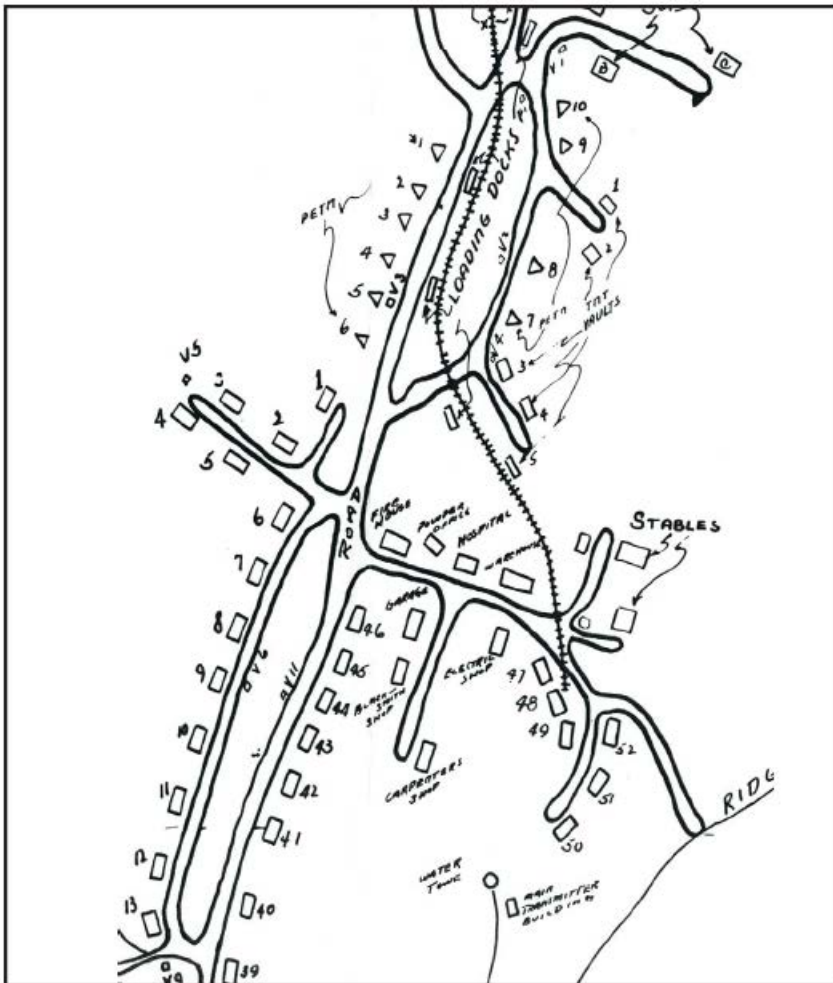
However, the only buildings of interest for this report are five igloos (Igloos 48, 49, 50, 51, 52), which likely stored radioactive material. NIOSH did not find any evidence of other areas at Tyson Valley Powder Farm being used for radioactive material storage or operations.

On May 10, 1946, the U.S. Army declared the Tyson Valley Powder Farm site surplus. Prior to this declaration, the property was placed in "closed-down condition" which was necessary for property disposal. During this time, all explosives decontamination work was conducted. The AEC first began using the building at Tyson Valley Powder Farm immediately after closure. The earliest reference to the AEC's desire to use the site to store radioactive materials is February 13, 1946, when Tyson Valley Powder Farm was being considered as a storage site (Clayton, 1946b). At some point between February 13, 1946 and June 28, 1946, AEC radioactive materials were moved onsite (Clayton, 1946a). For the purpose of this evaluation, NIOSH assumes that AEC related radioactive materials were present onsite beginning on February 13, 1946. In 1947, a contract for the sale of the property was granted to the County of St. Louis. According to all available documents, the AEC appears to have used the concrete storage igloos. Documents indicate that the AEC may have used as many as five

igloos (Igloos 48, 49, 50, 51, and 52); however, it is clear that at least two igloos (Igloos 48 and 49) were used. The maximum storage capacity for each igloo was 100,000 pounds. The approximate dimension of each igloo was 26 feet wide by 80 feet deep and 13 feet high. Therefore, each igloo had an approximate volume of 27,040 square feet. The land was relinquished to the County by 1949 (Ellis Environmental Group, 2002; HydroGeoLogic, 2004, pdf p. 275). The AEC continued to use this site until its permit was revoked on July 1, 1948 (HydroGeoLogic, 2004). NIOSH did not find any evidence of other areas at Tyson Valley Powder Farm being used for radioactive material storage or operations.

Figure 5-1 shows the historical layout of Tyson Valley Powder Farm.

Figure 5-1: Historical Tyson Valley Powder Farm Layout



Source: HydroGeoLogic, 2004, pdf p. 27

### 5.1.1 Types of Materials Stored at Tyson Valley Powder Farm

The types of materials stored at Tyson Valley Powder Farm included solid and metallic waste generated from extracting uranium from uranium-rich ore. These radioactive materials were used by the AEC during the 1940s to support United States weapons production. Mallinckrodt was the

apparent source of the radioactive materials stored at Tyson Valley Powder Farm by the Army Corps of Engineers (ACE) (Army Corps of Engineers, 2005; HydroGeoLogic, 2004, pdf p. 26).

Tyson Valley Powder Farm was a storage facility for primarily non-radioactive constituents. However, radioactive materials were temporarily stored at the site for a brief period from June 1946 until June 1948 (Missouri Department of Natural Resources, unknown date; Army Corps of Engineers, 2005; HydroGeoLogic, 2004). The radiological source term consisted of uranium metals in the form of “biscuits” or “derbies,” the “scrap” from the uranium metal conversion process, uranium-containing materials (presumably residues from production of uranium metal), and byproducts of uranium ore processing that were stored at Tyson Valley Powder Farm (Bower, 1989). These materials are described in further detail below.

Table 5-1 summarizes the materials the AEC stored at Tyson Valley Powder Farm.

