SEC Petition Evaluation Report
Petition SEC-00128

Report Rev #: 1 Report Submittal Date: July 27, 2009

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Site Expert(s):	

Petition Administrative Summary

Petition Under Evaluation

Petition #	Petition Type	Petition Qualification Date	DOE/AWE Facility Name
SEC-00128	83.13	March 13, 2009	Baker-Perkins Company

Petitioner Class Definition

All employees who worked at the Baker Perkins Atomic Weapons Employer facility in Saginaw, Michigan, from May 14, 1956 through July 12, 1968 for a number of work days aggregating at least 250 work days, occurring solely under this employment or in combination with work days within the parameters established for one or more other classes of employees in the Special Exposure Cohort.

Class Evaluated by NIOSH

All AWE employees who performed Atomic Energy Commission work at Baker Perkins Company, in Saginaw Michigan, from May 14, 1956 through May 18, 1956.

NIOSH-Proposed Class to be Added to the SEC

None

Related Petition Summary Information

SEC Petition Tracking #(s)	Petition Type	DOE/AWE Facility Name	Petition Status
N/A	N/A	N/A	N/A

Related Evaluation Report Information

Report Title	DOE/AWE Facility Name
None	N/A

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Evaluation Report Summary: SEC-00128, Baker-Perkins Company

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-00128, qualified on March 13, 2009, requested that NIOSH consider the following class: *All employees who worked at the Baker Perkins Atomic Weapons Employer facility in Saginaw, Michigan, from May 14, 1956 through July 12, 1968 for a number of work days aggregating at least 250 work days, occurring solely under this employment or in combination with work days within the parameters established for one or more other classes of employees in the Special Exposure Cohort.*

Class Evaluated by NIOSH

Based on its preliminary research, NIOSH reduced the petitioner-requested class. NIOSH evaluated the following class: All AWE employees who performed Atomic Energy Commission work at Baker Perkins Company, in Saginaw Michigan, from May 14, 1956 through May 18, 1956.

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

Based on its full research of the class under evaluation, NIOSH has obtained analytical data sheets with breathing zone and general air monitoring results taken during uranium operations and subsequent decontamination activities, as well as process data. 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.

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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: Ray Clark, 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 AWE employees who performed Atomic Energy Commission work at Baker Perkins Company, in Saginaw Michigan, from May 14, 1956 through May 18, 1956. 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.[1]

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

[1] 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.[2]

3.0 SEC-00128 Baker-Perkins Company Class Definitions

The following subsections address the evolution of the class definition for SEC-00128, Baker-Perkins Company. 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-proposed class. If some portion of the petitioner-proposed 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-00128, qualified on March 13, 2009, requested that NIOSH consider the following class for addition to the SEC: *All employees who worked at the Baker Perkins Atomic Weapons Employer facility in Saginaw, Michigan, from May 14, 1956 through July 12, 1968 for a number of work days aggregating at least 250 work days, occurring solely under this employment or in combination with work days within the parameters established for one or more other classes of employees in the Special Exposure Cohort.*

The petitioner provided information and affidavit statements in support of the petitioner's belief that accurate dose reconstruction over time is impossible for the Baker-Perkins Company workers in

[2] 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.

question. NIOSH deemed the following information and affidavit statements sufficient to qualify SEC-00128 for evaluation:

> *No dose monitoring records could be found in database* [sic].
>
> *No device was worn or offered to employees that registers radiation exposure.*
>
> *. . . internal radiation dose monitoring at the facility was grossly inadequate. Records indicate that air monitoring was not available and no urine samples were monitored on employees for exposure limits. There was no formal health physics program at facility. No external dose readings were reported.*

Based on its Baker-Perkins Company research and data capture efforts, NIOSH determined that it has access to air monitoring and process description records for Baker-Perkins Company personnel during the time period under evaluation. However, NIOSH concluded that there is sufficient documentation to support the petition basis that external radiation exposures were not adequately monitored at Baker-Perkins Company, 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 reduced the petitioner-proposed class because the Department of Energy (DOE) Office of Health, Safety and Security (DOE HSS) lists the covered period as 1956, and further defines the time period as May 1956 in the facility description section of the Baker-Perkins Company page on the DOE HSS website. Subsequent research by NIOSH determined that the period of potential exposure was May 14 through May 18, 1956. Therefore, NIOSH defined the following class for further evaluation: All AWE employees who performed Atomic Energy Commission work at Baker Perkins Company, in Saginaw Michigan, from May 14, 1956 through May 18, 1956.

3.3 NIOSH-Proposed Class to be Added to the SEC

Based on its research, NIOSH has obtained nine analytical data sheets for Baker-Perkins Company work dated May 14 through May 18, 1956. Information within these sheets provides a detailed description of the operations and reports the results of radiological monitoring that includes both general and breathing zone samples taken during both the test operations and the decontamination of equipment after the tests (Analytical Data Sheets, 1956). 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.

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 Baker-Perkins Company. 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 Baker-Perkins Company documents. The summary specifically 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 Site Profiles for insights into Baker-Perkins Company operations or related topics/operations at other sites:

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

- *Site Profiles for Atomic Weapons Employers that Refined Uranium and Thorium*, Battelle-TBD-6001, Rev. F0; December 13, 2006; SRDB Ref ID: 30673

- *Site Profiles for Atomic Weapons Employers that Refined Uranium and Thorium, Appendix P—Baker-Perkins-Michigan*, Battelle-TBD-6001 Appendix P, Rev. 0; September 14, 2007; SRDB Ref ID: 63730

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: Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures*, ORAUT-OTIB-0006; 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; April 7, 2005; SRDB Ref ID: 19445

- *TIB*: *Default Assumptions and Methods for Atomic Weapons Employer Dose Reconstructions*, Battelle-TIB-5000; April 2, 2007, SRDB Ref ID 32016

4.3 Facility Employees and Experts

To obtain additional information, including process descriptions and monitoring information, NIOSH interviewed two former Baker-Perkins Company employees. NIOSH attempted to contact one additional individual; however, multiple attempts to contact the individual were unsuccessful.

- Personal Communication, 2009a, *Personal Communication with Former Sheet Metal Worker/Supervisor*; Telephone Interview by ORAU Team; May 5, 2009; SRDB Ref ID: 67218

- Personal Communication, 2009b, *Personal Communication with Former Metal Worker*; Telephone Interview by ORAU Team; May 13, 2009; SRDB Ref ID: 67222

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 May 7, 2009)

Table 4-1: No. of Baker-Perkins Company Claims Submitted Under the Dose Reconstruction Rule

Description	Totals
Total number of claims submitted for dose reconstruction	8
Total number of claims submitted for energy employees who meet the definition criteria for the class under evaluation (May 14, 1956 through May 18, 1956)	8
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).	8
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 each claim to determine whether internal and/or external personal monitoring records could be obtained for the employees. NIOSH found no personnel exposure records**,** no reports of incidents, and no extraordinary events in any of the eight CATI claimant interviews. In consideration of the very limited duration of radiological operations at the site, the lack of such records is understandable. NIOSH reviewed the records used to perform previous dose reconstructions and located process and air monitoring data, as discussed in Sections 6.0 and 7.0 of this report.

4.5 NIOSH Site Research Database

NIOSH also examined its Site Research Database (SRDB) to locate documents supporting the evaluation of the proposed class. Eight documents in this database were identified as pertaining to site name. These documents were evaluated for their relevance to this petition. The documents include air monitoring/analytical data sheets, environmental surveys, contracts, a FUSRAP review, and various memoranda.

