

SEC Petition Evaluation Report Petition SEC-00129

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Petition Administrative Summary

Petition Under Evaluation

Petition #	Petition Type	Petition Qualification Date	DOE/AWE Facility Name
SEC-00129	83.13	November 6, 2008	Standard Oil Development Company

Petitioner Class Definition

All employees of Standard Oil Development Company in Linden, New Jersey, during the period from August 13, 1942 through December 31, 1963, who were monitored, or should have been monitored, for exposure to ionizing radiation while working for a number of work days aggregating at least 250 work days, 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 Special Exposure Cohort.

Class Evaluated by NIOSH

All AWE employees who worked in any area of the Standard Oil Development Company site in Linden, New Jersey, during the period from August 13, 1942 through December 31, 1945.

NIOSH-Proposed Class to be Added to the SEC

All AWE employees of the Standard Oil Development Company in Linden, New Jersey, during the period from August 13, 1942 through December 31, 1945, while working for a number of work days aggregating at least 250 work days, 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 Special Exposure Cohort.

Related Petition Summary Information

SEC Petition Tracking #(s)	Petition Type	DOE/AWE Facility Name	Petition Status
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Related Evaluation Report Information

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Evaluation Report Summary: SEC-00129, Standard Oil Development 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-00129, qualified on November 6, 2008, requested that NIOSH consider the following class: *All employees of Standard Oil Development Company in Linden, New Jersey during the period from August 13, 1942 through December 31, 1963, who were monitored, or should have been monitored, for exposure to ionizing radiation while working for a number of work days aggregating at least 250 work days, 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 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 worked in any area of the Standard Oil Development Company site in Linden, New Jersey during the period from August 13, 1942 through December 31, 1945.* The petitioner-requested class was reduced because there is uncertainty as to the length of the residual contamination period which warrants further research. Currently, there is only one individual dose reconstruction claimant for this site who is covered by the operational period evaluated. Therefore, the review of the residual radioactivity period (currently defined by the DOE Office of Health, Safety and Security as starting in 1946 and ending July 2006), including the dose reconstruction feasibility and health endangerment determinations, has been reserved in this evaluation report, pending further review and research. NIOSH will prioritize the evaluation of the residual radioactivity period upon clarification of the duration of this period and upon the receipt of individual claims submitted for individual dose reconstruction for the residual period. The decision to reserve the residual contamination period does not currently impact any claims.

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 AWE employees of the Standard Oil Development Company in Linden, New Jersey during the period from August 13, 1942 through December 31, 1945, while working for a number of work days aggregating at least 250 work days, 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 Special Exposure Cohort.*

Feasibility of Dose Reconstruction

Per EEOICPA and 42 C.F.R. § 83.13(c)(1), NIOSH has established that it does not have 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 not sufficient to document or estimate the maximum internal and external potential exposure to members of the proposed 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 required because NIOSH has determined that it does not have sufficient information to estimate dose for the members of the proposed class from August 13, 1942 through December 31, 1945.

NIOSH did not identify any evidence supplied by the petitioners 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, beta, and neutron 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 their employment or in combination with work days within the parameters established for other SEC classes (excluding aggregate work day requirements).

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SEC Petition Evaluation Report for SEC-00129

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: Mike Domal, MJW Corporation. 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 worked in any area of the Standard Oil Development Company site in Linden, New Jersey during the period from August 13, 1942 through December 31, 1945. 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 members of a class when it has been established that the class may have been exposed to radiation

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>.

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-00129, Standard Oil Development Company Class Definitions

The following subsections address the evolution of the class definition for SEC-00129, Standard Oil Development 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-00129, qualified on November 6, 2008, requested that NIOSH consider the following class for addition to the SEC: *all employees of Standard Oil Development Company in Linden, New Jersey during the period from August 13, 1942 through December 31, 1963, who were monitored, or should have been monitored, for exposure to ionizing radiation while working for a number of work days aggregating at least 250 work days, 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 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 Standard Oil Development Company

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>.

workers in question. NIOSH deemed the following information and affidavit statements sufficient to qualify SEC-00129 for evaluation:

The F.2 basis: Radiation monitoring records for members of the proposed class have been lost, falsified, or destroyed; or that there is no information regarding personnel or area monitoring, source term, or process information from the Standard Oil Development Company that would permit dose reconstruction with sufficient accuracy.

“...There is [sic] no personnel dosimetry data, there are no operating logs, no incident reports, and I am unaware of even any technical reports documenting the AEC sponsored uranium processing that occurred during the 1940s.”

“A defensible dose reconstruction cannot be completed. Conditions of incidents which could have resulted in significant dose are long forgotten and not recorded.”

Based on its Standard Oil Development Company research and data capture efforts, NIOSH determined that personnel exposure records and radiological monitoring records are not complete for all time periods or for all radionuclides. NIOSH concluded that there is sufficient documentation to support, for at least part of the proposed time period, the petition basis that internal and external radiation exposures and radiation doses were not adequately monitored at Standard Oil Development 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 to include only the operational period. The petitioner-requested class was reduced because there is uncertainty as to the length of the residual contamination period which warrants further research. Currently, there is only one individual dose reconstruction claimant for this site who is covered by the operational period evaluated. Based on this information, NIOSH is reserving the evaluation of the residual radioactivity period pending further review and research. Therefore, NIOSH defined the following class for further evaluation: all AWE employees who worked in any area of the Standard Oil Development Company site in Linden, New Jersey during the period from August 13, 1942 through December 31, 1945.

NIOSH will prioritize the evaluation of the residual radioactivity period upon clarification of the duration of this period and upon the receipt of individual claims submitted for individual dose reconstruction for the residual period. The decision to reserve the residual contamination period does not currently affect any claims.

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 AWE employees of the Standard Oil Development Company in Linden, New Jersey during the period from August 13, 1942 through December 31, 1945, while working for a number of work days aggregating at least 250 work days, 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 Special Exposure Cohort.

4.0 Data Sources Reviewed by NIOSH to Evaluate the Class

NIOSH data capture efforts for the Standard Oil Development Company (SODC) site focused on DOE databases, the NRC, and the Internet. Attachment 1 contains a summary of Standard Oil Development Company documents. The summary 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. As part of NIOSH's evaluation detailed herein, it examined the following site profile for insight into Standard Oil Development Company operations or related topics/operations at other sites:

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

4.2 ORAU Technical Information Bulletins (OTIBs)

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

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

4.3 Facility Employees and Experts

NIOSH was not successful in identifying any former SODC employees to interview for this evaluation report.

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 February 10, 2009)

Table 4-1: No. of SODC Claims Submitted Under the Dose Reconstruction Rule	
Description	Totals
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 (August 13, 1942 through December 31, 1945)	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

One claim was submitted and a dose reconstruction for that claim was completed. No personal dosimetry data or radiological monitoring records were provided or available for that claim. Dose estimations were based on Battelle-TBD-6001.

4.5 NIOSH Site Research Database

NIOSH also examined its Site Research Database (SRDB) to locate documents supporting the evaluation of the proposed class. Twenty-seven documents in this database were identified as pertaining to site name. These documents were evaluated for their relevance to this petition. The documents include MED contract descriptions, descriptions of contracted activities and processes, and discussion of dismantling and decontamination plans. They also included an inventory of stored material to be shipped and discussion of consulting activities.