Table 5-1: Materials Stored at Tyson Valley Powder Farm				
Parameters	Storage Material			
	306 Residue	C-4	C-Special	Graphite
Composition	%U3O8 -0.29 %V2O5-.50 <sup>4</sup>	Unknown	The bottom 1/3 of the slag biscuit <sup>1</sup>	Powdered Carbon
Uranium Content (%U/lb) <sup>2</sup>	Unknown	1.08%	~1.75%	Unknown
Process Source	Byproducts of pitchblende ore processing <sup>4</sup>	Unknown	Unknown	Likely used for graphite-moderated natural uranium reactors
Source Location	Unknown	Mallinckrodt Chemical Works	Mallinckrodt Chemical Works	Unknown
Storage Location at TVPF	Igloos near AOC <sup>3</sup>	Igloos near AOC <sup>3</sup>	Igloos near AOC <sup>3</sup>	Igloos near AOC <sup>3</sup>
Amount Stored at TYVP (lbs)	Unknown	53,252	68,103	Unknown
Dates Stored at TVPF	1946-Unknown	Unknown-May 11, 1948	Unknown-after May 11, 1948 and before June 1, 1948	1946-Unknown

Notes:

This table and associated notes were adapted and modified from HydroGeoLogic, 2004, pdf p. 26.

<sup>1</sup> According to the Linking Legacies Glossary, slag is defined as being “a waste product from blast furnaces that is mixed with decontaminated filtrate, cement, and fly ash to form grout, which is a stable disposal waste form.” This Glossary is available at <http://www.em.doe.gov/legacy3.1/resource/glossar.htm>.

<sup>2</sup> The uranium content was calculated from “SF Accountability Reports” which set forth the uranium content of material received by the Vitro Manufacturing Company. The reports indicate the net weight of the material received and the metal content of that material. HydroGeoLogic calculated the uranium content of the C-4 and C-Special by the following equation: (Metal Content)/ (Net Weight) X 100 = Percent of uranium per pound of material.

<sup>3</sup> Tyson Valley Powder Farm Areas of Concern (AOC); collected documentation specifically identified Igloos 48 and 49. These igloos were made available to the AEC for storage purposes.

<sup>4</sup> This information is from Miller, unknown date.

#### 5.1.1.1 Uranium Scrap Materials

This section describes uranium-bearing materials given specific designations during the Manhattan Project. These designations include C-4, Slag Biscuit, C-Special, and C-Slag. Per a Department of Energy official, C-Special and C-4 were believed to represent two different “grades” of waste material

from a uranium flex/limestone slag (HydroGeoLogic, 2004, pdf p. 15). C-slag was also a byproduct of the uranium biscuit production process. Further information on these materials is discussed below.

#### C-4

C-4 was a code designation believed to represent scrap materials contaminated with uranium. As of February 19, 1948, 53,252 pounds of C-4 were stored at Tyson Valley Powder Farm (Koenig, 1948a; Koenig, 1948c; HydroGeoLogic, 2004, pdf p. 18). Some of the C-4 material may have been stored onsite in wooden barrels without tops (Koenig, 1948b).

#### Slag Biscuit

The slag biscuit refers to the metal that forms on top of the uranium biscuit in the chemical reaction vessel. The term “biscuit” referred to the solidified uranium metal. The reaction vessel was lined with dolomite and then a charge or mixture of uranium tetrafluoride and magnesium was packed into the reaction vessel. Once heated, the chemicals would react and the uranium metal would form on the bottom of the vessel while the less dense metals would effectively float on the uranium. Upon cooling, there would be a uranium metal biscuit with “slag” (other metals) adhering to and solidified on top of the uranium metal. The slag had to be chipped from the uranium biscuit (Army Corps of Engineers, 2005).

#### C-Special

C-Special was also a code designation. NIOSH identified two definitions for C-Special in the reviewed literature. One definition included materials located in the bottom one-third of the slag biscuit, which was kept separate from the C-Slag (HydroGeoLogic, 2004, pdf p. 26). Alternatively, C-Special was defined as the slag portion of a slag metal cut—the “special” representing the 25% portion of a 25-75 cut, when “normal” consisted of a 10-90 cut.

C-Special averaged approximately 2.5% uranium by weight. As of February 19, 1948, 68,103 pounds of C-Special were stored at Tyson Valley Powder Farm (Koenig, 1948b). Per a memo issued by the AEC-New York Office on January 14, 1948, these materials were required to be removed from the site by June 1, 1948 (Koenig, 1948a).

#### C-Slag

C-Slag is comprised of the top 2/3 (two thirds) of the slag biscuit, plus the liner (dolomite). Although typically lower in uranium content, the top 2/3 of the slag biscuit also contains uranium. This material was classified as low uranium-high fluoride scrap and was also retained for extraction of uranium (Army Corps of Engineers, 2005).

#### 5.1.1.2 Byproducts of Uranium Ore Processing

This section identifies byproducts of uranium processing. Only radioactive materials specifically stored (or believed to have been stored) at Tyson Valley Powder Farm are emphasized.



Mallinckrodt Chemical Works was a source of uranium and other radioactive constituents stored at Tyson Valley Powder Farm. The uranium ores processed at Mallinckrodt Chemical Works came from both domestic and foreign mine/mill sources (e.g., the Belgian Congo) resulting in significant variations in uranium content and other radiologically significant daughter products. One of the end products of uranium processing during the war effort was high-grade pitchblende ores. The ores contained a significant level of radium as a decay product/progeny of the uranium. Because it is unclear as to whether these ores were stored or not, NIOSH assumes that they were stored at the Tyson Valley Powder Farm site. Consequently, significant external gamma radiation and airborne exposure hazards are a radiation safety concern (ORAUT-TKBS-0005).

### 306 Pitchblende Residues

306-pitchblende residues, containing 0.29%  $U_3O_8$ , were generated prior to 1948 and were carbonate precipitate byproducts of pitchblende ore processing. Two concrete igloos at Tyson Valley Powder Farm stored this residue beginning in 1946 (Clayton, 1946a; HydroGeoLogic, 2004, pdf p. 26). A 306 residue inventory of 895.49 pounds was cited in correspondence dated June 8, 1948 regarding a shipment of this material to the Vitro Manufacturing site (Belmore, 1948).