4.6 Documentation and/or Affidavits Provided by Petitioners

In qualifying and evaluating the petition, NIOSH reviewed the following documents submitted by the petitioners:

- *Petition Form B*; OSA Ref ID: 107473, pp. 4-12 (Form B, 2008)
- *Air Dust Sample Results (collected on May 14, 15, 16, 17, and 18, 1956)*; May 14-18, 1956; OSA Ref ID: 106893, pp. 4-13 (Analytical Data Sheets, 1956)
- *Radioactive Links Linger*, newspaper article; The Saginaw News; OSA Ref ID: 106893, pp. 14-15 (Saginaw, unknown date)
- *Official Report of Proceedings Before the Final Adjudication Branch of the U.S. Department of* Labor; U.S. Department of Labor Final Adjudication Branch; July 22, 2008; OSA Ref ID: 106893, pp. 17-66 (DOL, 2008)
- *NIOSH Report of Dose Reconstruction under the Energy Employees Occupational Illness Compensation Program Act (EEOICPA)*; National Institute for Occupational Safety and Health (NIOSH); October 25, 2007; OSA Ref ID: 106893, pp. 67-89 (NIOSH, 2007)
- *Summary of NIOSH's Re-examination of Lymphoma Target Organ* Selection; National Institute for Occupational Safety and Health (NIOSH); October 31, 2005; OSA Ref ID: 106893, pp. 91-97 (NIOSH, 2005)
- *Correspondence regarding the SEC000128 Special Exposure Cohort Process*; Name1 Redacted; February 8, 2009; OSA Ref ID: 108251 (Name1, 2009)

5.0 Radiological Operations Relevant to the Class Evaluated by NIOSH

The following subsections summarize both radiological operations at Baker-Perkins Company from May 14, 1956 through May 18, 1956 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 the identity and quantities of each radionuclide of concern, and information describing processes through which radiation exposures may have

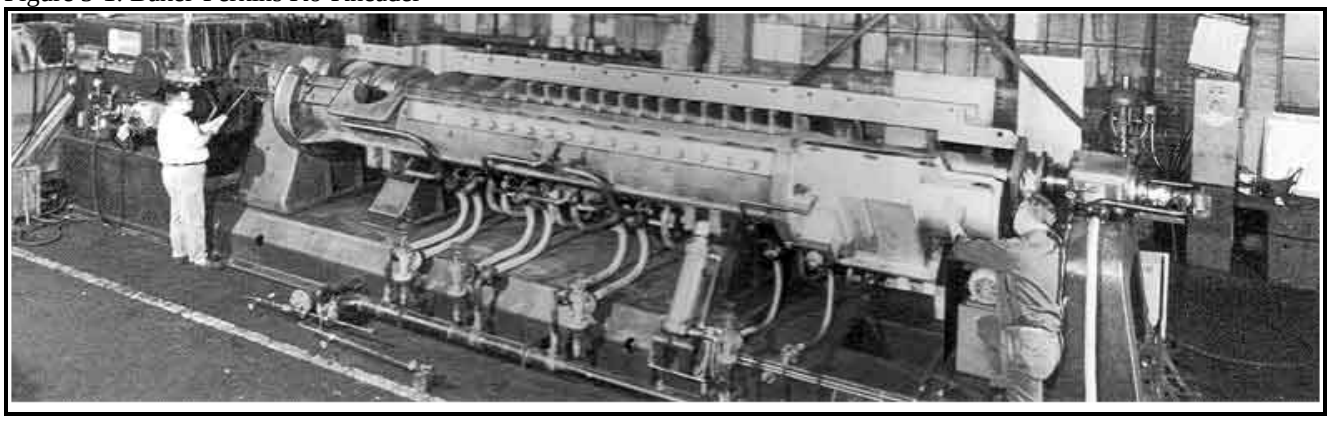
occurred and the physical environment in which they may have occurred. The information included within this evaluation report is intended only to be a summary of the available information.

5.1 Baker-Perkins Company Plant and Process Descriptions

Baker-Perkins Company was the result of the merger of two companies in the early 1900s. The company developed industrial mixing machines that were originally designed for and used in the food industry for mixing food products together. Considering the machinery's operating mechanics and the characteristics of the food products that the machines processed, the transition of operations from food industry processing to chemical industry processing was straight-forward, requiring few additional modifications to the machinery. The Saginaw factory, which was purchased by Baker-Perkins around 1919, produced the first "Universal" mixer, which was identified as a key piece of machinery for processing chemical pharmaceutical products, colors, paints, varnishes, paper pulp, cellulose, foundry sands and loams, rubber materials, etc. A company catalogue produced in the mid-1920s presented many of the Baker-Perkins food machines as suitable for processing chemicals. Baker Perkins continued to refine the design of the mixers for industrial chemical uses through World War II (Baker Perkins Historical Society, 2009a; Baker Perkins Historical Society, 2009b).

In the 1950s, Baker-Perkins chemical machinery business offered products including heavy duty mixers for use in industrial operations. One line of continuous heavy duty mixer produced by Baker-Perkins was called the "Ko-Kneader," shown below in Figure 5-1. In 1956, it was this line of mixer that was tested for its use in mixing uranium compounds for National Lead of Ohio (Fernald). These tests were performed on May 14-16, 1956, at Baker-Perkins in Saginaw, Michigan. Equipment used during the tests were decontaminated and cleaned on May 15-18, 1956 (Baumann, 1956).

Figure 5-1: Baker-Perkins Ko-Kneader



Source: Baker Perkins Historical Society, 2009a

The quantity of orange oxide (also known as uranium oxide or uranium trioxide) powder used during the tests is not specifically defined in the available documentation (Baumann, 1956). However, based upon descriptions of operations in analytical data sheets, it is indicated that at least one but no more than two "drums" of orange oxide are believed to have been used in the tests at its laboratory facility (a single building) (Battelle-TBD-6001 Appendix P; Stout, 1991). Based on the information associated with the processing of uranium-trioxide at the Feed Materials Production Center at Fernald, the uranium-trioxide consisted of refined natural uranium (Snapp, 1951, p. 9).

The tests involved mixing uranium-trioxide (orange oxide) with a water-ammonia solution and kneading the mixture, first in their "P" Ko-Kneader (on May 14-15, 1956) and then in their "K" Ko-Kneader (on May 15-16, 1956). The Baker-Perkins equipment used during the test included the P-100 Ko-Kneader, K-100 Ko-Kneader, Omega feeder, Proportioneers pump, and the Milton Roy pump. The Omega feeder was used to charge the uranium into the hopper of the Ko-Kneaders (configured to prevent dust generation). The Proportioneers pump and the Milton Roy pump were used to pump the water-ammonia solution into the Ko-Kneaders (Baumann, 1956). It was determined that the tests were not successful, in terms of continuous-use equipment.

After the tests were completed, both Ko-Kneader machines and the feeder were completely decontaminated (using a wire brush for polishing and washing the units with dilute nitric acid and using a hammer/chisel and vacuum). The decontamination of the "P" Ko-Kneader began on May 15, 1956, after it was determined that it would not be successful in the mixing test. Decontamination of the "K" Ko-Kneader began on May 17, 1956. The Omega feeder had to be disassembled to ensure complete cleaning of the unit (Baumann, 1956). Because all equipment was decontaminated and cleaned after the completion of the tests, there is no defined residual radioactivity period for the Baker-Perkins Company site (Stout, 1991).

5.2 Radiological Exposure Sources from Baker-Perkins Company Operations

The following subsections provide an overview of the internal and external exposure sources for the Baker-Perkins Company class under evaluation.

5.2.1 Internal Radiological Exposure Sources from Baker-Perkins Operations

During the brief period of operations and cleanup in May 1956, the only potential internal exposures came from possible ingestion and inhalation of uranium-trioxide dust suspended in the air during the blending of uranium-trioxide in the Baker-Perkins Ko-Kneader machine and subsequent equipment decontamination efforts.