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 [Survivor] with Supporting Documents*; September 9, 2008; OSA Ref ID: 106905
- *Clarification Regarding SEC-00129*, correspondence; October 17, 2008; OSA Ref ID: 107172
- *Presentation Contesting DOL's Recommended Decision*, February 19, 2009; OSA Ref ID: 108277

5.0 Radiological Operations Relevant to the Class Evaluated by NIOSH

The following subsections summarize both radiological operations at Standard Oil Development Company from August 13, 1942 through December 31, 1945 and the information available to NIOSH to characterize particular processes and radioactive source materials. From available sources NIOSH has gathered limited information regarding the processes performed and source term at the site during the operational period. The information included within this evaluation report is intended only to be a summary of the available information. As previously discussed, NIOSH's review and evaluation of the post-operational period (after December 31, 1945) is reserved. Therefore, only the radiological operations performed during the operational period, as defined by the DOE Office of Health, Safety and Security, will be reviewed throughout this report.

5.1 Standard Oil Development Company Plant and Process Descriptions

NIOSH has found little documentation that provides detailed process and operational information for the operations period from August 13, 1942 through December 31, 1945. Most information available regarding MED activities were based on documentation that contains SODC contracts information (FUSRAP, 1991). This contract information suggests that beginning in the early 1940s, SODC was involved in procurement activities and work for the MED. The procurement activities for the MED involved both procurement and coordination of uranium supplies for other sites, not for SODC. SODC was also involved in the development of uranium metal through a chemical reduction process using uranium chloride and sodium and several other research and development activities involving various uranium compounds (FUSRAP, 1991).

During the same period, SODC was involved in studies on the use of gaseous centrifuges for uranium enrichment. SODC was contracted to develop and operate a gaseous centrifuge pilot plant (FUSRAP, 1991). By end of the operational period, the centrifuge pilot plant was dismantled and stored on a part of SODC leased by the Office of Scientific Development and Research (FUSRAP, 1993).

Limited information regarding the amount of source material stored onsite and used during SODC's operational period is available. Documentation from Atlanta National Archives and Records Administration and some memos indicate that several hundred pounds of uranium trioxide (UO₃) and uranium hexafluoride (UF₆) were shipped to "Bayway" and the "ESSO Lab" in 1942, 1943, and 1944.

An inventory of material stored onsite after the end of the Office of Scientific Research and Development (OSRD)/MED operations, which was to be removed in 1949, included 475 pounds of UO_3 in 75-pound containers, approximately 1,100 pounds of uranium in process solution, and 3 steel drums of dilute uranium waste solutions (FUSRAP, 1991; Erickson, 1949). As stated in the memo, the 475 pounds of UO_3 was still packaged and was never opened (Erickson 1949).

SODC had two areas where radiological work was conducted, the Bayway Facility and the Linden Laboratory. The Centrifuge Pilot Plant was built at the Bayway Facility, but it is uncertain where the uranium reduction work occurred. An accurate layout or description of the affected areas of the facilities was not located, and documentation suggests that the original structures where radiological work took place no longer exist (Berger, 1990; FUSRAP, 1991).

5.2 Radiological Exposure Sources from SODC Operations

The following subsections provide an overview of the internal and external exposure sources for the SODC class under evaluation.

5.2.1 Internal Radiological Exposure Sources from SODC Operations

Based on the descriptions of the operations performed at SODC in the pre-1946 timeframe, there is a potential for personnel internal exposures from OSRD/MED operations at the site during the period from August 13, 1942 through December 31, 1945. Contracts suggest that beginning in the early 1940s, SODC was involved in uranium reduction development to produce metallic uranium (Kraus, 1942) as well as research and development with other uranium compounds. SODC was also involved in the study and development of uranium enrichment using gaseous centrifuges. In addition, SODC built and operated a gaseous centrifuge pilot plant. The timeframe for internal exposures during site operations is from August 13, 1942 through December 31, 1945, which is the timeframe when gaseous centrifuge activities and uranium reduction work took place (DOE, 1997; Young, 1987).

Internal exposures to uranium during the operational time period (August 13, 1942 through December 31, 1945), the time in which gaseous centrifuge activities and uranium reduction work took place, were likely. During these activities, uranium compounds could have become airborne. The extent of airborne concentrations would have depended on many factors, including the volatility of the uranium compounds, the physical processes that could cause airborne constituents, and the engineering controls such as containment of the compounds, ventilation flows, and filtration. The most likely mode of internal contamination from these processes was inhalation, and to a lesser extent ingestion (Battelle-TBD-6001). Uranium is an internal exposure hazard because of its decay mechanism (alpha) and the fact that it can remain in the body for a long period of time. Because of the operational timeframe, recycled uranium would not have been present. However, since enrichment operations took place, depleted, natural, and enriched uranium were present (Smyth, 1945 p.101).

5.2.2 External Radiological Exposure Sources from SODC Operations

External exposures from uranium were likely from both uranium-235 separation/enrichment activities as part of the gaseous centrifuge research and pilot plant activities and development/research with various uranium compounds. Due to its decay properties, uranium is an external exposure hazard that can result in photon, beta, and neutron exposures. The relative uranium isotopic mixtures, methods used to contain the uranium, and the quantities involved are key parameters in determining the extent of the external radiological hazards. The timeframe for external exposures from site operations is from August 13, 1942 through December 31, 1945, the times in which known gaseous centrifuge activities and uranium reduction work took place (Young, 1987). Based on the operations that took place, exposure to depleted, natural, and enriched uranium was possible.

5.2.2.1 Photon

Photon exposure from natural, depleted, and enriched uranium was likely during the operational period from equipment, materials, and contamination. Depending on the level of uranium progeny present in the uranium compounds, the external hazard from photon emissions can be from low-energy X-rays of approximately 13 keV to higher energy bremsstrahlung photons in the range of 30-250 keV (Battelle-TBD-6001). The low-energy X-rays originate from uranium-238 decay and the higher energy bremsstrahlung photons occur from interactions with the 2.28 MeV beta from the decay of protactinium-234 metastable (Battelle-TBD-6001). The gaseous centrifuge separation processes involved natural, depleted, and enriched uranium while the research and development work with uranium compounds and the uranium reduction processes were expected to have involved natural uranium. Uranium-235 presence is determined by the level of enrichment. It decays with the emission of several photons, the most prevalent (54%) having an energy of 0.186 keV (Battelle-TBD-6001). Documentation describing the source terms and quantities for the operational period is incomplete.

5.2.2.2 Beta

Exposure from beta radiation is primarily due to the decay of protactinium-234 metastable from uranium progeny. The degree of uranium progeny ingrowth would determine the magnitude of the potential hazard. The 2.28 MeV beta energies possess an external shallow dose hazard because of the penetrating ability of the beta particle (Battelle-TBD-6001). This beta source was present during the operational period.

5.2.2.3 Neutron

Incidental exposure to neutron radiation from uranium operations (spontaneous fission and alpha-neutron reactions with uranium) was possible during the operational period. Natural, depleted, and enriched uranium were present from the gaseous centrifuge operations.

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

No internal or external personal monitoring data, surveys, or area radiological monitoring at SODC are available for the operational period being evaluated in this report. NIOSH does not believe it has access to area monitoring or sufficient source term information that would sufficiently represent the radiological conditions that were present during the operations period at SODC.

Although medical X-ray data were unavailable during the operations period timeframe, NIOSH does believe it has sufficient information regarding medical monitoring programs across the OSRD/MED complex, as defined in ORAUT-OTIB-0006 that would apply to the SODC operational personnel.

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 assure that NIOSH can estimate either the maximum doses that members of the class might have incurred, or more precise quantities that reflect the variability of exposures experienced by groups or individual members of the class as summarized in Section 7.6. This approach is discussed in 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-00129 as submitted by the petitioner. (Section 7.4)

7.1 Pedigree of SODC 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 and External Monitoring Data Pedigree Review

NIOSH has not identified any radiological monitoring data (personnel internal dosimetry data/records, radiological surveys, or area monitoring data) to support bounding (reconstructing with sufficient accuracy) the internal or external dose during the operational period at SODC. Thus, an internal and external data pedigree review is not possible for the operational period (August 13, 1942 through December 31, 1945).