## **5.2 Radiological Exposure Sources from Tyson Valley Powder Farm Operations**

Although NIOSH has found no specific example of documentation relating specifically to container/barrel-handling practices or procedures, based on shipment documentation NIOSH has determined that radioactive materials were stored at Tyson Valley Powder Farm. To date, NIOSH has discovered no information to support a conclusion that any operational activities were performed with any of the radioactive materials stored onsite. However, based on information and documentation available to NIOSH discussing short-term weapons-related radioactive material storage between February 13, 1946 and June 30, 1948, and subsequent offsite shipments, the potential for internal and external radiation doses from uranium and uranium residues existed at the Tyson Valley Powder Farm site. For the purpose of postulating the worker class maximum exposure scenario, NIOSH must consider this information, coupled with the types and quantities of radioactive materials onsite, in determining its ability to bound the dose for the NIOSH-evaluated class in this report. The following subsections provide an overview of the internal and external exposure sources for the Tyson Valley Powder Farm class under evaluation.

### **5.2.1 Internal Radiological Exposure Sources from Tyson Valley Powder Farm**

Based on extensive data capture efforts and the review of the information available, NIOSH has concluded that the Tyson Valley Powder Farm workers had the potential for internal radiation exposures from uranium residues through inhalation and ingestion of airborne uranium dust and exposure from radon and radon progeny while working at the site.

Alpha particle emissions from the residues stored at Tyson Valley Powder Farm present the greatest potential for exposure through internal deposition via inhalation and ingestion pathways (alpha particles do not present an external exposure hazard). The principle alpha-emitting radioactive material associated with Tyson Valley Powder Farm was natural uranium, which contained 40 to 60% uranium oxide ( $U_3O_8$ ). Natural uranium refers to uranium consisting of approximately 0.7% uranium-235, 99.3% uranium-238, and a very small residual amount of uranium-234 by weight. In terms of

radioactivity, natural uranium contains approximately equal percentages of uranium-238 (48.6%) and uranium-234 (49.2%). These radionuclides emit alpha particles with primary emission energies of 4.20 MeV and 4.15 MeV (uranium-238), and 4.77 MeV and 4.72 MeV (uranium-234), respectively (Environmental Control, 1970). The activity contribution from uranium-235 is much smaller relative to uranium-238 or uranium-234 (approximately 2.2%) with alpha particle emissions of 4.40 MeV and 4.37 MeV. Alpha particles are also emitted from the decay of radium and thorium radionuclides, including radium-226 and progeny (originating in uranium residues) and thorium-230.

#### 5.2.1.1 Uranium Scrap

From 1944 until 1952, all uranium used by the DOE and predecessor agencies was derived from natural sources because processes that recover uranium from spent fuel were not yet available (Battelle-TBD-6000). Based on the information available to NIOSH at the time of this evaluation, 206,110 pounds of uranium metal was stored at the Tyson Valley Powder Farm at the end of 1946 (Clayton, 1946a). Additional documentation describes the storage of 68,103 pounds of C-Special and 53,252 pounds of C-4 in both metal drums and wood barrels (HydroGeoLogic, 2004, p. 26; Army Corps of Engineers, 2005). Based on its review of the available information, NIOSH concludes that this uranium scrap was not a significant personnel internal exposure source at the site.

#### 5.2.1.2 Uranium Residues

An inventory review of the documentation showed that 30,927 pounds of 306-residue was shipped from Tyson Valley Powder Farm to the Vitro Manufacturing Company as of December 31, 1946 (HydroGeoLogic, 2004). It is likely that uranium residues were stored at Tyson Valley Powder Farm, and Tyson Valley Powder Farm workers had the potential for internal radiation exposure through inhalation and ingestion of these residues. However, to date NIOSH has found no other documentation to support the evaluation of other materials that were potentially stored at the site.

#### 5.2.1.3 Radon

Radon levels could exist where residues containing uranium daughter products were stored. It is likely that workers may have been exposed to short, high-level exposures when opening the drums of stored uranium residues or opening enclosed storage rooms containing residues (especially in the case where the drums/containers were open). Drum storage was most likely during the February 13, 1946 through June 30, 1948 timeframe, and radon levels were likely to have varied based on different processes at Mallinckrodt Chemical Works.

### **5.2.2 External Radiological Exposure Sources from Tyson Valley Powder Farm**

Based on the information presented in this report, NIOSH has concluded that a potential for external radiological exposure could have resulted from drums and barrels containing uranium scrap and uranium residues that were stored at the Tyson Valley Powder Farm site. The exposure rates would have varied depending on the source term.

### 5.2.2.1 Photon

Photon external exposures may have resulted from radionuclides in the uranium decay chain. The uranium progeny that result in the most significant photon exposures include thorium-234 and protactinium-234m (Environmental Control, 1970).

According to ORAUT-OTIB-0004, the majority of photons from natural uranium are in the 30-250 keV energy range. Calculations using the program MicroShield indicate that about 56% of the photon energy released from natural uranium is above 250 keV. Uranium provides considerable shielding of the lower-energy photons and will tend to harden the spectrum, causing the majority of photons emitted from uranium to have energies greater than 250 keV. While it is recognized that uranium sources will have a somewhat hardened photon spectrum, exposure to a thin layer of uranium on a surface will result in a larger fraction of exposure to lower-energy photons (ORAUT-OTIB-0004).

### 5.2.2.2 Beta

As with alpha-emitters, beta exposures at Tyson Valley Powder Farm could have resulted from exposure to uranium and its decay products. In the uranium-series decay scheme, beginning with uranium-238, the short-lived isotope protactinium-234 emits the most energetic beta particle (2.28 MeV). It is this beta particle that accounts for the shallow-dose hazard associated with handling uranium scrap and uranium residues.

### 5.2.2.3 Neutron

Based on the information available to NIOSH regarding the forms of uranium stored at Tyson Valley Powder Farm, neutrons were an insignificant source of external exposure to personnel at the site.