5.2.1.1 Uranium

Uranium was present at Baker-Perkins in powder form as uranium trioxide powder. Exposure to uranium trioxide posed a potential internal exposure hazard through the inhalation or ingestion of the powder. Uranium trioxide is an intermediate step in the process of refining uranium ore into uranium hexafluoride. In terms of isotopic abundance, uranium trioxide is the same as natural uranium, which 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) (Radiological Health Handbook, 1970). The radioactivity contribution from uranium-235 is much smaller (approximately 2.2%) relative to uranium-238 or uranium-234. Uranium-235 emits alpha particles with energies of 4.40 MeV and 4.37 MeV.

5.2.2 External Radiological Exposure Sources from Baker-Perkins Operations

External radiological exposures from AEC operations at Baker-Perkins Company, during the period evaluated in this report, may have resulted from the uranium-trioxide tests performed at the Baker-

Perkins Company site. Uranium used for the tests was brought to the Baker-Perkins Company site and left the site in drums. Direct exposure to the materials may have occurred during the uranium-trioxide blending operations and subsequent mixing equipment decontamination.

5.2.2.1 Photon

Exposure to photon radiation was likely from individual exposures to drummed uranium-trioxide, provided by National Lead of Ohio (NLO), and from direct exposures to uranium-trioxide during test operations of the Ko-Kneaders for mixing uranium-trioxide with a water-ammonia solution. The external hazard from photon emissions is a result of the radioactive decay of uranium isotopes (uranium-234, uranium-235, and uranium-238) and X-ray emissions generated by interaction of beta particles (bremsstrahlung) (Battelle-TBD-6001).

5.2.2.2 Beta

Exposure to beta radiation was likely for individuals in direct contact with uranium source material during the test operations and during decontamination and cleanup of the machinery after the completion of the testing. Uranium-238 progeny (thorium-234 and protactinium-234m) could present a significant beta exposure for workers who were in direct contact with the uranium-trioxide (Battelle-TBD-6001).

5.2.2.3 Neutron

There are two potential sources of neutrons associated with the uranium-trioxide testing that occurred at Baker-Perkins Company: (1) neutrons as a result of alpha-neutron reactions, where the reactant is oxygen in the uranium oxide; and (2) neutrons as a result of spontaneous fission of the uranium. NIOSH has found no evidence of any monitoring for neutrons at Baker-Perkins. The neutron flux for uranium trioxide has been calculated, and that flux converted to a dose rate in Table 5-6 of ORAUT-OTIB-0024 (p. 11). The dose rate at 1 and 3 feet from 1 gram of natural uranium with alpha-emitting progeny present was calculated to be 1.04E-10 rem/hr-gram at 1 foot from the source and 1.16E-11 rem/hr-gram at 3 feet from the source. ORAUT-OTIB-0024 provides an effective neutron multiplication factor for natural uranium in secular equilibrium with alpha-emitting progeny (through radium-226 in the uranium-238 chain and through radium-223 in the uranium-235 chain). Based on the information available to NIOSH regarding uranium operations at Baker-Perkins Company, and considering NIOSH's assessment of potential neutron exposures associated with uranium oxides (in Battelle-TBD-6000, Section 3.3.4), NIOSH has concluded that neutrons were not a significant source of external exposure to Baker-Perkins Company personnel. Therefore, further discussion or assessment of neutron exposures for the Baker-Perkins evaluated class is not included in this evaluation.

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 Baker-Perkins Company class under evaluation.

6.1 Available Baker-Perkins Company Internal Monitoring Data

Due to the nature of the test operations at Baker-Perkins Company, there was no internal monitoring (bioassay) performed. However, there are data analysis sheets containing general area and breathing zone air sample results that can be used to evaluate the internal dose for the class evaluated in this report. These sheets provide detailed descriptions of the work going on during the sampling, as well as the time and date the samples were taken. Samples were taken to represent the general area conditions, the breathing zone conditions for the operators, and process exhaust samples (Analytical Data Sheets, 1956).

Details regarding the various analyses used and the associated minimum detectable activities are presented in *Site Profiles for Atomic Weapons Employers that Refined Uranium and Thorium, Appendix P—Baker-Perkins-Michigan* (Battelle-TBD-6001 Appendix P; Analytical Data Sheets, 1956).

The analytical data sheets documenting the results of air sampling that occurred during the blending tests (i.e., operations) and during the subsequent cleanup of the test equipment (i.e., decontamination) are summarized in Table 6-1 below.

Table 6-1: Maximum and Minimum Airborne Results as Reported in Analytical Data Sheets

	Type of Sample	Total No. of Samples	Maximum Result (dpm/m^3)	Minimum Result (dpm/m^3)	Type of work	Method of Analysis
5-14-56	BZ	3	14061	1661	Testing	Alpha scintillation counter
5-14-56	GA	4	2714	275	Testing	Alpha scintillation counter
5-15-56	BZ	6	13981	82	Testing	Alpha scintillation counter
5-15-56	GA	11	590	7	Testing	Alpha scintillation counter
5-16-56	GA/P	7	64	6	Testing	Alpha proportional counter
5-17-56	BZ	4	1375	462	Decon.	Alpha scintillation counter
5-17-56	GA	2	391	244	Decon.	Alpha scintillation counter
5-18-56	BZ	1	1509	N/A	Decon.	Alpha scintillation counter
5-18-56	GA/P	5	1647	104	Decon.	Alpha scintillation counter

Notes:
The source of information for this data is from Analytical Data Sheets, 1956. Background or "control" air sample results are excluded from this table.
No BZ samples were collected on 5-16-56.
BZ indicates breathing zone.
GA indicates general area.
GA/P indicates the compilation of GA and Process samples.

6.2 Available Baker-Perkins Company External Monitoring Data

Due to the nature of the test operations at Baker-Perkins Company, external monitoring was not performed; thus, there are no personnel or area external monitoring data available. However, available process data for Baker-Perkins operations, coupled with a dose reconstruction approach that is based on surrogate data from similar operations, can be used to support evaluating external dose for the class evaluated in this report, as presented and evaluated in Section 7 of this report.

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 and process 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. 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-00128 as submitted by the petitioner. (Section 7.4)

7.1 Pedigree of Baker-Perkins Company 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

Although there is information related to the operational and radiological air monitoring performed at Baker-Perkins Company (associated with the NLO monitoring program), NIOSH has been unable to find any records that would indicate that internal monitoring for uranium was performed during the duration of the Baker-Perkins testing operations. The air monitoring results that were logged on analytical data sheets included general area samples, process samples, and breathing zone samples. The analytical data sheets available to NIOSH are primary source data that support reconstructing internal dose for the Baker-Perkins Company evaluated class. These sheets provide a detailed accounting of the measurements performed, associated activities, and analytical results associated with the tests and equipment decontamination activities conducted from May 14 through May 18, 1956 at Baker-Perkins Company. Considering the limited scope of work and the available information, NIOSH considers this information sufficient to support the evaluation of internal dose in this report.

7.1.2 External Monitoring Data Pedigree Review

Since there are no external monitoring data available, a pedigree review specific to external monitoring data cannot be performed. The available air sampling data coupled with the process information for the radioactive materials handled on the Baker-Perkins site will be used to evaluate the external uranium-trioxide dose.

7.2 Evaluation of Bounding Internal Radiation Doses at Baker-Perkins Company

The principal source of internal radiation doses for members of the class under evaluation was uranium-trioxide (orange oxide) (Battelle-TBD-6001 Appendix P; Stout, 1991a). The following subsections address the ability to bound internal doses, methods for bounding doses, and the feasibility of internal dose reconstruction.

7.2.1 Evaluation of Bounding Process-Related Internal Doses

The breathing zone air samples taken over the mixing operations provide the highest air sample results for the Baker-Perkins uranium-trioxide mixing operations test. This is consistent with the explanation of the operations and the amount of dry-material work and dust generated during the tests. Although it was indicated that respirators were worn during the dusty operations (Analytical Data Sheets, 1956, p. 16)**,** no reduction in the air sample results as a result of respirator protection factors is included in this evaluation.