7.2 Evaluation of Bounding Internal Radiation Doses at SODC

The principal source of internal radiation dose for members of the class under evaluation was airborne uranium. During the operational period, internal exposure was possible from airborne activity generated from operations as well as from re-suspended contamination. Operational activities included the study and development of uranium enrichment using gaseous centrifuges, operating a gaseous centrifuge pilot plant, and development/research of various uranium compounds.

7.2.1 Evaluation of Bounding Process-Related Internal Doses

NIOSH has not identified any SODC internal radiological exposure monitoring data for the operational period. Some of the activities at SODC included the study, development and operation of a uranium enrichment gaseous centrifuges and research and development of various uranium compounds. The gaseous centrifuge process for enriching uranium was built and operated at SODC. This was a unique project for which there were no operational logs, descriptions of activities, or any corresponding radiological data. The source terms and radiological exposure scenarios are not known, and due to the unique nature of the pilot plant activities, it is not possible to use or develop adequate surrogate radiological data. There is insufficient SODC information or documentation to support correlating or comparing the SODC operations and exposure scenarios for the purpose of establishing internal bounding dose assessments for the operational period at SODC. NIOSH has therefore determined that internal doses at SODC cannot be bounded for the operational period (August 13, 1942 through December 31, 1945).

7.2.2 Internal Dose Reconstruction Feasibility Conclusion

Based on the unique nature of the gaseous centrifuge pilot plant activities and the lack of SODC information for the operational period, NIOSH has determined that it is not feasible to bound the internal dose (reconstruct the internal dose with sufficient accuracy) during the SODC operational period.

7.3 Evaluation of Bounding External Radiation Doses at SODC

The principal source of external radiation doses for members of the proposed class was exposure to uranium compounds (Battelle-TBD-6001). During the operational period, external exposures could have resulted from radioactive equipment and materials, surface contamination, and submersion in airborne activity generated from operations and from re-suspended contamination.

7.3.1 Evaluation of Bounding Process-Related External Doses

NIOSH has not identified any SODC external radiological monitoring data for the operational period. Some of the activities at SODC included the study, development and operation of a uranium enrichment gaseous centrifuges and research and development of various uranium compounds. The gaseous centrifuge process for enriching uranium was built and operated at SODC. This was a unique project for which there were no operational logs, descriptions of activities, or any corresponding radiological data. The source terms and radiological exposure scenarios are not known, and due to the unique nature of the pilot plant activities, it is not possible to use or develop adequate surrogate radiological data. There is insufficient SODC information or documentation to support correlating or comparing the SODC operations and exposure scenarios for the purpose of establishing external bounding dose assessments for the operational period at SODC. NIOSH has therefore determined that external doses at SODC cannot be bound for the operational period (August 13, 1942 through December 31, 1945).

7.3.2 Evaluation of Bounding Operational-Period Medical X-Rays

Occupational X-ray examinations were assumed to occur on an annual basis during the operational period as described in Battelle-TBD-6001 and ORAUT-OTIB-0006. SODC exposures from medical X-rays can be bound from August 13, 1942 through December 31, 1945, as assessed in the available documentation.

7.3.3 External Dose Reconstruction Feasibility Conclusion

Based on the lack of SODC information for the operational period and the unique nature of the gaseous centrifuge pilot plant activities, with the exception of medical X-rays, NIOSH has determined that it is not feasible to bound the external dose (reconstruct the external dose with sufficient accuracy) during the SODC operational period.

7.4 Evaluation of Petition Basis for SEC-00129

The following subsections evaluate the assertions made on behalf of petition SEC-00129 for SODC.

7.4.1 Insufficient documentation

SEC-00129: *There is [sic] no personnel dosimetry data, there are no operating logs, no incident reports, and I am unaware of even any technical reports documenting the AEC sponsored uranium processing that occurred during the 1940's.*

NIOSH Response: As evaluated in this report, NIOSH believes that there is insufficient documentation to support bounding the dose (reconstructing dose with sufficient accuracy) for the operational period at SODC, which covers both MED and any non-MED radiological work.

7.4.2 Concern regarding Battelle-TBD-6001

SEC-00129: The petitioner agrees with the findings of SC&A regarding Battelle-6001 and feels it is inadequate for performing dose reconstructions at SODC.

NIOSH Response: NIOSH has determined that Battelle-TBD-6001 is inadequate to support bounding the dose (reconstructing dose with sufficient accuracy) at SODC during the operational period.

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

During the feasibility evaluation for SEC-00129, a number of issues were identified that needed further analysis and resolution. The issues and their current status are:

- ISSUE: There is no site profile for SODC at this time.

RESPONSE: When available, site specific profiles are used to assist in determining doses during operational periods. Lacking specific information regarding the operations at the site, NIOSH has concluded in this evaluation that it is not feasible to bound doses (reconstruct dose with sufficient accuracy) during the operational period at SODC.

- ISSUE: There are no identified monitoring data at this time.

RESPONSE: No radiological monitoring data were found for SODC and NIOSH believes there is insufficient data to support bounding the dose (reconstructing dose with sufficient accuracy) for the operational period at SODC.

- ISSUE: Data Capture efforts need to be evaluated to determine if additional documents are available.

RESPONSE: No additional documents associated with radiological monitoring have been found. Only additional information regarding contracts and non-MED work were located. As previously discussed, the review of the residual radioactivity period for SODC is reserved by NIOSH pending additional research.

- **ISSUE:** Need to determine when the operational period stops.

RESPONSE: In 1945 the pilot plant was dismantled and decontaminated (FUSRAP, 1991). The operational period was determined to have ended on December 31, 1945, which agrees with the DOE Office of Health, Safety and Security defined operational period.

- **ISSUE:** Need to identify radiological work activities and define the affected area of the facility.

RESPONSE: Uranium reduction activities took place and a gaseous centrifuge pilot plant was built and partially operated. However, due to the lack of information, it is unclear if these activities are comprehensive and if other non-MED activities were occurring at the same time. The pilot plant was located at the Bayway Facility, but the location of other activities is not known (Young, 1987).

7.6 Summary of Feasibility Findings for Petition SEC-00129

This report evaluates the feasibility for completing dose reconstructions for employees at SODC from August 13, 1942 through December 31, 1945. Due to the lack of available radiological data, the uncertainty of radiological activities during the operational period, and the unique nature of the gaseous centrifuge pilot plant activities, NIOSH determined that it was infeasible to reconstruct doses from August 13, 1942 through December 31, 1945.

Table 7-1 summarizes the results of the feasibility findings at SODC for each exposure source during the time period August 13, 1942 through December 31, 1945.

Table 7-1: Summary of Feasibility Findings for SEC-00129		
<i>August 13, 1942 through December 31, 1945</i>		
Source of Exposure	Reconstruction Feasible	Reconstruction Not Feasible
Internal		X
- Uranium		X
External		X
- Gamma		X
- Beta		X
- Neutron		X
- Occupational Medical X-ray	X	

As of February 10, 2009, a total of one claim has been submitted to NIOSH for an individual who worked at SODC and was covered by the class definition evaluated in this report. Dose reconstructions have been completed for that individual (100%).

8.0 Evaluation of Health Endangerment for Petition SEC-00129

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.

NIOSH's evaluation determined that it is not feasible to estimate radiation dose for members of the NIOSH-evaluated class who worked during the operational period at SODC from August 13, 1942 through December 31, 1945, 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. NIOSH did not identify any evidence supplied by the petitioners 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, beta, and neutron 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 their employment or in combination with work days within the parameters established for other SEC classes (excluding aggregate work day requirements).