## **5.2.3 Incidents**

No documented discrete radiological incidents or accidents that resulted in exceptionally high personnel exposure levels or overexposures (such as a criticality event) at Tyson Valley Powder Farm were identified or discovered by NIOSH during the data research and investigations performed in support of this SEC evaluation. NIOSH is not aware of any recorded histories of fires, spills, or other releases at the former Tyson Valley Powder Farm.

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

The documentation available to NIOSH does not describe the work processes or exposure conditions associated with the Tyson Valley Powder Farm handling of the AEC shipments involving uranium and uranium residues. NIOSH has located limited documentation regarding the Tyson Valley Powder Farm shipments to Vitro Manufacturing.

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

## **6.1 Available Tyson Valley Powder Farm Internal Monitoring Data**

As of the date of this evaluation, NIOSH has been unable to find any records of internal monitoring data for Tyson Valley Powder Farm employees; this includes its search for bioassay data and air monitoring data. NIOSH does not believe that uranium scrap presents an internal hazard at Tyson Valley. However, although uranium residues do present a potential internal hazard, NIOSH has insufficient information to support evaluating the dose from those residues. Further information is discussed in Section 7.2.

## **6.2 Available Tyson Valley Powder Farm External Monitoring Data**

As of the date of this evaluation, NIOSH has been unable to find any records of external monitoring data for Tyson Valley Powder Farm employees; this includes its search for personnel or area monitoring data. However, from the perspective of exposures to uranium, NIOSH does have access to sufficient source term information from the site to support evaluating external dose for the proposed worker class (as discussed in Section 7.3).

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

The feasibility determinations for the class of employees under evaluation in this report are 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 ensure 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. This approach is discussed in OCAS'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-00115 as submitted by the petitioner. (Section 7.4)

## **7.1 Pedigree of Tyson Valley Powder Farm 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.

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

NIOSH has been unable to locate uranium internal monitoring records for Tyson Valley Powder Farm workers. Tyson Valley Powder Farm data, such as bioassay results and air sampling results, are not available. Therefore, an internal data sufficiency and pedigree evaluation is not possible for this data type.

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

NIOSH has been unable to locate external monitoring records for Tyson Valley Powder Farm employees associated with uranium and uranium exposures. This includes film badge or area monitoring data. Therefore, an external data sufficiency and pedigree evaluation is not possible for this data type.

## **7.2 Evaluation of Bounding Internal Radiation Doses at Tyson Valley Powder Farm**

The principal sources of internal radiation doses for members of the class under evaluation were uranium scrap and uranium residues (306 residues). The following subsections address the ability to bound internal doses and the feasibility of internal dose reconstruction.

### **7.2.1 Evaluation of Bounding Storage-Related Internal Doses**

As of the date of this evaluation, NIOSH has not found any personal or area monitoring data related to internal exposures for Tyson Valley Powder Farm employees.

The following subsections summarize the extent and limitations of information available for reconstructing the process-related internal doses of members of the class under evaluation.

#### **7.2.1.1 Uranium Scrap**

Uranium scrap stored at Tyson Valley Powder Farm had very low uranium content; consequently, internal exposure from uranium scrap is not believed to be a concern. Due to the lack of knowledge on the composition of the uranium residues, the lack of available information on the storage and handling of uranium materials at Tyson Valley Powder Farm, and the inability to reconstruct internal dose from uranium residues, further evaluation of the ability to reconstruct internal dose from uranium scrap is not included in the internal evaluation portion of this report.

### 7.2.1.2 Uranium Residues and Radon

Due to the lack of any available workplace or bioassay data for uranium residues, or information regarding the relative uranium-to-progeny ratios of the materials stored at the site, intakes from potential exposures from these materials cannot be reconstructed with sufficient accuracy.

### 7.2.1.3 Residual Contamination

Since there was no evidence of residual contamination in the storage locations, internal exposure pathways such as inhalation, ingestion, and resuspension were not a concern for Tyson Valley Powder Farm workers. Therefore, assessment of internal dose due to residual contamination is not necessary.

## **7.2.2 Internal Dose Reconstruction Feasibility Conclusion**

NIOSH did not find personnel monitoring data, area monitoring data, or source term data to estimate internal exposures at Tyson Valley Powder Farm for the period of February 13, 1946 through June 30, 1948, for uranium residues. In addition, no information exists on work activities, nor are the source terms known. Therefore, it is not possible to determine the magnitude of any potentially unmonitored internal doses for uranium residues (as previously discussed, because of the limitations associated with the uranium residues, further evaluation of the ability to bound the internal dose from uranium scrap has not been evaluated in this report). Based on the lack of relevant data, NIOSH is unable to estimate, with sufficient accuracy, the potential internal exposures at Tyson Valley Powder Farm for the period from February 13, 1946 through June 30, 1948.

## **7.3 Evaluation of Bounding External Radiation Doses at Tyson Valley Powder Farm**

As of the date of this evaluation, NIOSH has been unable to find any records of external monitoring for Tyson Valley Powder Farm employees associated with the storage of uranium materials at the site during the period of evaluation applicable to this petition. Principal sources of external radiation doses for members of the proposed class included potential exposures to uranium scrap and uranium residues from the storage of these materials in onsite igloos. Due to the form of uranium stored at Tyson Valley Powder Farm (natural rather than enriched uranium), external exposures could have resulted from photon and beta-particle radiation emissions. However, neutron radiation was not a plausible source of external exposure to personnel at the site. Although it is unknown whether the employer required medical X-ray examinations, X-ray exams are another possible source of external radiation dose at Tyson Valley Powder Farm.

### **7.3.1 Evaluation of Bounding Storage-Related External Doses**

As described above, NIOSH has been unable to find any records of external monitoring for Tyson Valley Powder Farm employees associated with the storage of uranium materials at the site during the period of evaluation applicable to this petition. Based on NIOSH's finding regarding internal dose reconstruction (inability to bound internal dose), NIOSH has not performed an exhaustive research effort or evaluation of its ability to bound the external dose (or reconstruct dose with sufficient accuracy). If a partial dose reconstruction were deemed necessary, NIOSH has both an applicable methodology and external uranium dose reconstruction assumptions and approaches as described in Battelle-TBD-6000. Based on Battelle-TBD-6000, it is possible for NIOSH to partially estimate

external dose associated with uranium scrap using Table 6.4 of Battelle-TBD-6000. In addition, the dose rates of 2 mR/hr at 6 feet and 10mR/hr at 1 inch can be applied when estimating external dose associated with uranium residues (306 pitchblende residues) (Miller, unknown date).