7.2.2 Methods for Bounding Internal Dose at Baker-Perkins Company

NIOSH reviewed analytical data sheets containing air sampling data from before the start of the operational tests to the end of the tests and during decontamination of the equipment. Both general air and breathing zone air dust samples were collected and analyzed for gross alpha activity. The

available data was fit to a lognormal distribution (Battelle-TBD-5000) and is presented in Table 7-1 below.

Table 7-1: NIOSH Analysis of Airborne Levels as Reported in Analytical Sheets (dpm/m^3)

	erall		During Operations		During Decontamination	
	BZ	GA	BZ	GA	BZ	GA
Median	1,210	92	6,135	217	491	65
GSD	4.9	5.5	2.4	4.5	2.9	5.4
95th Percentile	16,576	1,510	26,334	2,607	2,887	1,037
Number of Samples	14	24	5	7	9	17

The geometric mean and geometric standard deviation for breathing zone monitoring were 1,210 dpm/m and 4.91 respectively. The corresponding values for the general area samples were 92 dpm/m^3 and 5.48. Lacking detailed information on activity duration and occupancy, the breathing zone data can be used to bound internal exposure for individuals working at the facility. Intake estimates broken out by job task (operations versus decontamination), as presented in Table 7-1, can also be applied if sufficient information is available on actual work activities.

The values and methods assessed in Appendix P of Battelle-6001 can be used for the purpose of estimating internal dose in a more precise manner than the application of the bounding dose estimate for specific workers/work activities or job descriptions, if sufficient information is available on actual work activities or locations.

7.2.3 Internal Dose Reconstruction Feasibility Conclusion

Based on the review presented above, NIOSH has determined that it has access to sufficient Baker-Perkins Company 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. NIOSH has determined that actual air sample data, which includes breathing zone air sample data collected during the Baker-Perkins test operations with the Ko-Kneaders, can be used to bound internal dose from exposures to uranium. Based on the assessment of the available data, NIOSH concludes that the methods described above, consistent with those described and presented in Battelle-TBD-6001, Appendix P, provide reasonable approaches to bound internal dose for all members of the Baker-Perkins class under evaluation.

7.3 Evaluation of Bounding External Radiation Doses at Baker-Perkins Company

The principal source of external radiation doses for members of the proposed class was uranium oxide powder (orange oxide) (Stout, 1991a).

The following subsections address the ability to bound external doses, methods for bounding doses, and the feasibility of external dose reconstruction.

7.3.1 Evaluation of Bounding Process-Related External Doses

Based on information in the available documentation, uranium-trioxide was transported in drums to and from Baker-Perkins, and was transferred to and from the drums (into the mixing machinery) during the tests performed at the Baker-Perkins site. Therefore, there was potential for personnel to accumulate external dose from indirect external exposures to drummed uranium-trioxide and from direct exposure to uranium-trioxide during mixing and decontamination operations. As discussed in previous sections of this report, NIOSH has access to information regarding the type (uranium-trioxide) and quantity (1 – 2 drums) of radioactive material used during the Ko-Kneader mixing tests (Baumann, 1956).

Battelle-TBD-6001 provides external exposure data for either "boildown and denitration" and "oxide reduction-tray furnace" operations. Boildown and denitration is the process of converting extracted uranium nitrate to uranium trioxide, while oxide reduction is the process for converting uranium trioxide to uranium dioxide (Battelle-TBD-6001). Both of these operations involve the use of uranium-trioxide and are based upon industrial rather than experimental process volumes. Available process and source term information supports the use of this surrogate data for external dose reconstruction at Baker-Perkins Company. This conclusion is based on the amount (1-2 drums) and duration (1 week) of activities as compared to the full scale operations on which the surrogate data is based. In addition, the assessment of external radiation measurements on drums of uranium compounds, also available in Battelle-TBD-6001, can be used to bound exposure from contact with bulk materials. Considering the assessment of the external dose as presented in Battelle-TBD-6001, the external dose component associated with immersion dose does not represent a significant contributor to the external dose at Baker-Perkins Company.

7.3.2 Methods for Bounding External Dose at Baker-Perkins Company

Photon Dose

External exposure rates from uranium and its radioactive progeny are presented in Tables 7-1, 7-2, and 7-3 of Battelle-TBD-6001. External exposure to penetrating radiation can be bounded by assuming constant exposure (40 hr/wk) to a 55 gallon drum of material at a distance of 10 cm, resulting in an external exposure estimate of 112 mR. This value is higher than the external dose estimates for either the boildown and denitration or oxide reduction operations presented in Battelle-TBD-6001.

The values specific to boildown and denitration or oxide reduction can be used for the purpose estimating external dose in a more precise manner than the application of the bounding dose estimate

for specific workers/work activities or job descriptions, if sufficient information is available on actual work activities or location.

Beta Dose

The beta dose rates from uranium oxides and uranium tetrafluoride are sufficiently similar in magnitude to the dose rates from uranium metal; thus, uranium metal dose rates can be assumed to be bounding for the dose rates from all uranium compounds.

Non-penetrating dose from natural uranium consists primarily of electrons with energies >15 keV. Skin doses to uranium refining workers can be estimated using the same methods used to calculate the dose from uranium metal. Skin doses (7 mg/cm^2) are estimated for two worker cases: (1) the hands and forearms of a worker who handles uranium metal, and (2) the other skin surfaces of a worker who handles the metal. Assuming that an operator's hands are in contact with the uranium metal or compounds for 50% of the day provides a non-penetrating dose to the hands and forearms of 1.17 rad for a 10-hour workday (0.93 rad for an eight-hour workday)(Battelle-TBD-6001).

For dose to other skin on the worker's body that is not in direct contact with uranium, but is nearby (e.g., a worker's neck and face when the hands are in contact with metal), a dose relation that estimates this dose to be 10 times the photon dose rate at 1-foot can be used. This relation, based on a review of film badge data, is documented in ORAUT-TKBS-0034. The photon dose rate at 1 foot from a slab of uranium is 2.08 mrem/hour, which would give a non-penetrating dose rate of 20.8 mrem/hour. For a worker spending 50% of a 10-hour workday handling uranium, this would give a dose rate of 0.10 rad/day (0.083 rad/day for an eight-hour workday). This dose rate would be appropriate for areas of the skin other than the hands and forearms, and for tissues (ORAUT-TKBS-0034).

7.3.3 Evaluation of Occupational X-Ray Examinations

Although no medical records have been identified specific to Baker-Perkins Company, the dose associated with medical X-ray exams, required as a condition of employment, can be assessed using the methodology defined in ORAUT-OTIB-0006. Considering the short period of the tests performed at the site, and the likelihood that no medical X-rays were required as a condition of employment (i.e., it is unlikely that medical X-rays were administered for the Baker-Perkins personnel, NIOSH believes that this methodology supports its ability to bound the occupational medical X-ray doses for the Baker-Perkins evaluated class.

7.3.4 External Dose Reconstruction Feasibility Conclusion

Based on the review presented above, NIOSH has determined that it has access to sufficient Baker-Perkins Company 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. NIOSH concludes that it has access to sufficient information to support bounding the external dose for all members of the Baker-Perkins class under evaluation.

7.4 Evaluation of Petition Basis for SEC-00128

The following subsections evaluate the assertions made on behalf of petition SEC-00128 for the Baker-Perkins Company site.