9.0 Class Conclusion for Petition SEC-00129

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 employees of the Standard Oil Development Company in Linden, New Jersey during the period from August 13, 1942 through December 31, 1945, who were monitored, or should have been monitored, for exposure to ionizing radiation while working for a number of work days aggregating at least 250 work days, 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 Special Exposure Cohort.

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-00129. 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.

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

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; Oak Ridge, Tennessee; December 21, 2005; SRDB Ref ID: 20220

Berger, 1990, *Visit to Potential Sites in Newark and Linden, New Jersey*, correspondence to James Wagoner II; James D. Berger, Oak Ridge Associated Universities (ORAU); February 12, 1990; SRDB Ref ID: 40953

DOE, 1997, *Select Pages of Linking Legacies*; Department of Energy (DOE); January 1997; SRDB Ref ID: 12005, pdf pp. 2-3

Erickson, 1949, *Disposition Instructions*, correspondence to Belmore; W. A. Erickson; January 18, 1949; SRDB Ref ID: 12005, pdf p. 59

Form B, 2008, *Petition Form B [Survivor] with Supporting Documents*; [Name1 Redacted]; September 9, 2008; OSA Ref ID: 106905

FUSRAP, 1991, *Standard Oil Development Company Profile*, FUSRAP; March 1991; SRDB Ref ID: 12005, pdf pp. 11-14

FUSRAP, 1993, *License History for Standard Oil Development Co. of NJ, Linden*; FUSRAP Considered Sites database; July 16, 1993; SRDB Ref ID: 12005, pdf pp. 7-8

Kraus, 1942, *Progress Report*; Charles A. Kraus; December 15, 1942; SRDB Ref ID: 12005, pdf pp. 18-27

Name1, 2008, *Clarification Regarding SEC-00129*, correspondence to OCAS; [Name1 Redacted]; October 17, 2008; OSA Ref ID: 107172

Name1, 2009, *Presentation Contesting DOL's Recommended Decision*, [Name1 Redacted]; February 19, 2009; OSA Ref ID: 108277

Smyth, 1945, *The Official Report on the Development of the Atomic Bomb Under the Auspices of the United States Government*; Henry De Wolf Smyth; July 1, 1945; SRDB Ref ID: 43344

Young, 1987, Status of Investigation of the Former Standard Oil Development Company Linden and Bayway, New Jersey; Charles D. Young; December 9, 1987; SRDB Ref ID: 12005, pdf pp. 55-58

Attachment 1: Data Capture Synopsis

Table A1-1: Data Capture Synopsis for Standard Oil Development Company			
Data Capture Information	Data Capture Description	Completed	Uploaded into SRDB
<p>Primary Site/Company Name: Standard Oil Development Co. of NJ, Linden, NJ (1942-1945). Residual radiation period 1946-July 2006.</p> <p>Other company names: Bayway Exxon Conoco Phillips</p>	<p>In 1973 Standard Oil Company of New Jersey was renamed Exxon and the facility became known as Exxon Bayway Refinery.</p> <p>In 1993 Tosco Corporation purchased the refinery from Exxon, Exxon Chemical continued to run the Chemical Plant.</p> <p>In 1999 Exxon-Mobil Corporation formed.</p> <p>In 2002 Tosco bought by Phillips Petroleum, which was merged with Conoco to form ConocoPhillips.</p> <p>Bayway refinery was operated by Standard Oil and successors.</p> <p>Jessica Nacheman (Exxon-Mobil Attorney) reviewed records and determined that no relevant documents exist in their holdings (05/29/2008).</p> <p>Paul Hamada (Conoco-Phillips Attorney) verified on 05/05/2008 that they have no related information.</p>	05/29/2008	0
<p>State Contacted: New Jersey, Department of Environment, Radiation Programs. Nancy Stanley, Radiation Health Physicist NJDEP Radiation Programs (609) 984-5452</p>	<p>Search of state holdings revealed no relevant records related to Standard Oil Development Company.</p>	02/01/2008	0
<p>Comprehensive Epidemiologic Data Resource (CEDR)</p>	<p>No relevant data identified.</p>	01/18/2008	0
<p>Department of Energy</p>	<p>No relevant data identified.</p>	01/18/2008	0
<p>Department of Health & Human Services</p>	<p>No relevant data identified.</p>	01/18/2008	0
<p>DOE Hanford Declassified Document Retrieval System (DDRS)</p>	<p>Hanford monthly reports.</p>	01/18/2008	4
<p>DOE Legacy Management Considered Sites</p>	<p>FUSRAP items including site summaries, site plot/plans, and information on the uranium chemical processing.</p>	01/12/2008	4
<p>DOE OpenNet</p>	<p>No relevant data identified.</p>	01/18/2008	0
<p>DOE OSTI Energy Citations</p>	<p>No relevant data identified.</p>	04/04/2008	0
<p>DOE OSTI Information Bridge</p>	<p>No relevant data identified.</p>	01/18/2008	0
<p>Google</p>	<p>General information on isotope separation at SODC, process operations at Standard Oil for the MED, historical information, and a description of the separation process using Gas Centrifuge at</p>	04/04/2008	9

Table A1-1: Data Capture Synopsis for Standard Oil Development Company			
Data Capture Information	Data Capture Description	Completed	Uploaded into SRDB
	Bayway Refinery and other laboratories.		
NARA Atlanta	General discussion on aspects of handling isotopes in the laboratory.	06/19/2008	8
National Academies Press (NAP)	No relevant data identified.	02/28/2008	0
National Archives	No relevant data identified.	01/18/2008	0
National Institute of Health (NIH)	No relevant data identified.	01/18/2008	0
National Nuclear Security Administration (NNSA) - Nevada Site Office	No relevant data identified.	01/18/2008	0
NRC Agencywide Document Access and Management (ADAMS)	NRC inspection reports, letters, and license information for a company that performed radiological work at the site.	01/18/2008	1
Washington State University (U.S. Transuranium and Uranium Registries)	No relevant data identified.	04/04/2008	0
Unknown	Database report.	N/A	1
Total			27

Table A1-2: Database Searches for Standard Oil Development Company			
Database/Source	Keywords	Hits	Uploaded into SRDB
DOE Legacy Management Considered Sites http://csd.gjo.doe.gov/ COMPLETED 01/12/2008	N/A State of New Jersey	9	4
NRC ADAMS Reading Room http://www.nrc.gov/reading-rm/adams/web-based.html COMPLETED 01/18/2008	Standard Oil, 01/01/1941-12/31/2006 ESSO, 01/01/1941-12/31/2006 Bayway, 01/01/1941-12/31/2006 Standard Oil Development, 01/01/1941-12/31/2006	180	1
DOE CEDR http://cedr.lbl.gov/ COMPLETED 01/18/2008	Standard Oil Development ESSO	0	0

Table A1-2: Database Searches for Standard Oil Development Company			
Database/Source	Keywords	Hits	Uploaded into SRDB
	Standard Oil Bayway		
DOE Hanford DDRS http://www2.hanford.gov/declass/ COMPLETED 01/18/2008	Standard Oil, 01/01/1941-12/31/2006 ESSO, 01/01/1941-12/31/2006 Standard Oil Development, 01/01/1941-12/31/2006 Bayway, 01/01/1941-12/31/2006	27	4
Department of Energy http://www.doe.gov/ COMPLETED 01/18/2008	Standard Oil Development Standard Oil +radiation ESSO +radiation Bayway +radiation	88	0
Department of Health & Human Services http://www.hss.gov/ COMPLETED 01/18/2008	"Standard Oil" +radiation "Standard Oil Development" +radiation "ESSO" +radiation "Bayway" +radiation	112	0
DOE OpenNet http://www.osti.gov/opennet/advancedsearch.jsp COMPLETED 01/18/2008	Standard Oil Development, 01/01/1941-12/31/1946 Standard Oil Development, 01/01/1941-12/31/2006 ESSO, 01/01/1941-12/31/2006 Bayway, 01/01/1941-12/31/2006 Standard Oil, 01/01/1941-12/31/2006	142	0
DOE OSTI Information Bridge	Standard Oil Development, 01/01/1941-12/31/2006	227	0