### **7.3.2 Tyson Valley Powder Farm Occupational X-Ray Examinations**

NIOSH has found no records indicating that employees at Tyson Valley Powder Farm were required to complete medical examinations, including chest X-rays prior to beginning work, on a periodic basis (e.g, annually), or following termination. Although no records have been identified that indicate that occupational medical X-rays were required, for the purpose of partial dose reconstructions during the time period, X-ray exams will be assumed to have been required at termination. Organ doses from posterior-anterior chest X-rays for all time periods are available in ORAUT-OTIB-0006. NIOSH believes that by using this methodology, occupational medical X-ray doses can be reconstructed.

### **7.3.3 External Dose Reconstruction Feasibility Conclusion**

NIOSH has established that it can (based on assumptions and approaches presented in Battelle-TBD-6000) partially reconstruct external dose, including medical X-ray exposures, in support of partial external dose reconstruction for uranium for workers associated with Tyson Valley Powder Farm. Based on NIOSH's finding regarding internal dose reconstruction (inability to bound internal dose), NIOSH has not performed an exhaustive research effort or evaluation of its ability to bound external dose (or reconstruct dose with sufficient accuracy) for the proposed worker class evaluated in this report.

## **7.4 Evaluation of Petition Basis for SEC-00115**

The following subsection evaluates the assertions made on behalf of petition SEC-00115 for the Tyson Valley Powder Farm.

### **7.4.1 Unmonitored Workers**

*SEC-00115: To the best of my knowledge, radiation exposures and radiation dose potentially incurred by members of the proposed class, that relate to this petition, were not monitored, either through personal monitoring or through area monitoring.*

Personal internal, external monitoring, and/or area monitoring data are not always required to develop an exposure model for a given facility. However, if these monitoring data are not available, NIOSH must have access to source term information and detailed process information in order to develop a sufficiently accurate exposure model. To date, NIOSH does not have access to Tyson Valley Powder Farm personnel or area monitoring documentation that describes the extent of the storage and/or shipping activities that may have been performed with the uranium scrap and uranium residues.

NIOSH did determine that due to the unknown radiological makeup of the uranium residues, intakes from potential uranium residue exposure cannot be reconstructed with sufficient accuracy. NIOSH has determined that it does not have adequate internal monitoring data for members of the NIOSH-proposed class, nor does it have enough source term or process information applicable to the class, to develop a sufficiently accurate model for dose reconstruction for these exposures during the February

13, 1946 through June 30, 1948 timeframe. For the time periods from January 1, 1942 through June 27, 1946, or from July 1, 1948 through December 31, 1949 (the remaining portion of the NIOSH-evaluated class), NIOSH has not discovered any evidence of radioactive materials being stored at the Tyson Valley Powder Farm; therefore, there was no exposure potential.

## 7.5 Summary of Feasibility Findings for Petition SEC-00115

This report evaluates the feasibility for completing dose reconstructions for employees at the Tyson Valley Powder Farm from January 1, 1942 through December 31, 1949. NIOSH found that the available monitoring records, process descriptions and source term data available are not sufficient to complete internal dose reconstructions for the period February 13, 1946 through June 30, 1948. Because internal dose cannot be reconstructed for uranium residues, NIOSH has not performed an exhaustive research effort or evaluation of its ability to bound external dose (or reconstruct dose with sufficient accuracy) for the NIOSH-proposed class evaluated in this report.

Table 7-1 summarizes the results of the feasibility findings at Tyson Valley Powder Farm for each exposure source during the time period February 13, 1946 through June 30, 1948. For the periods from January 1, 1942 through June 27, 1946 and from July 1, 1948 through December 31, 1949, a feasibility finding is not required because NIOSH has determined that there was no exposure potential at Tyson Valley Powder Farm outside of the February 13, 1946 through June 30, 1948 timeframe.

<b>Table 7-1: Summary of Feasibility Findings for SEC-00115</b>		
February 13, 1946 through June 30, 1948		
<b>Source of Exposure</b>	<b>Reconstruction Feasible</b>	<b>Reconstruction Not Feasible</b>
<b>Internal</b>		<b>X</b>
- Uranium scrap		N/A
- Uranium residues		X
- Radon		X
<b>External</b>	<b>X</b>	
- Gamma	X	
- Beta	X	
- Neutron	N/A	
- Occupational Medical X-ray	X	

As of January 14, 2009, a total of one claim has been submitted to NIOSH for individuals who worked at Tyson Valley Powder Farm and are covered by the class definition evaluated in this report. A dose reconstruction has been completed for this individual.

## 8.0 Evaluation of Health Endangerment for Petition SEC-00115

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.

Based on the absence of survey and monitoring data, including limited information on source terms and radionuclide activities, NIOSH determined that it is not feasible to estimate radiation dose for all 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 required.

## **9.0 Class Conclusion for Petition SEC-00115**

Based on its full research of the class under evaluation, NIOSH has defined a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. The NIOSH-proposed class to be added to the SEC includes all Atomic Weapons Employer (AWE) employees who worked at Tyson Valley Powder Farm near Eureka, Missouri, from February 13, 1946 through June 30, 1948, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees in the SEC. The class under evaluation was modified because there is no evidence of radioactive materials on site prior to February 13, 1946, and available documentation indicates that all radioactive materials were offsite by June 30, 1948 (HydroGeoLogic, 2004, pdf p. 7).

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-00115. 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.