7.4.1 Internal Radiation Dose Monitoring

Issue: *This petition documents that internal radiation dose monitoring at the facility was grossly inadequate.*

Response: NIOSH agrees that there were no personnel internal radiation dosimetry (bioassay) performed at the Baker-Perkins Company site. However, as indicated in data analysis sheets, uranium operations were closely monitored and NIOSH has access to air and dust samples that are adequate to bound the internal dose for the 5-day period of operations and subsequent cleanup activities evaluated in this report.

7.4.2 Air Monitoring

Issue: *Records indicate that air monitoring was not available.*

Response: NIOSH has obtained and evaluated air monitoring data (in the form of analytical data sheets) for the entire period of operations. NIOSH does not find that there is corroborative evidence to support this petitioner claim.

7.4.3 Formal Health Physics Program

Issue: *There was no formal health physics program at the facility.*

Response: Baker-Perkins Company was not a radiological facility and did not require a formal health physics program. However, NLO, who did have an established monitoring program, provided health physics oversight for the operations (performed as a test for NLO) performed at Baker-Perkins.

7.4.4 Site Profile

Issue: *The Site Profile does not access* [sic] *exposures from inhalation and absorption by employees and lack of specific information for occupational medical dose, occupational internal dose, and occupational external dose and residual contamination calculations.*

Response: Because this test was performed over a 5-day period, which included the test and subsequent decontamination and equipment cleanup, NIOSH does not expect that the Baker-Perkins site would have established a radiological monitoring program to support the NLO test. As indicated in the monitoring documentation, NLO provided the health physics oversight and the assessment of the doses. Battelle-TBD-6001 and Battelle-TBD-6001 Appendix P, provides methods to bound all associated exposures, or to evaluate the exposures more precisely than a bounding dose estimate, for the evaluated Baker-Perkins Company class. The information associated with equipment cleanup after the test conducted at Baker-Perkins indicates that there was little potential for residual contamination outside of the period in which testing at the site was performed (Baumann, 1956).

7.4.5 Quantity of Radioactive Material

Issue: *It is unclear to the amount of radioactive material that was received by facility* [sic] *reports state "at least one but no more than two drums."*

Response: Based on the information available to NIOSH, there is sufficient process information and information associated with a dose reconstruction based on data from a surrogate site, to support its ability to bound the associated dose for the work performed at the Baker-Perkins site. The supporting methods and dose evaluation processes support NIOSH's ability to bound dose regardless of the quantity of material that would be present on a site.

7.5 Summary of Feasibility Findings for Petition SEC-00128

This report evaluates the feasibility for completing dose reconstructions for employees at Baker-Perkins Company from May 14, 1956 through May 18, 1956. NIOSH found that the available monitoring records and process descriptions are sufficient to complete dose reconstructions for the evaluated class of employees.

Table 7-2 summarizes the results of the feasibility findings at Baker-Perkins Company for each exposure source during the time period of May 14, 1956 through May 18, 1956.

Table 7-2: Summary of Feasibility Findings for SEC-00128
May 14, 1956 through May 18, 1956

Source of Exposure	Reconstruction Feasible	Reconstruction Not Feasible
Internal[1]	**X**	
- U	X	
External	**X**	
- Gamma	X	
- Beta	X	
- Neutron	N/A	
- Occupational Medical X-ray	X	

Note:
[1] Internal includes an evaluation of airborne dust.

As of May 7, 2009, a total of eight claims have been submitted to NIOSH for individuals who worked at Baker-Perkins Company and are covered by the class definition evaluated in this report. Dose reconstructions have been completed for eight individuals (100%).

8.0 Evaluation of Health Endangerment for Petition SEC-00128

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 reviews and analyses of the available data, 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-00128

Based on its full research of 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 AWE employees who performed Atomic Energy Commission work at Baker Perkins Company, in Saginaw Michigan, from May 14, 1956 through May 18, 1956.

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-00128. 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 Metals*, Rev. F0; Battelle Team; December 13, 2006; SRDB Ref ID: 30671

Battelle-TBD-6001, *Site Profiles for Atomic Weapons Employers that Worked Uranium and Thorium*, Rev. F0; Battelle Team; December 13, 2006; SRDB Ref ID: 30673

Battelle-TBD-6001 Appendix P, *Site Profiles for Atomic Weapons Employers that Refined Uranium and Thorium, Appendix P—Baker-Perkins-Michigan*, Rev. 0; Battelle Team; September 14, 2007; SRDB Ref ID: 63730

Battelle-TIB-5000, *Technical Information Bulletin: Default Assumptions and Methods for Atomic Weapons Employer Dose Reconstructions*, Rev 00; Battelle Team; April 2, 2007; SRDB Ref ID: 32016

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-0006, *Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures*, Rev. 03 PC-1; Oak Ridge Associated Universities (ORAU); Oak Ridge, Tennessee; 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); Oak Ridge, Tennessee; April 7, 2005; SRDB Ref ID: 19445

ORAUT-TKBS-0034, *An Exposure Matrix for Superior Steel, Carnegie, Pennsylvania, Period of Operation: January 1, 1952 through December 31, 1957*, Rev. 00 PC-1; Oak Ridge Associated Universities (ORAU); Oak Ridge, Tennessee; August 9, 2005; SRDB Ref ID: 20182

Analytical Data Sheets, 1956, *Air Dust Sample Results (collected on May 14, 15, 16, 17, and 18, 1956)*; May 14-18, 1956; SRDB Ref ID: 9505, pp. 16-25 and OSA Ref ID: 106893, pp. 4-13

Baker Perkins Historical Society, 2009a, *Baker Perkins in the Chemical Machinery Business*, website; Baker Perkins Historical Society; last accessed April 23, 2009; SRDB Ref ID: 55720

Baker Perkins Historical Society, 2009b, *History of Baker Perkins in North America*, website; Baker Perkins Historical Society; last accessed April 23, 2009; SRDB Ref ID: 55718

Baumann, 1956, *Discussion of Laboratory Test Performed by Baker-Perkins for National Lead of Ohio*, includes laboratory test report data sheets; J. E. Baumann; May 21, 1956; SRDB Ref ID: 63508

DOL, 2008, *Official Report of Proceedings Before the Final Adjudication Branch of the U.S. Department of* Labor; Department of Labor (DOL) Final Adjudication Branch; July 22, 2008; OSA Ref ID: 106893, pp. 17-66

Form B, 2008, *Petition Form B*; OSA Ref ID: OSA Ref ID: 107473, pp. 4-12

Name1, 2009, *Correspondence regarding the SEC000128 Special Exposure Cohort Process*; [Name1 Redacted]; February 8, 2009; OSA Ref ID: 108251

NIOSH, 2005, *Summary of NIOSH's Re-examination of Lymphoma Target Organ Selection*; National Institute for Occupational Safety and Health (NIOSH); October 31, 2005; OSA Ref ID: 106893, pp. 91-97

NIOSH, 2007, *NIOSH Report of Dose Reconstruction under the Energy Employees Occupational Illness Compensation Program Act (EEOICPA)*; National Institute for Occupational Safety and Health (NIOSH); October 25, 2007; OSA Ref ID: 106893, pp. 67-89

Personal Communication, 2009a, *Personal Communication with Former Sheet Metal Worker/Supervisor*; Telephone Interview by ORAU Team; May 5, 2009; SRDB Ref ID: 67218

Personal Communication, 2009b, *Personal Communication with Former Metal Worker*; Telephone Interview by ORAU Team; May 13, 2009; SRDB Ref ID: 67222

Radiological Health Handbook, 1970, *Radiological Health Handbook*; U.S. Department of Health, Education, and Welfare, compiled and edited by the Bureau of Radiological Health and the Training Institute, Environmental Control Administration; January 1970; SRDB Ref ID: publicly available

Saginaw, unknown date, *Radioactive Links Linger*, newspaper article; The Saginaw News; OSA Ref ID: 106893, pp. 14-15