Table A1-2: Database Searches for Standard Oil Development Company			
Database/Source	Keywords	Hits	Uploaded into SRDB
http://www.osti.gov/bridge/advancedsearch.jsp COMPLETED 01/18/2008	ESSO, 01/01/1941-12/31/2006 Bayway, 01/01/1941-12/31/2006 Standard Oil, 01/01/1941-12/31/2006		
National Archives http://www.archives.gov/ COMPLETED 01/18/2008	"Standard Oil" +radiation "Standard Oil Development" +radiation "ESSO" +radiation "Bayway" +radiation	2	0
National Institute of Health http://www.nih.gov/ COMPLETED 01/18/2008	"Standard Oil" +radiation "Standard Oil Development" +radiation "ESSO" +radiation "Bayway" +radiation	5	0
NNSA - Nevada Site Office www.nv.doe.gov/main/search.htm COMPLETED 01/18/2008	Standard Oil ESSO Standard Oil Development Bayway	1	0
National Academies Press http://www.nap.edu/ COMPLETED 02/28/2008	Bayway	5	0
DOE OSTI Energy Citations http://www.osti.gov/energycitations/ COMPLETED 04/04/2008	"Standard Oil Development" Linden 01/01/1947-04/04/2008 Bayway Linden 01/01/1947-04/04/2008	122	0

Table A1-2: Database Searches for Standard Oil Development Company			
Database/Source	Keywords	Hits	Uploaded into SRDB
	ESSO Linden 01/01/1947-04/04/2008		
U.S. Transuranium & Uranium Registries http://www.ustur.wsu.edu/ COMPLETED 04/04/2008	Standard Oil OR ESSO OR Bayway	0	0
Google http://www.google.com COMPLETED 04/04/2008	"Standard Oil" +"Linden" +radiation +contamination "ESSO" +"Linden" +radiation +contamination "FUSRAP" +"Standard Oil" "RCRA" +"Standard Oil" +Linden +radiation "CERCLA" +"Standard Oil" +Linden +radiation "Standard Oil Development" +"Linden" +radiation "Bayway" +"Linden" +radiation +contamination FUSRAP +"Standard Oil Development" FUSRAP +"Standard Oil Development" FUSRAP +"Bayway" RCRA +"Standard Oil Development" RCRA +"ESSO" +Linden +Radioactive RCRA +"Bayway" +Linden +Radioactive CERCLA +"Standard Oil Development" CERCLA +"ESSO" +radioactive +contamination +Linden	5,700	9

Table A1-2: Database Searches for Standard Oil Development Company			
Database/Source	Keywords	Hits	Uploaded into SRDB
	CERCLA +"Bayway" +radioactive +contamination +Linden "Standard Oil Development" +uranium +Linden "New Jersey" OR Bayway OR americium -ORAU -NIOSH -EEOICPA -compensation New Jersey, Bayway Am241 -ORAU, -NIOSH, -EEOICPA, -compensation "New Jersey" OR Bayway OR AM-241 -ORAU -NIOSH -EEOICPA -compensation ** Without the following words (ORAU, NIOSH, EEOICPA, compensation) Am 241, Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation New Jersey, Bayway 241Am -ORAU, -NIOSH, -EEOICPA, -compensation 241 Am, Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation ionium, Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation Th230 , Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation Th-230, Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation Th 230, Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation		

Table A1-2: Database Searches for Standard Oil Development Company			
Database/Source	Keywords	Hits	Uploaded into SRDB
	New Jersey, Bayway Th230 Linden rad -ORAU, -NIOSH, -EEOICPA, -compensation -refinery		
	New Jersey, Bayway Th-230 -ORAU, -NIOSH, -EEOICPA, -refinery		
	230 Th, Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation		
	New Jersey, Bayway neptunium Linden -ORAU, -NIOSH, -EEOICPA, -compensation		
	New Jersey, Bayway Np237 -ORAU, -NIOSH, -EEOICPA, -compensation		
	New Jersey, Bayway Np-237 -ORAU, -NIOSH, -EEOICPA, -compensation		
	Np 237, Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation		
	237Np, Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation		
	New Jersey, Bayway Po210 -ORAU, -NIOSH, -EEOICPA, -compensation		
	New Jersey, Bayway 237 Np -ORAU, -NIOSH, -EEOICPA, -compensation		
	polonium, Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation		

Table A1-2: Database Searches for Standard Oil Development Company			
Database/Source	Keywords	Hits	Uploaded into SRDB
	New Jersey, Bayway Po210 -ORAU, -NIOSH, -EEOICPA, -compensation		
	New Jersey, Bayway Po-210 -ORAU, -NIOSH, -EEOICPA, -compensation		
	Po 210, Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation		
	New Jersey, Bayway 210Po -ORAU, -NIOSH, -EEOICPA, -compensation		
	New Jersey, Bayway 210-Po -ORAU, -NIOSH, -EEOICPA, -compensation		
	210 Po, Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation		
	New Jersey, Bayway thorium -ORAU, -NIOSH, -EEOICPA, -compensation		
	New Jersey, Bayway Th232 -ORAU, -NIOSH, -EEOICPA, -compensation		
	New Jersey, Bayway Th-232 -ORAU, -NIOSH, -EEOICPA, -compensation		
	Th 232, Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation		
	New Jersey, Bayway 232Th -ORAU, -NIOSH, -EEOICPA, -compensation		
	New Jersey, Bayway 232-Th -ORAU, -NIOSH, -EEOICPA, -		

Table A1-2: Database Searches for Standard Oil Development Company			
Database/Source	Keywords	Hits	Uploaded into SRDB
	compensation		
	232 Th, Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation		
	z metal, Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation		
	myrnalloy, Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation		
	chemical 10-66 , Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation		
	chemical 10-12, Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation		
	ionium , Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation		
	UX1 , Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation		
	UX2, Bayway New Jersey -ORAU, -NIOSH, -EEOICPA, -compensation		
	New Jersey, Bayway Th-230 -ORAU, -NIOSH, -EEOICPA, -compensation		
	New Jersey, Bayway Th230 -ORAU, -NIOSH, -EEOICPA, -compensation		
	New Jersey, Bayway 230-Th -ORAU, -NIOSH, -EEOICPA, -		

Table A1-2: Database Searches for Standard Oil Development Company

Database/Source	Keywords	Hits	Uploaded into SRDB
	compensation		
	bayway New Jersey "230 Th " -ORAU -NIOSH -EEOICPA - compensation		
	bayway New Jersey "230Th" -ORAU -NIOSH -EEOICPA - compensation		
	bayway Th-234, OR Th234 "New Jersey" -ORAU -NIOSH - EEOICPA -compensation		
	bayway "Th 234" OR 234-Th OR 234Th "New Jersey" -ORAU - NIOSH -EEOICPA –compensation		
	bayway "234 Th" OR tritium "New Jersey" -ORAU -NIOSH - EEOICPA -compensation		
	bayway H3 Linden "New Jersey" -ORAU -NIOSH -EEOICPA - compensation		
	bayway H-3 Linden "New Jersey" -ORAU -NIOSH -EEOICPA - compensation		
	bayway Linden mint OR HTO "New Jersey" -ORAU -NIOSH - EEOICPA -compensation		
	bayway uranium OR U233 "New Jersey" -ORAU -NIOSH - EEOICPA –compensation		
	bayway U-233 OR "U 233" "New Jersey" -ORAU -NIOSH - EEOICPA -compensation		
	bayway 233U OR 233-U "New Jersey" -ORAU -NIOSH - EEOICPA -compensation		