## 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

Battelle-TBD-6000, *Site Profiles for Atomic Weapons Employers that Worked Uranium and Thorium*, PSWS-3738 Rev. F0; Battelle; December 13, 2006; SRDB Ref ID: 30671

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

ORAUT-OTIB-0004, *Estimating the Maximum Plausible Dose to Workers at Atomic Weapons Employer Facilities*, Rev. 03 PC-2; Oak Ridge Associated Universities (ORAU); December 6, 2006; SRDB Ref ID: 36191

ORAUT-OTIB-0006, *Dose Reconstruction from Occupationally Related X-Ray Procedures*, Rev. 03 PC-1; Oak Ridge Associated Universities (ORAU); December 21, 2005; SRDB Ref ID: 20220

ORAUT-OTIB-0024, *Estimation of Neutron Dose Rates from Alpha-Neutron Reactions in Uranium and Thorium Compounds*, Rev. 00; Oak Ridge Associated Universities (ORAU); April 7, 2005; SRDB Ref ID: 19445

ORAUT-TKBS-0005, *Basis for Development of an Exposure Matrix for the Mallinckrodt Chemical Company St. Louis Downtown Site and the St. Louis Airport Site, St. Louis, Missouri*, Rev. 02; Oak Ridge Associated Universities (ORAU); June 14, 2007; SRDB Ref ID: 32277

Affidavits and Authorization Form; June 13, 2008; OSA Ref ID: 106263

Army Corps of Engineers, 2005, *Final Technical Memorandum Atomic Energy Commission Material Storage Concerns-Former Tyson Valley Powder Farm, Eureka, Missouri*; U.S. Army Corps of Engineers, Kansas City District; January 2005; SRDB Ref ID: 49707

Belmore, 1948, *SF Accountability Reports*, correspondence; F. M. Belmore; June 8, 1948; SRDB Ref ID: 49432, pdf pp. 45-46

Bower, 1989, *Rediscovering Four Forgotten Sites... Government Lost Track of Nuclear Operations Here and Nationwide*; Carolyn Bower, Louis J. Rose, and Theresa Tighe, St. Louis Post-Dispatch; February 17, 1989; SRDB Ref ID: 49405

Clayton, 1946a, *Disposition of Graphite, C Special Slag*, correspondence; Calvin Clayton; June 28, 1946; SRDB Ref ID: 10508, pdf pp. 22-24

Clayton, 1946b, *Disposition of Plant 6 Residues*, memo to the files; Calvin Clayton; February 13, 1946; SRDB Ref ID: 10508, pdf pp. 27-31

Ellis Environmental Group, 2002, *Final Work Plan for Remedial Investigation/Site Investigation at Former Tyson Valley Powder Farm Eureka, Missouri*; Ellis Environmental Group, LC; May 2002; SRDB Ref ID: 49428

Environmental Control, 1970, *Radiological Health Handbook*; Compiled and edited by the Bureau of Radiological Health and the Training Institute—Environmental Control Administration; January 1970; SRDB Ref ID: publicly available

HydroGeoLogic, 2004, *Final Historical Document Research Report for Tyson Valley Powder Farm Eureka, Missouri*; HydroGeoLogic, Inc.; April 2004; SRDB Ref ID: 49432

Koenig, 1948a, *Storage of "C-Special" Material*, memorandum; James J. Koenig; January 14, 1948; SRDB Ref ID: 49432, pdf p. 672

Koenig, 1948b, *Storage of "C-Special" Material*, memorandum; James J. Koenig; February 19, 1948; SRDB Ref ID: 49432, pdf p. 674

Koenig, 1948c, *Slag from Metal Step*, correspondence; James J. Koenig; July 7, 1948; SRDB Ref ID: 10508, pdf p. 43

Miller, unknown date, *Waste Residues Located at Vitro Rare Metals Company, Canonsburg, Pennsylvania*; Miller; unknown date; SRDB Ref ID: 10288 pdf p. 734

Missouri Department of Natural Resources, unknown date, *Federal Facilities Section-Department of Defense Sites*; Missouri Department of Natural Resources; <http://www.dnr.mo.gov/env/hpw/fedfac/ffs-dod.htm>; SRDB Ref ID: 49439

Personal Communication, 2008a, *Personal Communication with [Name One Redacted]*; Email contact; October 27, 2008; SRDB Ref ID: 53358

Personal Communication, 2008b, *Personal Communication with [Name Two Redacted]*; Telephone Interview by ORAU Team; October 1, 2008; SRDB Ref ID: 54623

Personal Communication, 2008c, *Personal Communication with [Name Three Redacted]*; Telephone Interview by ORAU Team; November 5, 2008; SRDB Ref ID: 54621

TechLaw, 2002, *Expanded Site Inspection at the Tyson Valley (ex) Army Powder Storage Farm*, DCN: RR7-TLI-07ZZ-01-TR-0037; TechLaw, Inc.; January 11, 2002; SRDB Ref ID: 49427

This page intentionally left blank

## Attachment 1: Data Capture Synopsis

<b>Table A1-1: Data Capture Synopsis for Tyson Valley Powder Farm</b>			
<b>Data Capture Information</b>	<b>Data Capture Description</b>	<b>Completed</b>	<b>Uploaded</b>
Primary Site/Company Name: Tyson Valley Powder Farm 1942-1949  Other Site Names: N/A	Site is no longer in existence; therefore no specific site contact was made.	N/A	0
State Contacts: MO Department of Natural Resources - Rhonda Loveall (POC: 573-751-3043), Brandon Doster (TVPF PM: 573-526-2739) MO Department of Health and Senior Service - Keith Henke (State Initial Contact/Planner: 573-751-6111) Jonathan Garoutte (POC Risk Manager: 573-751-6102)	Introduction to the former Tyson Valley Powder Farm (TVPF); depleted uranium (DU) history; drums left at Tyson Research Center by the Army Corps of Engineers; engineering final report on the confirmation study at the former Tyson Valley Powder Farm areas of concern no. 3, 4, 5, 6 and 8; interview records; survey of elevated radiation levels at Tyson Research Center; and Tyson Valley Powder Farm chronology.	09/22/2008	142
Other Contacts: St. Louis office of US Army Corp of Engineering - Jonathan Rankins (HP USACE: 314-260-3933) St. Louis County Library Eureka - (Ken: 314-516-5143)	No relevant documents identified.	10/02/2008	0
Comprehensive Epidemiologic Data Resource (CEDR)	No relevant documents identified.	08/12/2008	0
DOE Hanford Declassified Document Retrieval System (DDRS)	No relevant documents identified.	08/12/2008	0
DOE Legacy Management Considered Sites	No relevant documents identified.	08/18/2008	0
DOE OpenNet	No relevant documents identified.	08/12/2008	0
DOE OSTI Energy Citations	No relevant documents identified.	08/12/2008	0
DOE OSTI Information Bridge	No relevant documents identified.	08/12/2008	0
Google	Surface geophysical investigation of the areal and vertical extent of metallic waste at the former Tyson Valley Powder Farm near Eureka, Missouri.	08/13/2008	2