Snapp, 1951, *Atomic Energy Commission-The Production of Uranium Feed Materials*; Roy B. Snapp; May 22, 1951; SRDB Ref ID: 4125

Stout, 1991a, *Baker-Perkins Company Consideration Recommendation with Site Summary*; Dan Stout; February 19, 1991; SRDB Ref ID: 9505, pp. 10-13

Attachment 1: Data Capture Synopsis

Table A1-1: Data Capture Synopsis for Baker-Perkins Company			
Data Capture Information	**Data Capture Description**	**Completed**	**Uploaded into SRDB**
Primary Site/Company Name: Baker-Perkins Co.; AWE 1956 Other company names: APV Chemical Company (merged with BP in 1987 and sold to BP Group in 1995, sold to private investors and now is BP Group) Baker Perkins Group (Kari Patton 616-784-3111) B & P Processes (Jerry Jones 989-757-1324)	Laboratory test report, 05/21/1956 (B&P Processes).	04/14/2009	1
State Contacted: Thor Strong, MI Dept of Environmental Quality (517-241-1252)	No relevant documents identified.	12/17/2008	0
DOE Comprehensive Epidemiologic Data Resource (CEDR)	No relevant documents identified.	04/08/2009	0
DOE Hanford Declassified Document Retrieval System (DDRS)	No relevant documents identified.	04/08/2009	0
DOE Legacy Management Considered Sites	Letter indicating Baker-Perkins does not require DOE involvement.	04/24/2009	1
DOE Legacy Management - Grand Junction	No relevant documents identified.	04/22/2009	0
DOE Legacy Management - MoundView (Fernald Holdings, includes Fernald Legal Database)	No relevant documents identified.	04/27/2009	0
DOE OpenNet	No relevant documents identified.	04/08/2009	0
DOE OSTI Energy Citations	No relevant documents identified.	04/08/2009	0
DOE OSTI Information Bridge	No relevant documents identified.	04/08/2009	0
Google	History of Baker Perkins.	04/08/2009	3
Kansas City Federal Records Center (Lenexa)	No relevant documents identified.	03/27/2009	0
National Academies Press (NAP)	No relevant documents identified.	04/08/2009	0
National Nuclear Security Administration (NNSA) - Nevada Site Office	No relevant documents identified.	04/22/2009	0
NRC Agencywide Document Access and Management (ADAMS)	Final staff evaluation of sites.	04/08/2009	1
Oak Ridge Associated Universities (ORAU) Team	Environmental survey spreadsheet and a site profile.	04/16/2009	2
Unknown	Radiological survey data.	Unknown	1
Washington State University (U.S.	No relevant documents identified.	04/08/2009	0

Table A1-1: Data Capture Synopsis for Baker-Perkins Company			
Data Capture Information	**Data Capture Description**	**Completed**	**Uploaded into SRDB**
Transuranium and Uranium Registries)			
Total			**9**

Table A1-2: Database Searches for Baker-Perkins Company			
Database/Source	**Keywords**	**Hits**	**Uploaded into SRDB**
DOE CEDR http://cedr.lbl.gov/ COMPLETED 04/08/2009	"B & P Process Equipment" in title "Baker-Perkins Group" in title "Baker Perkins" in abstract "APV Chemical Company" in abstract	0	0
DOE Hanford DDRS http://www2.hanford.gov/declass/ COMPLETED 04/08/2009	"Baker" in Title (Advanced search mode) "Baker-Perkins" (simple search mode) "APV Chemical" in Title (Advanced search mode) "APV Chemical" (simple search mode) "B & P Process Equipment" simple "Baker-Perkins Group" (simple search mode)	32	0
DOE OpenNet http://www.osti.gov/opennet/advancedsearch.jsp COMPLETED 04/08/2009	"Baker Perkins" in any field "APV Chemical Company" in any field "B & P Process Equipment" in full text "Baker-Perkins Group" in full text	0	0
DOE OSTI Energy Citations http://www.osti.gov/energycitations/ COMPLETED 04/08/2009	"B & P Process Equipment" in any field "Baker-Perkins Group" in any field "Baker Perkins" in any field "APV Chemical Company" in any field	5	0
DOE OSTI Information Bridge http://www.osti.gov/bridge/advancedsearch.jsp COMPLETED 04/08/2009	"Baker Perkins" in any field "APV Chemical Company" in any field "B & P Process Equipment" in any field "Baker-Perkins Group" in any field	4	0
Google http://www.google.com COMPLETED 04/08/2009	"Baker-Perkins Co." "Baker-Perkins Co." oralloy "Baker-Perkins Co." postum "Baker-Perkins Co." tuballoy "Baker-Perkins Co." "uranyl nitrate hexahydrate" OR UNH "Baker-Perkins Co." "K-65"	2,625	5

Table A1-2: Database Searches for Baker-Perkins Company			
Database/Source	**Keywords**	**Hits**	**Uploaded into SRDB**
	"Baker-Perkins Co." "sump cake" "Baker-Perkins Co." "uranium dioxide" "Baker-Perkins Co." "uranium tetrafluoride" "Baker-Perkins Co." "uranium trioxide" "Baker-Perkins Co." "uranium hexafluoride" "Baker-Perkins Co." accident "Baker-Perkins Co." "air count" "Baker-Perkins Co." "air dust" "Baker-Perkins Co." "air filter" "Baker-Perkins Co." "airborne test" "Baker-Perkins Co." alpha "Baker-Perkins Co." "belgian congo ore" "Baker-Perkins Co." bioassay OR bio-assay "Baker-Perkins Co." breath OR "breathing zone" OR BZ "Baker-Perkins Co." calibration "Baker-Perkins Co." columnation "Baker-Perkins Co." contamination "Baker-Perkins Co." curie "Baker-Perkins Co." "denitration" OR "denitration pot" "Baker-Perkins Co." derby OR regulus "Baker-Perkins Co." dose "Baker-Perkins Co." dosimeter "Baker-Perkins Co." dosimetric "Baker-Perkins Co." dosimetry "Baker-Perkins Co." electron "Baker-Perkins Co." environment "Baker-Perkins Co." "Ether-Water Project" "Baker-Perkins Co." exposure OR "exposure investigation" OR "radiation exposure" "Baker-Perkins Co." external "Baker-Perkins Co." "F machine" "Baker-Perkins Co." fecal "Baker-Perkins Co." "feed material" "Baker-Perkins Co." femptocurie		

Table A1-2: Database Searches for Baker-Perkins Company			
Database/Source	**Keywords**	**Hits**	**Uploaded into SRDB**
	"Baker-Perkins Co." film "Baker-Perkins Co." fission "Baker-Perkins Co." fluoroscopy "Baker-Perkins Co." "Formerly Utilized Sites Remedial Action Program" OR FUSRAP "Baker-Perkins Co." gamma-ray "Baker-Perkins Co." "gas proportional" "Baker-Perkins Co." "gaseous diffusion" "Baker-Perkins Co." health OR "health instrument" OR "health physics" OR H.I. OR HI OR HP "Baker-Perkins Co." highly enriched uranium" OR HEU "Baker-Perkins Co." hydrofluorination "Baker-Perkins Co." "in vitro" "Baker-Perkins Co." "in vivo" "Baker-Perkins Co." incident "Baker-Perkins Co." ingestion "Baker-Perkins Co." inhalation "Baker-Perkins Co." internal "Baker-Perkins Co." investigation "Baker-Perkins Co." isotope "Baker-Perkins Co." isotopic "Baker-Perkins Co." "isotopic enrichment" "Baker-Perkins Co." "JS Project" "Baker-Perkins Co." Landauer "Baker-Perkins Co." "liquid scintillation" "Baker-Perkins Co." log OR "log sheet" OR "log book" "Baker-Perkins Co." "low enriched uranium" OR LEU "Baker-Perkins Co." "maximum permissible concentration" OR MPC "Baker-Perkins Co." metallurgy "Baker-Perkins Co." microcurie "Baker-Perkins Co." millicurie "Baker-Perkins Co." "mixed fission product" OR MFP "Baker-Perkins Co." monitor OR "air monitoring" "Baker-Perkins Co." nanocurie		