Table A1-2: Database Searches for Standard Oil Development Company			
Database/Source	Keywords	Hits	Uploaded into SRDB
	bayway "U 233" OR U234 "New Jersey" -ORAU -NIOSH - EEOICPA -compensation		
	bayway "U 234" OR U-234 "New Jersey" -ORAU -NIOSH - EEOICPA -compensation		
	bayway 234U OR 234-U "New Jersey" -ORAU -NIOSH - EEOICPA -compensation		
	bayway "234 U" OR U235 "New Jersey" -ORAU -NIOSH - EEOICPA -compensation		
	bayway "U 235" OR U-235 "New Jersey" -ORAU -NIOSH - EEOICPA -compensation		
	bayway 235-U OR 235U "New Jersey" -ORAU -NIOSH - EEOICPA -compensation		
	bayway "235 U" OR U238 "New Jersey" -ORAU -NIOSH - EEOICPA -compensation		
	bayway "U 238" OR U-238 "New Jersey" -ORAU -NIOSH - EEOICPA -compensation		
	bayway U238 OR 238U "New Jersey" -ORAU -NIOSH -EEOICPA -compensation		
	bayway 238-U OR "238 U" "New Jersey" -ORAU -NIOSH - EEOICPA -compensation		
	bayway U308 OR U-308 "New Jersey" -ORAU -NIOSH - EEOICPA -compensation		

Table A1-2: Database Searches for Standard Oil Development Company			
Database/Source	Keywords	Hits	Uploaded into SRDB
	bayway "U 308" OR 308-U "New Jersey" -ORAU -NIOSH -EEOICPA -compensation		
	bayway 308U OR "308 U" "New Jersey " -ORAU -NIOSH -EEOICPA -compensation		
	bayway "uranium extraction" OR "Black oxide" "New Jersey" -ORAU -NIOSH -EEOICPA -compensation		
	bayway "brown oxide" OR "green salt" "New Jersey" -ORAU -NIOSH -EEOICPA -compensation		
	bayway "orange oxide" OR "yellow cake" "New Jersey" -ORAU -NIOSH -EEOICPA -compensation		
	bayway UO2 OR UO3 "New Jersey" -ORAU -NIOSH -EEOICPA -compensation		
	bayway UF4 OR UF6 "New Jersey" -ORAU -NIOSH -EEOICPA -compensation		
	bayway C-216 OR C-616 "New Jersey" -ORAU -NIOSH -EEOICPA -compensation		
	bayway C-65 OR C-211 "New Jersey" -ORAU -NIOSH -EEOICPA -compensation		
	bayway U3O8 OR plutonium "New Jersey " -ORAU -NIOSH -EEOICPA -compensation		
	bayway Pu-238 OR Pu238 OR "Pu 238" "New Jersey" -ORAU -NIOSH -EEOICPA -compensation		
	bayway 238Pu OR 238-Pu OR "238 Pu" "New Jersey" -ORAU -		

Table A1-2: Database Searches for Standard Oil Development Company

Database/Source	Keywords	Hits	Uploaded into SRDB
	NIOSH -EEOICPA -compensation bayway Pu239 OR Pu-239 OR "Pu 239" "New Jersey" -ORAU - NIOSH -EEOICPA -compensation bayway 239Pu OR 239-Pu OR "239 Pu" "New Jersey" -ORAU - NIOSH -EEOICPA -compensation bayway Pu-240 OR Pu240 OR "Pu 240" "New Jersey" -ORAU - NIOSH -EEOICPA -compensation bayway 240Pu OR 240-Pu OR "240 Pu" "New Jersey" -ORAU - NIOSH -EEOICPA -compensation bayway Pu-241 OR Pu241 OR "Pu 241" "New Jersey" -ORAU - NIOSH -EEOICPA -compensation bayway 241Pu OR 241-Pu OR "241 Pu" "New Jersey" -ORAU - NIOSH -EEOICPA -compensation bayway radium Standard Oil "New Jersey" -ORAU -NIOSH -EEOICPA -compensation bayway Ra-226 OR Ra226 "New Jersey" -ORAU -NIOSH -EEOICPA -compensation bayway "Ra 226" OR 226Ra OR 226-Ra "New Jersey" -ORAU - NIOSH -EEOICPA -compensation bayway New-Jersey "226 Ra" OR Ra-228 OR Ra228 " " -ORAU - NIOSH -EEOICPA -compensation bayway "Ra 228" OR 228Ra OR 228-Ra "New Jersey " -ORAU - NIOSH -EEOICPA -compensation		

Table A1-2: Database Searches for Standard Oil Development Company			
Database/Source	Keywords	Hits	Uploaded into SRDB
	bayway "228 Ra" OR radon OR Rn-222 "New Jersey" -ORAU - NIOSH -EEOICPA -compensation bayway Rn222 OR "Rn 222" OR 222Rn "New Jersey" -ORAU - NIOSH -EEOICPA -compensation bayway 222-Rn OR "222 Rn" "New Jersey" -ORAU -NIOSH -EEOICPA -compensation bayway thoron OR Rn-220 OR Rn220 OR "Rn 220" "New Jersey" -ORAU -NIOSH -EEOICPA -compensation 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, Bayway Chemical thermal diffusion, OR "thermoluminescent dosimeter", OR TLD, OR "Tiger Team" bayway 220Rn OR 220-Rn OR "220 Rn" "New Jersey" -ORAU - NIOSH -EEOICPA -compensation bayway "220 Rn" OR protactinium "New Jersey" -ORAU -NIOSH -EEOICPA -compensation bayway Pa234m OR Pa-234m "New Jersey " -ORAU -NIOSH -EEOICPA -compensation bayway "Pa 234" OR 234mPa "New Jersey " -ORAU -NIOSH -EEOICPA -compensation bayway 234m-Pa OR "234m Pa" "New Jersey" -ORAU -NIOSH -EEOICPA -compensation		

Table A1-2: Database Searches for Standard Oil Development Company

Database/Source	Keywords	Hits	Uploaded into SRDB
	bayway strontium OR Sr-90 "New Jersey" -ORAU -NIOSH -EEOICPA -compensation bayway Sr90 OR "Sr 90" "New Jersey" -ORAU -NIOSH -EEOICPA -compensation bayway 90-Sr OR 90Sr "New Jersey" -ORAU -NIOSH -EEOICPA -compensation bayway oralloy OR postum "New Jersey" -ORAU -NIOSH -EEOICPA -compensation bayway tuballoy OR UNH "New Jersey" -ORAU -NIOSH -EEOICPA -compensation bayway "uranyl nitrate hexahydrate" "New Jersey" -ORAU -NIOSH -EEOICPA -compensation bayway K-65 OR "sump cake" "New Jersey" -ORAU -NIOSH -EEOICPA -compensation bayway "uranium dioxide" OR "uranium tetrafluoride" "New Jersey" -ORAU -NIOSH -EEOICPA -compensation bayway "uranium trioxide" OR "uranium hexafluoride" "New Jersey" -ORAU -NIOSH -EEOICPA -compensation bayway accident Linden Standard Oil "New Jersey" -ORAU -NIOSH -EEOICPA -compensation bayway "air count" OR "air dust" "New Jersey" -ORAU -NIOSH -EEOICPA -compensation		