<b>Table A1-1: Data Capture Synopsis for Tyson Valley Powder Farm</b>			
<b>Data Capture Information</b>	<b>Data Capture Description</b>	<b>Completed</b>	<b>Uploaded</b>
NARA Atlanta	Storage of Tyson Valley scrap.	05/23/2008	1
NARA Kansas City	No relevant documents identified.	08/15/2008	0
National Academies Press (NAP)	No relevant documents identified.	08/12/2008	0
National Nuclear Security Administration (NNSA) - Nevada Site Office	No relevant documents identified.	08/12/2008	0
NRC Agencywide Document Access and Management (ADAMS)	No relevant documents identified.	08/12/2008	0
St. Louis County Library - Eureka	No relevant documents identified.	10/02/2008	0
Southern Illinois University	Designation of Dow Madison and Tyson Valley Powder Farm; U.S. NRC Report of Inspection; disposal of radioactive wastes in the Metropolitan St. Louis area; and the environmental and health legacy of the Mallinckrodt chemical work.	10/08/2008	3
Washington State University (U.S. Transuranium and Uranium Registries)	No relevant documents identified.	08/12/2008	0
Washington University Libraries - St. Louis	No relevant documents identified.	08/12/2008	0
Unknown	Uranium and thorium inventory in the Madison Square area.	Unknown	2
<b>Total</b>			<b>150</b>

<b>Table A1-2: Database Searches for Tyson Valley Powder Farm</b>			
<b>Database/Source</b>	<b>Keywords</b>	<b>Hits</b>	<b>Uploaded</b>
CEDR <a href="http://cedr.lbl.gov/">http://cedr.lbl.gov/</a> COMPLETED 08/12/2008	Tyson Valley Powder Farm  Tyson Valley	0	0
DOE OpenNet <a href="http://www.osti.gov/opennet/advancedsearch.jsp">http://www.osti.gov/opennet/advancedsearch.jsp</a> COMPLETED 08/12/2008	Tyson Valley Powder Farm  Tyson Valley	0	0
DOE OSTI Information Bridge <a href="http://www.osti.gov/bridge/advancedsearch.jsp">http://www.osti.gov/bridge/advancedsearch.jsp</a> COMPLETED 08/12/2008	Tyson Valley Powder Farm  Tyson Valley	0	0
DOE Hanford DDRS <a href="http://www2.hanford.gov/declass/">http://www2.hanford.gov/declass/</a>	Tyson Valley Powder Farm	0	0



<b>Table A1-2: Database Searches for Tyson Valley Powder Farm</b>			
<b>Database/Source</b>	<b>Keywords</b>	<b>Hits</b>	<b>Uploaded</b>
COMPLETED 08/12/2008	Tyson Valley		
National Academies Press <a href="http://www.nap.edu/">http://www.nap.edu/</a> COMPLETED 08/12/2008	Tyson Valley Powder Farm  Tyson Valley	3	0
NRC ADAMS Reading Room <a href="http://www.nrc.gov/reading-rm/adams/web-based.html">http://www.nrc.gov/reading-rm/adams/web-based.html</a> COMPLETED 08/12/2008	Tyson Valley Powder Farm  Tyson Valley	0	0
U.S. Transuranium & Uranium Registries <a href="http://www.ustur.wsu.edu/">http://www.ustur.wsu.edu/</a> COMPLETED 08/12/2008	Tyson Valley Powder Farm  Tyson Valley	0	0
DOE Energy Citations <a href="http://www.osti.gov/energycitations/">http://www.osti.gov/energycitations/</a> COMPLETED 08/12/2008	Tyson Valley Powder Farm  Tyson Valley	0	0
Washington University Library - St. Louis <a href="http://www.wulib.wustl.edu">http://www.wulib.wustl.edu</a> COMPLETED 08/12/2008	Tyson Valley Powder Farm  Tyson Valley	0	0
NNSA - Nevada Site Office <a href="http://www.nv.doe.gov/main/search.htm">www.nv.doe.gov/main/search.htm</a> COMPLETED 08/12/2008	Tyson Valley Powder Farm  Tyson Valley	0	0
Google <a href="http://www.google.com">http://www.google.com</a> COMPLETED 08/13/2008	americium, OR Am241, OR Am-241, OR "AM 241", OR 241Am, OR 241-Am, OR "241 Am"  ionium, OR Th230, OR Th-230, OR "Th 230", OR 230Th, OR 230-Th, OR "230 Th"  polonium, OR Po210, OR Po-210, OR "Po 210", OR 210Po, OR 210-Po, OR "210 Po"	489	2