Table A1-2: Database Searches for Baker-Perkins Company			
Database/Source	**Keywords**	**Hits**	**Uploaded into SRDB**
	"Baker-Perkins Co." nanocurie "nasal wipe" "Baker-Perkins Co." neutron "Baker-Perkins Co." "nose wipe" "Baker-Perkins Co." nuclear OR "Chicago-Nuclear" OR "nuclear fuels" "Baker-Perkins Co." "nuclear track emulsion" OR "type A" OR NTA "Baker-Perkins Co." "occupational radiation exposure" "Baker-Perkins Co." occurrence "Baker-Perkins Co." "ore concentrate" "Baker-Perkins Co." "PC Project" "Baker-Perkins Co." permit OR "radiation work permit" OR "safe work permit" OR "special work permit" OR RWP OR SWP "Baker-Perkins Co." "phosphate research" "Baker-Perkins Co." photon "Baker-Perkins Co." picocurie "Baker-Perkins Co." pitchblende "Baker-Perkins Co." "pocket ion chamber" OR PIC "Baker-Perkins Co." problem "Baker-Perkins Co." procedure "Baker-Perkins Co." radeco "Baker-Perkins Co." radiation "Baker-Perkins Co." radioactive "Baker-Perkins Co." radioactivity "Baker-Perkins Co." radiograph "Baker-Perkins Co." radiological "Baker-Perkins Co." "Radiological Survey Data Sheet" OR RSDS "Baker-Perkins Co." radionuclide "Baker-Perkins Co." raffinate "Baker-Perkins Co." reactor "Baker-Perkins Co." respiratory "Baker-Perkins Co." "retention schedules" "Baker-Perkins Co." roentgen "Baker-Perkins Co." sample OR "air sample" OR "dust sample" OR "general area air sample"		

Table A1-2: Database Searches for Baker-Perkins Company			
Database/Source	**Keywords**	**Hits**	**Uploaded into SRDB**
	"Baker-Perkins Co." sampling OR "air sampling" OR "dust sampling" OR "general area air sampling" "Baker-Perkins Co." "solvent extraction" "Baker-Perkins Co." source OR "sealed source" "Baker-Perkins Co." spectra "Baker-Perkins Co." spectrograph "Baker-Perkins Co." spectroscopy "Baker-Perkins Co." spectrum "Baker-Perkins Co." standard OR "operating standard" OR "processing standard" "Baker-Perkins Co." survey "building survey" OR "routine survey" OR "special survey" "Baker-Perkins Co." "technical basis" "Baker-Perkins Co." "thermal diffusion" "Baker-Perkins Co." "thermoluminescent dosimeter" OR TLD "Baker-Perkins Co." "Tiger Team" "Baker-Perkins Co." "tolerance dose" "Baker-Perkins Co." urinalysis "Baker-Perkins Co." urine "Baker-Perkins Co." "whole body count" OR WBC "Baker-Perkins Co." "working level" OR WL "Baker-Perkins Co." "X-ray" OR "X ray" OR Xray "Baker-Perkins Co." americium OR Am241 OR Am-241 OR "AM 241" OR 241Am OR 241-Am OR "241 Am" "Baker-Perkins Co." ionium OR Th230 OR Th-230 OR "Th 230" OR 230Th OR 230-Th OR "230 Th" "Baker-Perkins Co." neptunium OR Np237 OR Np-237 OR "Np 237" OR 237Np OR 237-Np OR "237 Np" "Baker-Perkins Co." polonium OR Po210 OR Po-210 OR "Po 210" OR 210Po OR 210-Po OR "210 Po" "Baker-Perkins Co." 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" OR ionium OR UX1 OR UX2		

Table A1-2: Database Searches for Baker-Perkins Company			
Database/Source	**Keywords**	**Hits**	**Uploaded into SRDB**
	"Baker-Perkins Co." 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" "Baker-Perkins Co." tritium OR H3 OR H-3 OR mint OR HTO "Baker-Perkins Co." 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" OR U235 OR "U 235" OR U-235 OR 235-U "Baker-Perkins Co." 235U OR "235 U" OR U238 OR "U 238" OR U-238 OR 238-U OR 238U OR "238 U" OR U308 OR "U 308" OR U-308 OR 308-U OR 308U OR 308 U OR "uranium extraction" "Baker-Perkins Co." "black oxide" OR "brown oxide" OR "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 "Baker-Perkins Co." 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" "Baker-Perkins Co." 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" "Baker-Perkins Co." radium OR Ra-226 OR Ra226 OR Ra 226 OR 226-Ra OR 226Ra OR 226-Ra OR Ra-228 OR Ra228 OR Ra 228 OR 228Ra OR 228-Ra OR 228 Ra "Baker-Perkins Co." radon OR Rn-222 OR Rn222 OR Rn 222 OR 222Rn OR 222-Rn OR 222 Rn "Baker-Perkins Co." thoron OR Rn-220 OR Rn220 OR "Rn 220" OR 220Rn OR 220-Rn OR "220 Rn" "Baker-Perkins Co." protactinium OR Pa-234m OR Pa234m OR "Pa 234m" OR 234mPa OR 234m-Pa OR "234m Pa" "Baker-Perkins Co." strontium OR Sr-90 OR Sr90 OR "Sr 90" OR 90-Sr OR 90Sr OR "90 Sr" "APV Chemical Company" "APV Chemical Company" oralloy "APV Chemical Company" postum		

Table A1-2: Database Searches for Baker-Perkins Company			
Database/Source	**Keywords**	**Hits**	**Uploaded into SRDB**
	"APV Chemical Company" tuballoy "APV Chemical Company" "uranyl nitrate hexahydrate" OR UNH "APV Chemical Company" "K-65" "APV Chemical Company" "sump cake" "APV Chemical Company" "uranium dioxide" "APV Chemical Company" "uranium tetrafluoride" "APV Chemical Company" "uranium trioxide" "APV Chemical Company" "uranium hexafluoride" "APV Chemical Company" accident "APV Chemical Company" "air count" "APV Chemical Company" "air dust" "APV Chemical Company" "air filter" "APV Chemical Company" "airborne test" "APV Chemical Company" alpha "APV Chemical Company" "belgian congo ore" "APV Chemical Company" bioassay OR bio-assay "APV Chemical Company" breath OR "breathing zone" OR BZ "APV Chemical Company" calibration "APV Chemical Company" columnation "APV Chemical Company" contamination "APV Chemical Company" curie "APV Chemical Company" "denitration" OR "denitration pot" "APV Chemical Company" derby OR regulus "APV Chemical Company" dose "APV Chemical Company" dosimeter "APV Chemical Company" dosimetric "APV Chemical Company" dosimetry "APV Chemical Company" electron "APV Chemical Company" environment "APV Chemical Company" "Ether-Water Project" "APV Chemical Company" exposure OR "exposure investigation" OR "radiation exposure" "APV Chemical Company" external "APV Chemical Company" "F machine"		