Table A1-2: Database Searches for Standard Oil Development Company			
Database/Source	Keywords	Hits	Uploaded into SRDB
	bayway "air filter" OR "airborne test" "New Jersey" -ORAU - NIOSH -EEOICPA -compensation		
	bayway alpha Standard Oil "New Jersey" -ORAU -NIOSH - EEOICPA -refinery		
	bayway "belgian congo ore" -ORAU -NIOSH -EEOICPA -refinery		
	bayway bioassay OR bio-assay "New Jersey" -ORAU -NIOSH - EEOICPA -refinery		
	bayway Standard Oil breath OR "breathing zone" "New Jersey" - ORAU -NIOSH -EEOICPA -refinery		
	bayway BZ "New Jersey" -ORAU -NIOSH -EEOICPA -refinery		
	bayway calibration OR columnation "New Jersey" -ORAU -NIOSH -EEOICPA -refinery		
	bayway contamination Standard Oil "New Jersey" -ORAU -NIOSH - EEOICPA -refinery		
	bayway curie OR denitration "New Jersey" -ORAU -NIOSH - EEOICPA -refinery		
	bayway New Jersey "denitration pot " -ORAU -NIOSH -EEOICPA -refinery		
	bayway derby Linden "New Jersey" -ORAU -NIOSH -EEOICPA - garden		
	bayway Linden regulus OR dose "New Jersey" -ORAU -NIOSH - EEOICPA -garden		

Table A1-2: Database Searches for Standard Oil Development Company

Database/Source	Keywords	Hits	Uploaded into SRDB
	bayway Linden dosimeter OR dosimetric "New Jersey" -ORAU - NIOSH -EEOICPA -garden		
	bayway Linden dosimetry OR electron "New Jersey" -ORAU - NIOSH -EEOICPA -garden		
	bayway Linden environment standard "New Jersey" -ORAU - NIOSH -EEOICPA -refinery		
	bayway "ether-project project" "New Jersey" -ORAU -NIOSH -EEOICPA -refinery		
	bayway exposure Linden "New Jersey" -ORAU -NIOSH -EEOICPA -refinery		
	bayway "exposure investigation" OR "radiation investigation" "New Jersey" -ORAU -NIOSH -EEOICPA -refinery		
	bayway external Linden Standard "New Jersey" -ORAU -NIOSH -EEOICPA -refinery		
	bayway "F machine" OR fecal "New Jersey" -ORAU -NIOSH -EEOICPA -refinery		
	bayway "feed material" OR femptocurie "New Jersey" -ORAU -NIOSH -EEOICPA -refinery		
	bayway Linden film OR fission "New Jersey" -ORAU -NIOSH -EEOICPA -home -refinery		
	bayway fluoroscopy "New Jersey" -ORAU -NIOSH -EEOICPA -refinery		
	bayway "Formerly Utilized Sites Remedial Action Program" -		

Table A1-2: Database Searches for Standard Oil Development Company

Database/Source	Keywords	Hits	Uploaded into SRDB
	ORAU -NIOSH -EEOICPA bayway FUSRAP OR gamma-ray -ORAU -NIOSH -EEOICPA bayway "gas proportional" -ORAU -NIOSH -EEOICPA bayway "gas diffusion" -ORAU -NIOSH -EEOICPA bayway New Jersey "health instrument" -ORAU -NIOSH -EEOICPA -refinery bayway health Linden standard oil "New Jersey" -ORAU -NIOSH -EEOICPA -refinery bayway New Jersey "health physics" -ORAU -NIOSH -EEOICPA -refinery bayway Linden New Jersey standard oil HI -ORAU -NIOSH -business -refinery bayway Linden HP "New Jersey" -ORAU -NIOSH -EEOICPA -use -job -refinery bayway Linden New Jersey "highly enriched uranium" -ORAU -NIOSH -EEOICPA bayway HEU "New Jersey" -ORAU -NIOSH -EEOICPA bayway hydrofluorination "New Jersey" -ORAU -NIOSH -EEOICPA bayway New-Jersey "in vitro " -ORAU -NIOSH -EEOICPA bayway New-Jersey "in vivo " -ORAU -NIOSH -EEOICPA -		

Table A1-2: Database Searches for Standard Oil Development Company			
Database/Source	Keywords	Hits	Uploaded into SRDB
	refinery		
	bayway ingestion Linden "New Jersey" -ORAU -NIOSH -EEOICPA -refinery		
	bayway inhalation Linden "New Jersey" -ORAU -NIOSH -EEOICPA -refinery		
	bayway incident Linden "New Jersey" -ORAU -NIOSH -EEOICPA -refinery		
	bayway Linden internal Standard oil "New Jersey" -ORAU -NIOSH -EEOICPA -refinery		
	bayway Linden investigation Standard oil "New Jersey" -ORAU -NIOSH -EEOICPA -refinery		
	bayway Linden isotope OR isotopic "New Jersey" -ORAU -NIOSH -EEOICPA -refinery		
	bayway Linden New Jersey "isotopic enrichment" -ORAU -NIOSH -EEOICPA -refinery		
	bayway Linden New Jersey "JS project" OR landauer -ORAU -NIOSH -EEOICPA -refinery		
	bayway Linden New Jersey "liquid scintillation" -ORAU -NIOSH -EEOICPA -refinery		
	bayway linden log Standard oil "New Jersey" -ORAU -NIOSH -EEOICPA		
	americium, OR Am241, OR Am-241, OR "AM 241", OR 241Am, OR 241-Am, OR "241 Am" +"Bayway" +"Linden" -EEOICPA, -		

Table A1-2: Database Searches for Standard Oil Development Company

Database/Source	Keywords	Hits	Uploaded into SRDB
	<p>ORAU, -NIOSH</p> <p>bayway linden New Jersey "log book" -ORAU -NIOSH -EEOICPA</p> <p>ionium, OR Th230, OR Th-230, OR "Th 230", OR 230Th, OR 230-Th, OR "230 Th" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>neptunium, OR Np237, OR Np-237, OR "Np 237", OR 237Np, OR 237-Np, OR "237 Np" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>polonium, OR Po210, OR Po-210, OR "Po 210", OR 210Po, OR 210-Po, OR "210 Po" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <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" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</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" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>tritium, H3, H-3, mint, HTO +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</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" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p>		

Table A1-2: Database Searches for Standard Oil Development Company			
Database/Source	Keywords	Hits	Uploaded into SRDB
	<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" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</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" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</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 +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>bayway linden New Jersey "low enriched uranium" -ORAU -NIOSH -EEOICPA</p> <p>bayway linden LEU OR MPC "New Jersey" -ORAU -NIOSH -EEOICPA -DISH -digital</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" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>bayway metallurgy Linden "New Jersey" -ORAU -NIOSH -EEOICPA</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" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>bayway Linden microcurie OR millicurie "New Jersey" -ORAU -NIOSH -EEOICPA</p> <p>radium, OR Ra-226, OR Ra226, OR "Ra 226", OR 226-Ra, OR</p>		