<b>Table A1-2: Database Searches for Tyson Valley Powder Farm</b>			
<b>Database/Source</b>	<b>Keywords</b>	<b>Hits</b>	<b>Uploaded</b>
	<p>thorium, OR Th232, OR Th-232, OR "Th 232", OR 232Th, OR 232-Th, OR "232 Th", OR "Z metal", OR myrnalloy, OR "chemical 10-66", OR "chemical 10-12"</p> <p>ionium, OR UX1, OR UX2, OR Th-230, OR Th230, OR "Th 230", OR 230-Th, OR "230 Th", OR 230Th, OR Th-234, OR Th234, OR "Th 234", OR 234-Th, OR 234Th, OR "234 Th"</p> <p>tritium, H3, H-3, mint, HTO</p> <p>uranium, OR U233, OR U-233, OR "U 233", OR 233U, OR 233-U, OR "233 U", OR U234, OR "U 234", OR U-234, OR 234U, OR 234-U, OR "234 U"</p> <p>U235, OR "U 235", OR U-235, OR 235-U, OR 235U, OR "235 U", OR U238, OR "U 238", OR U-238, OR 238-U, OR 238U, OR "238 U"</p> <p>U308, OR "U 308", OR U-308, OR 308-U, OR 308U, OR "308 U", OR "uranium extraction", OR "black oxide", OR "brown oxide"</p> <p>green salt, OR "orange oxide", OR "yellow cake", OR UO2, OR UO3, OR UF4, OR UF6, OR C-216, OR C-616, OR C-65, OR C-211, OR U3O8</p> <p>plutonium, OR Pu-238, OR Pu238, OR "Pu 238", OR 238Pu, OR 238-Pu, OR "238 Pu", OR Pu-239, OR Pu239, OR "Pu 239", OR 239Pu, OR 239-Pu, OR "239 Pu"</p> <p>Pu-240, OR Pu240, OR "Pu 240", OR 240Pu, OR 240-Pu, OR "240 Pu", OR Pu-241, OR Pu241, OR "Pu 241", OR 241Pu, OR 241-Pu, OR "241 Pu"</p> <p>radium, OR Ra-226, OR Ra226, OR "Ra 226", OR 226-Ra, OR</p>		

<b>Table A1-2: Database Searches for Tyson Valley Powder Farm</b>			
<b>Database/Source</b>	<b>Keywords</b>	<b>Hits</b>	<b>Uploaded</b>
	226Ra, OR 226-Ra, OR Ra-228, OR Ra228, OR "Ra 228", OR 228Ra, OR 228-Ra, OR "228 Ra"		
	radon, OR Rn-222, OR Rn222, OR "Rn 222", OR 222Rn, OR 222-Rn, OR "222 Rn"		
	thoron, OR Rn-220, OR Rn220, OR "Rn 220", OR 220Rn, OR 220-Rn, OR "220 Rn"		
	protactinium, OR Pa-234m, OR Pa234m, OR "Pa 234m", OR 234mPa, OR 234m-Pa, OR "234m Pa"		
	oralloy, OR postum, OR tuballoy, OR "uranyl nitrate hexahydrate", OR UNH, OR K-65, OR "sump cake"		
	uranium dioxide, OR "uranium tetrafluoride", OR "uranium trioxide"		
	uranium hexafluoride, OR accident, OR "air count"		
	air dust, OR "air filter", OR "airborne test"		
	alpha, OR "belgian congo ore", OR bioassay, OR bio-assay, OR beta, OR body burden		
	breath, OR "breathing zone", OR BZ, OR calibration, OR columnation, OR chest count		
	contamination, OR collimation, OR curie, OR denitration, OR "denitration pot"		
	derby, OR regulus, OR dose, OR dosimeter, OR DAC, OR "derived air concentration"		
	dosimetric, OR dosimetry, OR electron, OR environment		

<b>Table A1-2: Database Searches for Tyson Valley Powder Farm</b>			
<b>Database/Source</b>	<b>Keywords</b>	<b>Hits</b>	<b>Uploaded</b>
	<p>Ether-Water Project, OR exposure, OR "exposure investigation", OR "radiation exposure"</p> <p>external, OR "F machine", OR fecal, OR "feed material", OR femptocurie, OR film, OR fission, OR fluoroscopy</p> <p>Formerly Utilized Sites Remedial Action Program, OR FUSRAP, OR gamma-ray, OR "gas proportional", OR "gaseous diffusion"</p> <p>health, OR "health instrument", OR "health physics", OR "H.I.", OR HI, OR HP, OR "highly enriched uranium", OR HEU</p> <p>hydrofluorination, OR "in vitro", OR "in vivo", OR incident, OR ingestion, OR inhalation, OR internal</p> <p>investigation, OR isotope, OR isotopic, OR "isotopic enrichment", OR "JS Project", OR Landauer, OR "liquid scintillation"</p> <p>log, "log sheet", "log book", "low enriched uranium", LEU, OR "lung count"</p> <p>maximum permissible concentration, OR MPC, OR metallurgy, OR microcurie, OR millicurie</p> <p>mixed fission product, OR MFP, OR monitor, OR "air monitoring", OR nanocurie, OR "nasal wipe", OR neutron, OR "nose wipe"</p> <p>nuclear, OR Chicago-Nuclear, OR "nuclear fuels", OR "nuclear track emulsion", OR "type A"</p> <p>NTA, OR "occupational radiation exposure", OR occurrence, OR "ore concentrate", OR "PC Project"</p>		

<b>Table A1-2: Database Searches for Tyson Valley Powder Farm</b>			
<b>Database/Source</b>	<b>Keywords</b>	<b>Hits</b>	<b>Uploaded</b>
	permit, OR "radiation work permit", OR "safe work permit", OR "special work permit", OR RWP, OR SWP  radeco, OR radiation, OR radioactive, OR radioactivity, OR radiograph, OR radiological  Radiological Survey Data Sheet, OR RSDS, OR radionuclide, OR raffinate, OR reactor  respiratory, OR "retention schedules", OR roentgen  sample, OR "air sample", OR "dust sample", OR "general area air sample"  solvent extraction, OR source, OR "sealed source", OR spectra, OR spectrograph, OR spectroscopy, OR spectrum, OR standard, OR "operating standard", OR "processing standard"  survey, OR "building survey", OR "routine survey", OR "special survey", OR "technical basis"  thermal diffusion, OR "thermoluminescent dosimeter", OR TLD, OR "Tiger Team"  tolerance dose, OR urinalysis, OR urine, OR "whole body count", OR WBC, OR "working level", OR WL, OR X-ray, OR "X ray", OR Xray, OR X Ray		

<b>Table A1-3: OSTI Documents Ordered for Tyson Valley Powder Farm</b>			
<b>Document Number</b>	<b>Document Title</b>	<b>Requested Data</b>	<b>Date Received</b>
No documents requested	N/A	N/A	N/A