Table A1-2: Database Searches for Baker-Perkins Company			
Database/Source	**Keywords**	**Hits**	**Uploaded into SRDB**
	"APV Chemical Company" fecal "APV Chemical Company" "feed material" "APV Chemical Company" femptocurie "APV Chemical Company" film "APV Chemical Company" fission "APV Chemical Company" fluoroscopy "APV Chemical Company" "Formerly Utilized Sites Remedial Action Program" OR FUSRAP "APV Chemical Company" gamma-ray "APV Chemical Company" "gas proportional" "APV Chemical Company" "gaseous diffusion" "APV Chemical Company" health OR "health instrument" OR "health physics" OR H.I. OR HI OR HP "APV Chemical Company" highly enriched uranium" OR HEU "APV Chemical Company" hydrofluorination "APV Chemical Company" "in vitro" "APV Chemical Company" "in vivo" "APV Chemical Company" incident "APV Chemical Company" ingestion "APV Chemical Company" inhalation "APV Chemical Company" internal "APV Chemical Company" investigation "APV Chemical Company" isotope "APV Chemical Company" isotopic "APV Chemical Company" "isotopic enrichment" "APV Chemical Company" "JS Project" "APV Chemical Company" Landauer "APV Chemical Company" "liquid scintillation" "APV Chemical Company" log OR "log sheet" OR "log book" "APV Chemical Company" "low enriched uranium" OR LEU "APV Chemical Company" "maximum permissible concentration" OR MPC "APV Chemical Company" metallurgy "APV Chemical Company" microcurie		

Table A1-2: Database Searches for Baker-Perkins Company			
Database/Source	**Keywords**	**Hits**	**Uploaded into SRDB**
	"APV Chemical Company" millicurie "APV Chemical Company" "mixed fission product" OR MFP "APV Chemical Company" monitor OR "air monitoring" "APV Chemical Company" nanocurie "APV Chemical Company" nanocurie "nasal wipe" "APV Chemical Company" neutron "APV Chemical Company" "nose wipe" "APV Chemical Company" nuclear OR "Chicago-Nuclear" OR "nuclear fuels" "APV Chemical Company" "nuclear track emulsion" OR "type A" OR NTA "APV Chemical Company" "occupational radiation exposure" "APV Chemical Company" occurrence "APV Chemical Company" "ore concentrate" "APV Chemical Company" "PC Project" "APV Chemical Company" permit OR "radiation work permit" OR "safe work permit" OR "special work permit" OR RWP OR SWP "APV Chemical Company" "phosphate research" "APV Chemical Company" photon "APV Chemical Company" picocurie "APV Chemical Company" pitchblende "APV Chemical Company" "pocket ion chamber" OR PIC "APV Chemical Company" problem "APV Chemical Company" procedure "APV Chemical Company" radeco "APV Chemical Company" radiation "APV Chemical Company" radioactive "APV Chemical Company" radioactivity "APV Chemical Company" radiograph "APV Chemical Company" radiological "APV Chemical Company" "Radiological Survey Data Sheet" OR RSDS "APV Chemical Company" radionuclide "APV Chemical Company" raffinate		

Table A1-2: Database Searches for Baker-Perkins Company			
Database/Source	**Keywords**	**Hits**	**Uploaded into SRDB**
	"APV Chemical Company" reactor "APV Chemical Company" respiratory "APV Chemical Company" "retention schedules" "APV Chemical Company" roentgen "APV Chemical Company" sample OR "air sample" OR "dust sample" OR "general area air sample" "APV Chemical Company" sampling OR "air sampling" OR "dust sampling" OR "general area air sampling" "APV Chemical Company" "solvent extraction" "APV Chemical Company" source OR "sealed source" "APV Chemical Company" spectra "APV Chemical Company" spectrograph "APV Chemical Company" spectroscopy "APV Chemical Company" spectrum "APV Chemical Company" standard OR "operating standard" OR "processing standard" "APV Chemical Company" "building survey" OR "routine survey" OR "special survey" "APV Chemical Company" "technical basis" "APV Chemical Company" "thermal diffusion" "APV Chemical Company" "thermoluminescent dosimeter" OR TLD "APV Chemical Company" "Tiger Team" "APV Chemical Company" "tolerance dose" "APV Chemical Company" urinalysis "APV Chemical Company" urine "APV Chemical Company" "whole body count" OR WBC "APV Chemical Company" "working level" OR WL "APV Chemical Company" "X-ray" OR "X ray" OR Xray "APV Chemical Company" americium OR Am241 OR Am-241 OR "AM 241" OR 241Am OR 241-Am OR "241 Am" "APV Chemical Company" ionium OR Th230 OR Th-230 OR "Th 230" OR 230Th OR 230-Th OR "230 Th" "APV Chemical Company" neptunium OR Np237 OR Np-237 OR "Np 237" OR 237Np OR 237-Np OR "237 Np"		

Table A1-2: Database Searches for Baker-Perkins Company			
Database/Source	**Keywords**	**Hits**	**Uploaded into SRDB**
	"APV Chemical Company" polonium OR Po210 OR Po-210 OR "Po 210" OR 210Po OR 210-Po OR "210 Po" "APV Chemical Company" 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" OR ionium OR UX1 OR UX2 "APV Chemical Company" 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" "APV Chemical Company" tritium OR H3 OR H-3 OR mint OR HTO "APV Chemical Company" 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" OR U235 OR "U 235" OR U-235 OR 235-U "APV Chemical Company" 235U OR "235 U" OR U238 OR "U 238" OR U-238 OR 238-U OR 238U OR "238 U" OR U308 OR "U 308" OR U-308 OR 308-U OR 308U OR 308 U OR "uranium extraction" "APV Chemical Company" "black oxide" OR "brown oxide" OR "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 "APV Chemical Company" 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" "APV Chemical Company" 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" "APV Chemical Company" radium OR Ra-226 OR Ra226 OR Ra 226 OR 226-Ra OR 226Ra OR 226-Ra OR Ra-228 OR Ra228 OR Ra 228 OR 228Ra OR 228-Ra OR 228 Ra "APV Chemical Company" radon OR Rn-222 OR Rn222 OR Rn 222 OR 222Rn OR 222-Rn OR 222 Rn "APV Chemical Company" thoron OR Rn-220 OR Rn220 OR "Rn 220" OR 220Rn OR 220-Rn OR "220 Rn" "APV Chemical Company" protactinium OR Pa-234m OR Pa234m OR "Pa 234m" OR 234mPa OR 234m-Pa OR "234m Pa"		

Table A1-2: Database Searches for Baker-Perkins Company			
Database/Source	**Keywords**	**Hits**	**Uploaded into SRDB**
	"APV Chemical Company" strontium OR Sr-90 OR Sr90 OR "Sr 90" OR 90-Sr OR 90Sr OR "90 Sr" "B & P Process Equipment" "Baker-Perkins Group"		
National Academies Press http://www.nap.edu/ COMPLETED 04/08/2009	"Baker Perkins" in any field "APV Chemical Company" in any field "B & P Process Equipment" "Baker-Perkins Group"	0	0
NRC ADAMS Reading Room http://www.nrc.gov/reading-rm/adams/web-based.html COMPLETED 04/08/2009	"Baker Perkins" in any field "APV Chemical Company" in any field "B & P Process Equipment" "Baker-Perkins Group"	2	1
U.S. Transuranium & Uranium Registries http://www.ustur.wsu.edu/ COMPLETED 04/08/2009	"Baker Perkins" in any field "APV Chemical Company" in any field "B & P Process Equipment" "Baker-Perkins Group"	0	0
NNSA - Nevada Site Office www.nv.doe.gov/main/search.htm COMPLETED 04/22/2009	"Baker-Perkins Group" "B & P Process Equipment" "APV Chemical" "Baker Perkins"	0	0

Table A1-3: OSTI Documents Ordered for Baker-Perkins Company			
Document Number	**Document Title**	**Requested Data**	**Date Received**
No documents ordered	N/A	N/A	N/A

Table A1-4: Cincinnati Public Library Baker-Perkins Company Documents Ordered			
Document Number	**Document Title**	**Requested Data**	**Date Received**
N/A	An Introduction to Baker-Perkins Inc., Saginaw, Michigan, 1960s	12/18/2008	Only available from Saginaw Public Library-in library use only