Table A1-2: Database Searches for Standard Oil Development Company			
Database/Source	Keywords	Hits	Uploaded into SRDB
	<p>226Ra, OR 226-Ra, OR Ra-228, OR Ra228, OR "Ra 228", OR 228Ra, OR 228-Ra, OR "228 Ra" +"Bayway" +"Linden" - EEOICPA, -ORAU, -NIOSH</p> <p>bayway New Jersey "mixed fission product" -ORAU -NIOSH - EEOICPA</p> <p>radon, OR Rn-222, OR Rn222, OR "Rn 222", OR 222Rn, OR 222-Rn, OR "222 Rn" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>bayway New Jersey Linden MFP -ORAU -NIOSH -EEOICPA</p> <p>thoron, OR Rn-220, OR Rn220, OR "Rn 220", OR 220Rn, OR 220-Rn, OR "220 Rn" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>protactinium, OR Pa-234m, OR Pa234m, OR "Pa 234m", OR 234mPa, OR 234m-Pa, OR "234m Pa" +"Bayway" +"Linden" - EEOICPA, -ORAU, -NIOSH</p> <p>strontium, OR Sr-90, OR Sr90, OR "Sr 90", OR 90-Sr, OR 90Sr, OR "90 Sr" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>oralloy, OR postum, OR tuballoy, OR "uranyl nitrate hexahydrate", OR UNH, OR K-65, OR "sump cake" +"Bayway" +"Linden" - EEOICPA, -ORAU, -NIOSH</p> <p>"uranium dioxide", OR "uranium tetrafluoride", OR "uranium trioxide" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>"uranium hexafluoride", OR "air count" +"Bayway" +"Linden" - EEOICPA, -ORAU, -NIOSH</p>		

Table A1-2: Database Searches for Standard Oil Development Company			
Database/Source	Keywords	Hits	Uploaded into SRDB
	accident +AEC +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH		
	accident +ERDA +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH		
	accident +MED +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH		
	"air dust", OR "air filter", OR "airborne test" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH		
	"alpha particle", OR "belgian congo ore", OR bioassay, OR bioassay +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH		
	breath, OR "breathing zone", OR BZ, OR calibration, OR columnation +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH		
	contamination, OR curie, OR denitration, OR "denitration pot" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH		
	derby, OR regulus, OR dose, OR dosimeter +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH		
	dosimetric, OR dosimetry, OR electron, OR environment +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH		
	"Ether-Water Project", OR exposure, OR "exposure investigation", OR "radiation exposure" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH		
	external, OR "F machine", OR fecal, OR "feed material", OR femptocurie, OR film, OR fission, OR fluoroscopy +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH		

Table A1-2: Database Searches for Standard Oil Development Company

Database/Source	Keywords	Hits	Uploaded into SRDB
	<p>Formerly Utilized Sites Remedial Action Program, OR FUSRAP, OR gamma-ray, OR "gas proportional", OR "gaseous diffusion" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>health, OR "health instrument", OR "health physics", OR "H.I.", OR HI, OR HP, OR "highly enriched uranium", OR HEU +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>hydrofluorination, OR "in vitro", OR "in vivo", OR incident, OR ingestion, OR inhalation, OR internal +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>investigation, OR isotope, OR isotopic, OR "isotopic enrichment", OR "JS Project", OR Landauer, OR "liquid scintillation" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>log, OR "log sheet", OR "log book", OR "low enriched uranium", OR LEU +"Bayway" +"Linden, N.J." -EEOICPA, -ORAU, -NIOSH</p> <p>"maximum permissible concentration", OR MPC, OR metallurgy, OR microcurie, OR millicurie +"Bayway" +"Linden, N.J." -EEOICPA, -ORAU, -NIOSH</p> <p>mixed fission product, OR MFP, OR monitor, OR "air monitoring", OR nanocurie, OR "nasal wipe", OR neutron, OR "nose wipe" +"Bayway" +"Linden, N.J." -EEOICPA, -ORAU, -NIOSH</p> <p>nuclear, OR Chicago-Nuclear, OR "nuclear fuels", OR "nuclear track emulsion", OR "type A" +"Bayway" +"Linden, N.J." -EEOICPA, -ORAU, -NIOSH</p> <p>NTA, OR "occupational radiation exposure", OR occurrence, OR "ore concentrate", OR "PC Project" +"Bayway" +"Linden, N.J." -</p>		

Table A1-2: Database Searches for Standard Oil Development Company

Database/Source	Keywords	Hits	Uploaded into SRDB
	<p>EEOICPA, -ORAU, -NIOSH</p> <p>permit, OR "radiation work permit", OR "safe work permit", OR "special work permit", OR RWP, OR SWP +"Bayway" +"Linden, N.J." -EEOICPA, -ORAU, -NIOSH</p> <p>phosphate research, OR photon, OR picocurie, OR pitchblende, OR "pocket ion chamber", OR PIC, OR problem, OR procedure +"Bayway" +"Linden, N.J." -EEOICPA, -ORAU, -NIOSH</p> <p>radeco, OR radiation, OR radioactive, OR radioactivity, OR radiograph, OR radiological +"Bayway" +"Linden, N.J." -EEOICPA, -ORAU, -NIOSH</p> <p>Radiological Survey Data Sheet, OR RSDS, OR radionuclide, OR raffinate, OR reactor +"Bayway" +"Linden, N.J." -EEOICPA, -ORAU, -NIOSH</p> <p>respiratory, OR "retention schedules", OR roentgen +"Bayway" +"Linden, N.J." -EEOICPA, -ORAU, -NIOSH</p> <p>sample, OR "air sample", OR "dust sample", OR "general area air sample" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>"solvent extraction", OR source, OR "sealed source", OR spectra, OR spectrograph, OR spectroscopy, OR spectrum, OR standard, OR "operating standard", OR "processing standard" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>survey, OR "building survey", OR "routine survey", OR "special survey", OR "technical basis" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>thermal diffusion, OR "thermoluminescent dosimeter", OR TLD, OR</p>		

Table A1-2: Database Searches for Standard Oil Development Company			
Database/Source	Keywords	Hits	Uploaded into SRDB
	<p>"Tiger Team" +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>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 +"Bayway" +"Linden" -EEOICPA, -ORAU, -NIOSH</p> <p>"Standard Oil" collimation OR photofluorography OR "x-ray screening" -NIOSH -EEOICPA -ORAU</p> <p>Bayway collimation OR photofluorography OR "x-ray screening" -NIOSH -EEOICPA -ORAU</p> <p>ESSO AND Linden collimation OR photofluorography OR "x-ray screening" -NIOSH -EEOICPA -ORAU</p>		

Table A1-3: OSTI Documents Ordered for Standard Oil Development Company			
Document Number	Document Title	Requested Date	Date Received
A-2354 OSTI ID: 4360540 or 6625211	Investigation of the System Methyl Ether and Methyl Borate-Boron Fluoride Complex dated 8/2/1945	10/19/2007	09/04/2008 – did not contain useful information
A-2357 OSTI ID: 4319825 or 6624676	Interpretation of the Isotopic Separation in the Distillation of Methyl Ether-Boron Fluoride Complex dated 10/3/1945	10/19/2007	09/04/2008 – did not contain useful information
A-2358 OSTI ID: 4342237 or 6667681	Exchange Method of Preparing Boron Trifluoride Samples for Mass Spectrometer Analysis of Dimethyl Ether-Boron Trifluoride dated 10/23/1945	10/19/2007	09/04/2008 – did not contain useful information
A-2359	Analysis of Dimethyl Ether-	10/19/2007	09/04/2008 –

OSTI ID: 4352508 or 6684884	Boron Trifluoride dated 10/26/1945		did not contain useful information
A-2363 OSTI ID: 4361563 or 6667254	Study of the Reactions of Methyl Ether-Boron Fluoride Complex with Water Under Fractionation Conditions dated 10/31/1945	10/19/2007	09/04/2008 – did not contain useful information
A-2365 OSTI ID: 4319918 or 6660119	Reactions of Boric Acid and Boric Oxide with Methyl Ether- Boron Fluoride Complex dated 10/31/1945	10/19/2007	09/04/2008 – did not contain useful information
M-2433 OSTI ID: 4330665 or 6667247	Formation of Methyl Borate from the Methyl Borate-Boron Fluoride Complex dated 9/4/1945	10/19/2007	09/04/2008 – did not contain useful information